HANDBOOK OF HOSPITAL CARE FOR MATERNAL EMERGENCIES INCLUDING MAJOR TRAUMA

MCAI Maternal & Childhealth Advocacy International

Irish Aid
Rialtas na hÉireann
Government of Ireland

UNFPA

unicef
for every child

THE UNIVERSITY of EDINBURGH

Advanced Life Support Group
A charity dedicated to saving life by providing training

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SBAR report to senior clinician requesting advice and/or attendance

S

Situation: I am calling about (name): …….. The time is……
The main problem I am calling about is:
Tick relevant sections below

Vital signs: BP ___ / ___ Pulse ____Respiration ____SpO2 ___% Temp. ___°C
Awake ☐ **Responds voice** ☐ **Responds to pain** ☐ **Unconscious** ☐

I am concerned because:
Systolic BP over 160 ☐
Diastolic BP over 100 ☐
Systolic BP less than 90 ☐
Pulse because it is:
Over 120 ☐ Less than 60 ☐
Respirations because they are:
Less than 10 ☐ Over 30 ☐
Woman is needing oxygen ☐
Maternal temperature is _____°C

Urine output because it is:
Less than 100mls over the last 4 hours ☐
Proteinuria is present ☐
No of + _____
Haemorrhage:
Antepartum ☐
Postpartum ☐

Fetal Distress ☐

B

Background (*Tick relevant sections*)
The woman is:
Parity:
Gestation: _____wks Singleton ☐ Multiple ☐
Previous Caesarean section ☐ or uterine surgery ☐
Fetal wellbeing
Fundal height: _____cm Presentation _____ Fifths palpable_____
Fetal Heart Rate _____bpm
Antenatal Problem details: ……
Labour problem
Spontaneous onset ☐ Induced ☐ Caesarean section ☐
IUGR ☐ Pre-eclampsia ☐ Reduced fetal movement ☐ APH ☐
Oxytocin ☐ Misoprostol ☐
Most recent vaginal examination: Time _____hrs
Cervical dilatation:_____ cm, Station of presenting part: _____ Position: _____
Membranes intact ☐ Meconium Stained liquor ☐ Fresh red loss PV ☐
Third stage complete ☐ Retained placenta ☐
Postnatal problem details……
Delivery Date: _____ Delivery Time: _____
Type of delivery: _____ Cervical Trauma? _____
Vaginal blood Loss: _____ml Oxytocin Infusion ☐
Uterus: High ☐ Atonic ☐ Tender ☐ Abdominal/perineal wound problem ☐

A

Assessment
I think the problem is: _____
I am not sure what the problem is but the woman is deteriorating and we need to do something

Treatment given/ in progress:
_____

R

Recommendation
Request: 1. Please come to see the woman immediately/within 15 minutes
OR 2. I would like advice please
Reported to (name): _____ Response:

_____

Person Completing form Name: _____ Date:_____

Acknowledgments and editors

This updated handbook compliments our textbook "International Maternal & Childhealth Care. A practical manual for hospitals worldwide". Readers may also find the textbook helpful. The contents of this handbook are designed to take into consideration the situation in low resource settings and to provide the best available management when drugs, supplies and equipment are limited.

Editors: Prof. David Southall, Dr. Diane Watson, Dr. Maire Casement and Dr. Brigid Hayden.

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Section A1 Antenatal care and the hospital

Introduction

For a variety of logistic and cultural reasons in resource-limited countries, the first time a woman attends a health facility during pregnancy may be because of a medical problem or because she is in labour. This often means that she maybe medically compromised even before giving birth, and at high risk of morbidity and mortality.

Antenatal care in such settings tends to be opportunistic, and the ways in which care is delivered must be innovative and optimised to ensure that comprehensive care reaches as many pregnant women and girls as possible. This might mean **outreach teams** going out to the rural areas ('trekking'), rather than the women having to make the long journey to the healthcare facility, often on foot. Usually the staff who undertake such visits are midwives and nurses, rarely doctors. With the availability of trained obstetric clinicians and portable ultrasound scanners, such outreach can identify previously undetected major problems such as placenta praevia, pre-eclampsia, multiple pregnancy, intrauterine fetal deaths, malpresentations etc.

Such problems particularly affect rural areas at long distances from the nearest facility and where roads are poor. Hospital workers have a duty to ensure that they work with the community health teams to facilitate antenatal care.

Definitions of pregnancy-related events

Maternal mortality is the death of any woman or girl, from any cause, while pregnant or within 42 days of the end of pregnancy.

Gravidity is the number of times that a woman or girl has been pregnant. Parity is the number of times that she has given birth to a fetus with a gestational age of 24/28 weeks or more, regardless of whether the child was born alive or was stillborn.

For example, in gravida 2:para 2 (G2 + P2) the woman or girl has had two pregnancies and two deliveries after 24/28 weeks, and in gravida 2:para 0 (G2 + P0) the woman has had two pregnancies, neither of which survived to a gestational age of 24/28 weeks. If these individuals are both currently pregnant again, they can be referred to as G3 + P2 and G3 + P0, respectively.

- A nulliparous woman has not given birth previously (regardless of outcome).
- A primigravid woman (a primigravida) is in her first pregnancy.
- A primiparous woman or girl has given birth once.

- A multigravid woman (a multigravida) has been pregnant more than once.
- A multiparous woman has given birth more than once.
- A grand multipara is a woman who has already delivered four or more infants who have achieved a gestational age of 24/28 weeks or more. Such women are considered to be at higher than average risk in subsequent pregnancies.
- A grand multigravida has been pregnant four times or more.

Multiple pregnancies present a problem with regard to terminology. A multiple gestation counts as a single event, and a multiple birth, should be interpreted as a single parous event.

Rationale for antenatal care

Antenatal care is primarily a means of screening for, diagnosing, and treating conditions which could cause problems during the continuation of the pregnancy, at delivery and after birth. These conditions may be pre-existing maternal medical disorders or obstetric or fetal complications which arise during the pregnancy itself.

Basic antenatal care

Two conditions are of particular importance to detect and manage antenatally, namely pre-eclampsia and anaemia, as they contribute to a large proportion of maternal and perinatal deaths.

Pre-eclampsia may vary in severity, but commonly presents with mildly raised blood pressure and proteinuria and may progress to full-blown severe pre-eclampsia with dangerously high blood pressures, heavy proteinuria and generalised oedema (*see* Section A+13). Mild and moderate pre-eclampsia is usually asymptomatic, and therefore routine testing of blood pressure and urine in pregnancy is crucial to its detection.

Severe pre-eclampsia can be associated with symptoms such as headache, visual disturbance and epigastric pain, and commonly leads to eclamptic fits, cerebrovascular accidents or HELLP syndrome (Haemolysis, Elevated Liver enzymes and Low Platelets), all of which carry a high mortality. Timely intervention, by lowering the blood pressure, delivering the baby and treating fits if they occur, may be life-saving.

It is also vitally important to detect and treat anaemia antenatally, to reduce the woman's risk of dying should she experience a postpartum haemorrhage (*see* Sections A+1 and A+11).

As far as possible there should be a structured approach to antenatal care. (A card or booklet designed and implemented by individual Ministries of Health for pregnant women or girls to keep and bring to clinics is helpful.) At the first encounter, an attempt should be made to obtain as full a history as possible, time permitting. This should include the following details:

* the date of the last menstrual period (LMP), regularity of the menstrual cycle, any contraceptive usage, the date of the positive pregnancy test (if available), and any particular complaints in pregnancy to date
* the previous obstetric history, including complications, mode of delivery and outcome
* the previous medical history
* the family history, especially with regard to hypertension, diabetes mellitus, multiple births and congenital abnormalities
* use of drugs, smoking, and alcohol consumption
* allergies.

The patient must always be examined.

- Look for signs of anaemia (pallor, leuconychia or white nails, koilonychia or spoon-shaped nails, and angular stomatitis), malnutrition, oedema and other medical conditions unrelated to the pregnancy.
- The blood pressure must be measured, and ideally the woman should be weighed.
- The chest should be examined for cardiac and respiratory signs.
- Abdominal inspection and palpation should be done, looking for scars and checking for signs of pregnancy, including measurement of the symphysio-fundal height and feeling for the number of fetuses, fetal lie and presentation, and engagement of the presenting part (*see* Figures A1.1 and A1.2).
- An attempt should be made to auscultate the fetal heart with a Pinard's or doppler ultrasound stethoscope, if the uterus is palpable abdominally.

Accurate dating of the pregnancy is important, as it influences decision making during the antenatal period, particularly around the timing of delivery and whether this is by Caesarean section (CS) or induction of labour. It also aids assessment of the maturity of the fetus if the mother goes into spontaneous labour early.

Bimanual examination, which must be undertaken in an aseptic and careful way (especially if there could be an ectopic pregnancy), is a useful diagnostic tool for dating an early pregnancy (in conjunction with the menstrual date), and in the absence of ultrasound scanning facilities might be the only available means of calculating the estimated date of delivery (EDD).

At around 4 weeks' gestation, the cervix starts to change in colour and texture, feels soft and acquires a bluish tinge which may be visualised on speculum examination. The uterus first becomes palpable abdominally at around 12 weeks' gestation.

Prior to this an estimation of gestational age can be obtained from vaginal examination by assessing uterine size with the following comparisons:

- 6 weeks is equivalent to a plum
- 8 weeks is equivalent to a small ball
- 10 weeks is equivalent to an orange
- 12 weeks is equivalent to a grapefruit
- 14 weeks is equivalent to a small melon (palpable abdominally).

The accuracy of clinical assessment may be reduced by obesity, fibroids, and if the uterus is retroverted.

Multiple pregnancy and molar change can also lead to a pregnancy larger than dates.

At follow-up visits, the history and examination can be more focused on pregnancy events since the last visit. Examination should look for signs of intercurrent problems, anaemia and oedema. At every visit, the blood pressure must be measured, and the abdomen palpated to check on the progress of pregnancy.

At all visits after 20 weeks there should be direct questioning for symptoms of pre-eclampsia. If the blood pressure is elevated or rapidly progressive oedema is present, a urine sample must be tested for protein.

Prior to the due date, there should be a discussion about the mode and place of delivery for women with a previous Caesarean section scar. Birth attendants and family members must be informed that there is a high risk of scar rupture, and the woman must deliver in a healthcare site where comprehensive emergency obstetric care is available if needed. They should also be informed of any concerns you may have which might put them at risk of needing intervention at delivery (e.g. twins, a high fetal head at term). These would indicate that they must deliver at an appropriate healthcare facility.

A typical pregnancy lasts, on average, 280 days, or 40 weeks—starting with the first day of the last normal menstrual period as day 1. An estimated due date can be calculated by following steps 1 through 3:

1. First, determine the first day of the last menstrual period.
2. Next, count back 3 calendar months from that date.
3. Lastly, add 1 year and 7 days to that date.

For example: The last menstrual period began on September 9, 2010. Counting back 3 calendar months would be June 9, 2010. Adding 1 year and 7 days would bring pregnancy to June 16, 2011, as the estimated due date.

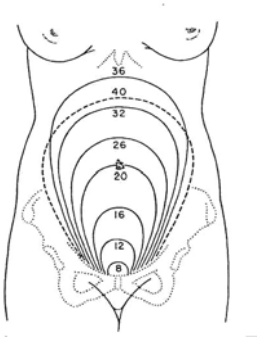


Figure A1.1 *Average size of normal gravid uterus at different gestations.*

Ideally, there should be waiting homes or existing family based accommodation near the health-care facility where comprehensive emergency obstetric care(CEmOC) is available, set up by the regional health teams, to which they and their attendants can move near to the time of delivery so that they do not have to make a long and potentially dangerous journey while in labour.

All of these details, along with the results of any investigations, should be noted on a small hand-held record which the pregnant woman is encouraged to carry with her at all times throughout the pregnancy.
http://www.healthcareimprovementscotland.org/our_work/reproductive,_maternal_child/woman_held_maternity_record/swhmr_maternity_record.aspx

As the pregnancy progresses, the uterus continues to grow and has usually reached the level of the umbilicus by 20–24 weeks (*see* Figure A1.1). Measuring the height of the fundus above the symphysis pubis can also provide a good indication of the growth and gestation of the fetus. The woman should first empty her bladder. The measurement is then made by placing the zero point of the tape measure on the upper border of the symphysis and taking the tape along the uterus in a longitudinal direction to the upper border of the fundus, with the mother lying in the left lateral tilt position.

Between 20 and 34 weeks' gestation, the length of this measurement (in centimetres) should correspond to the gestational age in weeks of a well-grown fetus (*see* Figure A1.2).

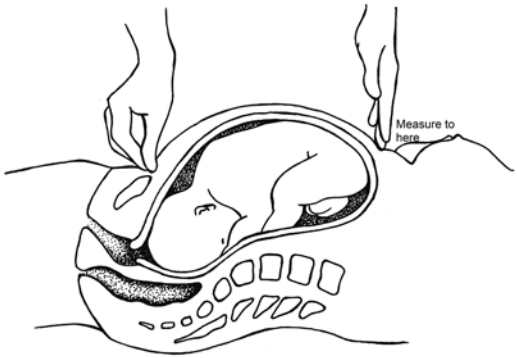


***Figure A1.2 Measuring** fundal height.*

A difference of more than 2 cm too long or too short can indicate complications such as multiple pregnancy (too long), intrauterine growth retardation (too short), or inaccurate measurements of the estimated date of delivery. It should be recognised that fundal height is not an accurate assessment of gestation or fetal size. Even in the absence of confounding factors such as multiple gestation and poly/oligohydramnios, it varies widely depending on the height and weight of the mother and lie of the fetus. In addition, the 'normal' fetal size also varies widely depending on patient build and ethnic origin.

Antenatal investigations and interventions

- Ideally a full blood count should be done at least once during the pregnancy, to check the haemoglobin level and, if possible, the red cell indices. Portable systems for measuring haemoglobin include the haemacue and WHO colour card from a finger prick sample, or perhaps, in the future, percutaneous measurement using a transcutaneous haemoglobinometer (currently under development).
- Urinalysis must be performed at every visit, to check for protein and glucose.
- Screening for bloodborne viruses (hepatitis B and C and HIV) is not always available (*see* Section B15). All mothers should be advised of the risks involved, and of the precautions they can take to reduce the risk of transmission. Healthcare professionals also need to be made aware of universal precautions and adhere to them at all times.
- Serum samples should be taken for blood grouping and Rhesus status and evidence of the results held by the mother.
- All women should be tested for and when appropriate treated for syphilis (*see* Section B13).

ABO and Rhesus incompatibility

At a mother's first visit to the healthcare site, blood should be taken for ABO typing, determination of Rhesus (Rh) status and detecting the presence of harmful antibodies.

The main antibodies of concern are anti-D (usually acquired following feto-maternal haemorrhage), anti-c and anti-kell (which usually follow blood transfusion), all of which can cause severe haemolytic disease of the newborn. ABO incompatibility can also cause neonatal jaundice in one in 30 cases.

Potential Rh-D sensitising events for a Rhesus-negative mother include miscarriage, termination of pregnancy, ectopic pregnancy, antepartum haemorrhage, and invasive procedures such as external cephalic version. If the mother is not given anti-D immunoglobulin after such events, a second challenge will lead to a major rise in anti-D anti- bodies in the mother's circulation, which can then cross the placenta and destroy Rhesus-positive fetal cells, causing fetal anaemia. The anti-D immunoglobulin should ideally be given within 3 days of the sensitising challenge, but may be effective when given up to 13 days after the challenge. The WHO recommends 125 IU per mL of fetal red blood cells found in the maternal circulation. A Kleihauer test can be performed to identify the presence and quantity of feto-maternal haemorrhage. In well-resourced countries, a dose of 250 IU of anti-D immunoglobulin is given before 20 weeks' gestation, and 500 IU after 20 weeks. (This is almost always adequate but additional units are given if the Kleihauer test indicates a larger feto-maternal haemorrhage.)

Due to limited infrastructure, blood bank facilities will not be available at all healthcare sites, but staffed laboratories should be available in district hospitals where the serum sample, taken at the healthcare site, adequately labelled and batched, can be sent for processing.

Immunisation and antimalarial prophylaxis

Routine administration of anti-tetanus toxoid should be offered to all women to reduce the risk of neonatal and maternal tetanus. For women who have never received tetanus toxoid vaccine, or who have no documentation of such immunisation, a total of five doses is recommended – two doses given 1 month apart in the first pregnancy, then one dose in each subsequent pregnancy (or at intervals of at least 1 year), up to a total of five doses.

A single dose does not offer adequate protection, and as the highest level of antibody occurs 24 weeks following the second dose, ideally this should be

given around 16 weeks' gestation, with the first dose being given at least 4–8 weeks earlier in the first trimester, if early attendance allows this.

Intermittent antimalarial prophylaxis should also be offered. Among its other advantages, this may reduce the burden of severe anaemia (*see* Section A+1).

Ultrasound scanning

Facilities for ultrasound scanning in low resource setting are usually limited. There may be no funding for a machine. If there is a machine, the staff need to be adequately trained and have the time to use it. Scanning can be useful for assessing the site of pregnancy, the period of gestation, viability, the number of fetuses, presentation and the progress of the pregnancy. If the image quality is good enough, it may also allow the detection of abnormalities, and although intervention might not be possible, this would mean that problems could be anticipated, delivery planned, and the mother counselled appropriately.

Specific antenatal problems

It is not possible to discuss the management of every antenatal condition here. Conditions such as anaemia, hypertension and diabetes, which are common complications of pregnancy and becoming increasingly so, are discussed in detail elsewhere in this textbook.

Hyperemesis

Some nausea and vomiting are common in early pregnancy. However, in a small proportion of patients, severe vomiting (hyperemesis) can occur. This condition is more common where there is a larger than normal placental mass (e.g. in multiple pregnancy and molar pregnancy).

Signs of dehydration such as tachycardia, dry mucous membranes and a slow skin pinch can develop. The patient often develops ketoacidosis, which makes the nausea and vomiting worse. For details on managing this condition, *see* Section A+27.

Organising an effective antenatal care system

Blood bank facilities

A functional and effective blood transfusion service (*see* Section C5) is a vital component of a national health system.

The WHO expects all countries to have national policies and a legislative framework for blood safety, with a centrally coordinated and quality system in

place. Ideally, all donors should be unpaid volunteers, and unnecessary transfusion should be avoided. Currently there are large discrepancies between wealthy and resource-limited countries in the availability of this service.

Antenatal care networks

One important factor in the delivery of an effective antenatal service is establishing good networks between the community and the healthcare facilities in which births occur.

As was mentioned in the introduction to this section, 'trekking' is the setting up of an outreach service by which healthcare providers go to the women, rather than vice versa. This serves to offset the problems of distance and lack of transportation, and may be the first step in facilitating these linkages, as the staff have an opportunity to offer education to the mothers, birth attendants, family and community members on the potential benefits for women of delivering in a healthcare facility. The staff can also advise on warning signs to look out for, and on emergency measures that can be taken before professional help arrives.

Patients and their attendants need to know that they will receive the care they need regardless of whether or not they can afford it. Perhaps most importantly, hospital staff need to reiterate the vital role that community members can have in averting a tragedy. This will hopefully reduce suspicion and encourage early communication when help is needed, so that critical delays in getting help to a mother can be avoided. A local emergency taxi service set up in each village, and ideally funded by the community and available at all times for women to be taken to the healthcare facility, is one way of addressing this.

One of the responsibilities of the regional health teams is to provide waiting homes or existing family homes near to a health facility, providing comprehensive EmOC, as mentioned earlier, where the high-risk expectant mother and her family members can stay for a short period prior to the birth in case an emergency arises.

If help is summoned following an emergency in the community, an emergency ambulance system, manned by personnel who have been trained in resuscitation and stabilisation, can be used for retrieval, further reducing the delay before the mother first receives skilled care e.g. wheelbarrow ambulances, https://www.youtube.com/watch?v=jmkYI4jeEpw

Conclusion

The main keys to providing effective antenatal care are education on the role that it plays and emphasis on the importance of teamwork by all of the parties involved, to ensure the best possible outcome for both mother and baby.

Section A2. Advanced obstetric care in the hospital including WHO Safe childbirth checklist

Introduction

Irrespective of where midwifery care is provided, there are universal requirements that should govern the provision of care:

1 provision of a safe healthcare environment for patients and staff
2 respectful and compassionate care for women, the neonate(s) and the family
3 skilled and competent staff to provide a good standard of evidence-based care
4 health education and promotion.

These areas of critical importance are further considered and described concisely in the subsections below. More detailed information on each area can be found in the references listed at the end of this section.

The global human resources target for effective delivery of obstetric care is one skilled birth attendant (SBA) for every 100 expected births. SBAs are defined as midwives, nurses, health officers, medical doctors and obstetricians/ gynaecologists and now obstetric clinicians.

Definition of maternal death

In every action that is undertaken as part of midwifery, the prevention of maternal death must be the first priority.

According to the WHO, pregnancy-related death is defined as the death of a woman or adolescent girl while pregnant or within 42 days of the termination of pregnancy, irrespective of the cause of death.

Safe environment

WHO surgical safety checklist

The WHO has recently produced a helpful checklist for patient safety with regard to surgery

www.who.int/patientsafety/implementation/checklists/en/index.html

This followed a similar checklist being developed for airline pilots.

Infection control

The microorganisms that cause infection can be transmitted to patients and staff by several routes. These include aerosol, droplet (e.g. coughing and sneezing) and faecal–oral routes, direct contact (person to person), indirect contact (through contaminated food or water, contaminated surfaces or objects), via blood and body fluids, and via insects and parasites. It is vital that basic infection control practices are adhered to in order to reduce or eliminate the sources and spread of infection (*see* Section C3).

TABLE 2.1 WHO Safe Childbirth Checklist

BEFORE BIRTH Completed by ……..

1. On Admission	
Does mother need referral? ☐No ☐Yes, organised	Check your Facility's Criteria
Partograph Started? ☐No, will start when > or = 4cm ☐Yes	Start Plotting when cervix ≥ 4cm, then cervix should dilate ≥ 1cm/hr • Every 30 min: plot HR, contractions, fetal HR • Every 2hrs: plot temperature • Every 4hrs: plot BP
Does mother need to start: *Antibiotics?* ☐No ☐Yes, given *Magnesium Sulphate and antihypertensive treatment?* ☐No ☐Yes, Magnesium Sulphate given ☐Yes, Antihypertensive medication given	Ask for allergies before administration of any medication Give antibiotics to mother if any of: • Mother's temperature ≥ 38°C • History of foul-smelling vaginal discharge • Rupture of membrane >18hrs Give magnesium sulphate to mother if any of: • Diastolic BP ≥ 110 mmHg and 3+ proteinuria • Diastolic BP ≥ 90mmHg 2+ proteinuria, and any: severe headache, visual disturbance, epigastric pain Give antihypertensive medication to mother if systolic BP >160 mmHg • Goal: keep BP < 150/100 mmHg
Confirm supplies are available to clean hands and wear gloves for each vaginal exam ☐	
Encourage birth companion to be present at birth ☐	

Confirm that mother or companion will call for help during labour if needed ☐	Call for help if any of: • Bleeding • Severe abdominal pain • Severe headache or visual disturbance • Unable to urinate • Urge to push
2. Just Before Pushing (Or Before Caesarean) Completed by ……..	
Does mother need to start: *Antibiotics?* ☐ No ☐Yes, given *Magnesium sulphate and antihypertensive treatment?* ☐No ☐Yes, magnesium sulphate given ☐Yes, antihypertensive medication given	Ask for allergies before administration of any medication Give antibiotics to mother if any of: • Mother's temperature ≥ 38°C • History of foul-smelling vaginal discharge • Rupture of membrane >18hrs • Caesarean section Give magnesium sulphate to mother if any of: • Diastolic BP ≥ 110 mmHg and 3+ proteinuria • Diastolic BP ≥ 90mmHg 2+ proteinuria, and any: severe headache, visual disturbance, epigastric pain Give antihypertensive medication to mother if systolic BP >160 mmHg • Goal: keep BP < 150/100 mmHg
Confirm essential supplies are at bedside and prepare for delivery: *For mother* ☐ Gloves ☐Alcohol-based hand rub or soap and clean water ☐Oxytocin 10 units in syringe	Prepare to care for mother immediately after birth: Confirm single baby only (not multiple birth) 1) Give Oxytocin within 1 minute after birth 2) Deliver placenta 1-3 minutes after birth 3) Massage uterus after placenta is delivered 4) Confirm uterus is contracted

For baby ☐ Clean towel ☐ Sterile blade to cut cord ☐ Suction device ☐ Bag and mask	Prepare to care for baby immediately after birth: 1) Dry baby keep warm 2) If not breathing, stimulate and clear airway 3) If still not breathing: • Clamp and cut cord • Clean airway if necessary • Ventilate with bag and mask • Shout for help
Assistant Identified and ready to help at birth if needed. ☐	
3. Soon After Birth (Within 1 Hour) Completed by ……..	
Is mother bleeding abnormally? ☐No ☐Yes, shout for help	If bleeding abnormally: • Massage uterus • Consider more uterotonic • Start IV and keep mother warm • Treat cause: uterine atony, retained placenta/fragments, vaginal tear, uterine rupture
Does mother need to start: *Antibiotics?* ☐No ☐Yes, given *Magnesium sulphate and antihypertensive treatment?* ☐No ☐Yes, Magnesium sulphate given ☐Yes, Antihypertensive medication given	Ask for allergies before administration of any medication Give antibiotics to mother if placenta manually removed or if mother's temperature ≥ 38°C and any of: • Chills • Foul-smelling vaginal discharge If the mother has a third or fourth degree of perineal tear give antibiotics to prevent infection Give magnesium sulphate to mother if any of: • Diastolic BP ≥ 110 mmHg and 3+ proteinuria

	• Diastolic BP ≥ 90 mmHg, 2+ proteinuria, and any: severe headache, visual disturbance, epigastric pain Give antihypertensive medication to mother if systolic BP >160 mmHg • Goal: keep BP < 150/100 mmHg
Does baby need: *Referral?* ☐No ☐Yes, given *Antibiotics?* ☐No ☐Yes, given *Special care and monitoring?* ☐No ☐Yes, organised	Check your facility's criteria Give baby antibiotics if antibiotics given to mother for treatment of maternal infection during childbirth or if baby has any of: • Respiratory rate >60/min or <30/min • Chest in-drawing, grunting or convulsions • Poor movement on stimulation • Baby's temperature <35°C (and not rising after warming) or baby's temperature ≥ 38°C Arrange special care/ monitoring for baby if any: • More than 1 month early • Birth weight <2500 grams • Needs antibiotics • Required resuscitation
Started breastfeeding and skin-to-skin contact (If mother and baby are well) ☐	
Confirm mother/ companion will call for help if danger signs present ☐	
4. AFTER BIRTH Before Discharge	
Confirm stay at facility for 24 hours after delivery ☐	

Does mother need to start antibiotics? ☐No ☐Yes, given and delay discharge	Ask for allergies before administration of any medication Give antibiotics to mother if any of: • Mother's temperature ≥ 38°C • Foul-smelling vaginal discharge
Is mother's blood pressure normal? ☐No, treat and delay discharge ☐Yes	Give magnesium sulphate to mother if any of: • Diastolic BP ≥ 110 mmHg and 3+ proteinuria • Diastolic BP ≥ 90 mmHg, 2+ proteinuria, and any: severe headache, visual disturbance, epigastric pain Give antihypertensive medication to mother if systolic BP > 160 mmHg • Goal: keep BP <150/100 mmHg
Is mother bleeding abnormally? ☐No ☐Yes, treat and delay discharge	If pulse > 110 beats per minute and blood pressure < 90 mmHg • Start IV and keep mother warm • Treat cause (hypovolemic shock)
Does baby need to start antibiotics? ☐No ☐Yes, give antibiotics, delay discharge, give special care	Give antibiotics to baby if any of: • Respiratory rate >60/min or <30/min • Chest in-drawing, grunting or convulsions • Poor movement on stimulation • Baby's temperature <35°C (and not rising after warming) or baby's temperature ≥ 38°C • Stopped breastfeeding well • Umbilicus redness extending to skin or draining pus
Is baby feeding well? ☐No, establish good breastfeeding practices and delay discharge ☐Yes	

Discuss and offer family planning options to mother ☐	
Arrange follow-up and confirm mother/ companion will seek help if danger signs appear after discharge ☐	
Danger Signs	
Mother *has any of:* • Bleeding • Severe abdominal pain • Severe headache or visual disturbance • Breathing difficulty • Fever or chills • Difficulty emptying bladder • Epigastric pain	***Baby*** *has any of:* • Fast/ difficult breathing • Fever • Unusually cold • Stops feeding well • Less activity than normal • Whole body becomes yellow

Completed by: ……

Situations in which equipment, treatment rooms and delivery beds are covered in dirt, old blood and rat droppings, with cats, goats and pigs wandering freely through the grounds and rats nesting in incubators and other equipment (all of which can be seen in resource-limited settings in public health facilities) are unacceptable and a source of infection. It is important to understand the reasons why women are developing serious wound infections post Caesarean section, which include, for example, over-crowded recovery rooms, with beds and surroundings not cleaned properly for months.

Washing hands between patients and after all invasive procedures is one of the infection control procedures that is of paramount importance, as dirty hands play a large part in spreading infection. Facilities for handwashing (i.e. a basin and clean towels), plus the availability of soap and water, are essential within any ward or healthcare facility.

It is also extremely important to ensure that any equipment used for the care of patients is cleaned after every use, with anything broken being replaced or mended. It is also necessary for the equipment to be stored in a clean and tidy area, so that it does not become contaminated when not in use. This will ensure that vital equipment is kept clean and in working order, ready to be used safely at any time. An example of a situation where the above basic minimum standards are not met is the absence of clean oxygen tubing with nasal cannulae to help a baby to survive, and only dirty

equipment available, with nothing to thoroughly clean it. There is then the dilemma of whether to use the unclean equipment with the associated severe risk of infection to the sick infant.

The environment in which women and babies are cared for also needs to be regularly cleaned. This includes regular cleaning of trolleys, bedding and sanitation facilities. Omission of these tasks will lead to infection, whether this is through direct or indirect contact or by the attraction of flies and mosquitoes to dirty surfaces or pools of fluid.

It is appreciated that, in some healthcare facilities, cleaning solutions (e.g. disinfectant) can be difficult to obtain because of lack of supplies or their cost making them unavailable. Using basic soap and water or even just cooled boiled water is better than not cleaning at all and will remove microorganisms and the organic matter on which they thrive.

Instruments and other equipment that penetrates skin or mucous membranes or enters the vascular system or sterile spaces needs to be free of viable microorganisms, including viruses and bacterial spores. This is achieved by sterilising the equipment, usually in a hot oven or autoclave. It is important that the healthcare staff maintain the ovens and/or autoclaves in working order. They also need to fully appreciate how the process of sterilisation works. It is not appropriate for instruments to be placed in hot ovens or autoclaves without first cleaning them to remove visible blood and organic debris. Another common mistake is for healthcare staff to remove sterilised instruments and then proceed to cool them off using unsterilised water from the roof or tap.

Healthcare staff should wear protective clothing when indicated, if it is available. This includes new sterile gloves for every invasive procedure, and disposable or cleanable plastic aprons to avoid contamination of uniforms with bodily fluids during messy or potentially messy procedures.

Another extremely important element of infection control is to ensure that healthcare staff have received appropriate training in the disposal of used sharps (e.g. needles) into sharps boxes. The process for removal of these full "sharps boxes" from the health facility, and their incineration, also needs to be clear and robust, to prevent contaminated sharps from ending up on the local village dump, where children often scavenge and play.

Physical safety

The safety of the physical environment in which women and their babies are cared for is also very important, and staff need to give this full consideration. Broken beds and equipment can be dangerous. The former may collapse, and the latter may have sharp edges that can cause a wound. Babies can fall off high surfaces if these are not guarded.

Respectful and compassionate care

A good midwife or healthcare worker will treat every woman, irrespective of her personal circumstances, with compassion and respect. Pregnancy, labour, delivery and the postnatal period can all be anxious times for a woman. It is at these times that guiding, supportive and empathetic care is required. It is completely unacceptable within any society for women to be verbally and physically assaulted by their carers. Fellow staff should never tolerate this type of behaviour from colleagues towards women.

Good care will involve providing full, understandable explanations of any required interventions to the woman and her family, with the woman giving her consent to those interventions.

When in labour, women often find the intense pain of contractions easier to bear if they can be upright and moving about. This position is also better physiologically, as it promotes the progress of labour and promotes the well-being of the fetus. In most cases this is the position which should be encouraged until delivery is imminent. The position for delivery should, where possible, be the one that the woman prefers (e.g. upright or squatting), but this will also be dictated by the type of delivery and the degree of observation of the mother and her baby that is required. Women should not be instructed by their carers to lie flat on a hard trolley for almost their entire labour, as there is no necessity for them to do so, and this position is detrimental to the progress of labour and to the well-being of the fetus. It is also important during labour and delivery to ensure that the basic care needs of women for a comfortable, safe environment are met. Light food and drinking water need to be available, with intake of water and light food encouraged throughout labour to prevent dehydration and ketosis. Ideally a relative or friend should be able to stay with the woman during labour and delivery to provide emotional support throughout. However, this may not always be possible in the very cramped, busy delivery wards that exist in some countries. If this is the case, there is all the more need for caring, empathetic staff.

Strong analgesics for pain relief during labour may be unavailable in developing countries, and therefore these women often require greater resilience and coping skills, so encouragement and support from healthcare staff and the family is crucial throughout this time. Recently, MCAI have introduced intravenous infusions of

paracetamol for providing pain control in labour when the level of pain becomes intolerable. Early results are encouraging. In adequate pain control in labour may also be a serious risk factor for cervical tear. The women or adolescent girl is desperate to remove her baby from her body and by pushing before the cervix is dilated lead to dangerous tears.

Skilled and competent staff

Management of emergencies

All midwives, traditional birth attendants and healthcare staff who provide maternity care need training to recognise what is normal and what is abnormal for both the mother and the fetus/neonate. Healthcare workers should know how to manage emergency situations relevant to their level of knowledge, and when and who to call for help.

In many areas within resource-limited countries there is no accessible surgical or anaesthetic care, and the nurse-midwife may well be the last point of referral. The nurse-midwife therefore needs to be trained and competent in all emergency procedures that may need to be performed within the environment in which they work. These emergency procedures are described in more detail within the relevant sections of this book.

General care

In the antenatal period, it will be the midwives' responsibility to ensure through physical examination, fetal heart auscultation, blood pressure monitoring, urinalysis, and screening for and treatment of anaemia that the pregnancy is progressing satisfactorily (see Section A+1). WHO recommends 4 routine antenatal visits: <16, 24–28, 30–32 and 36–38 weeks' gestation, and more frequently if at any stage it is identified as a high-risk pregnancy. During the pregnancy it may be necessary for the midwife to initiate treatment and follow up any problems that are discovered (e.g. anaemia, hypertension, infections).

When a woman goes into established labour her well- being and progress should be regularly monitored by either the traditional birth attendant or ideally a skilled birth attendant using the modified WHO partograph (see Section A3). This monitoring should include a 4-hourly check of the blood pressure and body temperature, a half-hourly check of the maternal pulse and fetal heart rate, and vaginal examination 4-hourly in the first stage of labour to check that the labour is progressing appropriately. During labour, the woman should be encouraged to void urine at regular intervals and as a minimum every 4 hours to avoid having an overfull bladder which could impede descent of the fetus through the birth canal. For poor progress in labour, foley catheter massage, amniotomy and/or careful augmentation with oxytocin may be indicated (see Section A4).

All observations that are recorded in labour should be recorded on a WHO partograph. Use of the partograph will help healthcare staff to recognise poor labour progress and/or observations of concern.

Fetal heart auscultation with a Pinard's stethoscope or portable Doppler ultrasound device (e.g. a Sonicaid) also needs to occur regularly, although the effectiveness of the frequency of the latter in the first stage of labour will be determined by the availability of facilities for performing an urgent Caesarean section or instrumental delivery for fetal distress (see Section A+19 for more details). Once the second stage of labour has been reached the woman will usually start to experience the urge to push, and the midwife should encourage pushing in normal labour once this urge is sufficiently intense but ONLY if the cervix is fully dilated. Vaginal examinations should then occur to assess progress if delivery is not imminent. At this stage it can be possible to deliver the fetus more rapidly (if the fetal heart rate is indicating signs of distress) by using episiotomy, forceps or ventouse. The second stage of labour can be particularly stressful for the fetus and therefore in the second stage the fetal heart rate (FHR) should be auscultated at least every 5 minutes to determine signs of distress that would necessitate an accelerated delivery. Alternatively, as recommended in Section A+19 FHR can be documented for 30 to 60 seconds immediately following every contraction.

During delivery, the nurse-midwife needs to assist the woman in having a controlled delivery in order to avoid perineal trauma and/or harm to the newborn child.

Active management of the third stage of labour by a skilled birth attendant using oxytocin is essential. Sterile delivery equipment needs to be available. At the very least in the community for the traditional birth attendant this should include a sterile instrument to cut the cord, with a sterile cord clamp and/or ties.

As previously stated, the healthcare worker needs to be constantly alert for any deviation of labour and delivery away from the normal (e.g. premature delivery, twin delivery, haemorrhage, hypertension, etc.), so that care can be adapted and emergency assistance sought if it is required and available.

The healthcare worker needs to be able to perform basic resuscitation of the newborn if this is required at delivery. Therefore bag-valve-mask resuscitation equipment needs to be readily available to healthcare staff all of whom must be trained in its correct use, including traditional birth attendants.

In addition, during the postnatal period the healthcare worker will need to ensure that they have the skills and knowledge necessary to provide appropriate care for the

mother and child. This will include monitoring the progress of both mother and child, again being able to recognise the abnormal and initiate and/or provide the appropriate care to address any problems. The healthcare worker will need to be able to give all necessary advice to the mother and her family on her postnatal recovery and childcare, including advice and support with infant feeding.

Health education and promotion

The midwife or healthcare worker should use every interaction she has with the woman and her family throughout pregnancy, labour and the postnatal period as an opportunity to provide health advice, promote good health and deliver education. This should include antenatal education and information on the recognition of danger signs occurring at any stage during the pregnancy and in the postnatal period, including haemorrhage, abdominal pain, reduced fetal movements, severe headache and any other signs and symptoms of pre-eclampsia, and the immediate action to take when these signs occur. The healthcare worker also needs to provide education on parenting and childcare, again with advice on recognising abnormalities in the child, in order to seek appropriate medical advice. There will also be an ideal opportunity to give family planning advice and advice on the necessary immunisations, prophylactic treatments and available health screening for the whole family.

Critical incident audit, feedback and action plans to improve perinatal and maternal mortality and morbidity

There is little doubt that this is a vital activity that should be undertaken on a regular basis, and that resources and time must be made available for this. Effective methods of preventing maternal and perinatal mortality are available, but the systems of care that should ensure they are put in place are frequently impaired. Critical incident reviews are potentially a simple cost-effective way of defining the local problems and pointing the way to local solutions.

Further reading

Pattinson RC, Say L, Makin JD *et al*. (2005) Critical incident audit and feedback to improve perinatal and maternal mortality and morbidity. *Cochrane Database of Systematic Reviews*, Issue 4. Art. No.: CD002961. DOI: 10.1002/14651858. CD002961.pub2.

Section A3. Managing labour and delivery

Positions for assisting with delivery of the baby

All mothers in labour should be sitting upright or in a lateral or semi-recumbent position (*see* Figure A3.1). They should not lie flat on their back (Figure A3.2), as this causes compression of the inferior vena cava and aorta, with reduced cardiac output, as well as limited ability to push. They should be encouraged to stand and be mobile for as long as is comfortably possible.

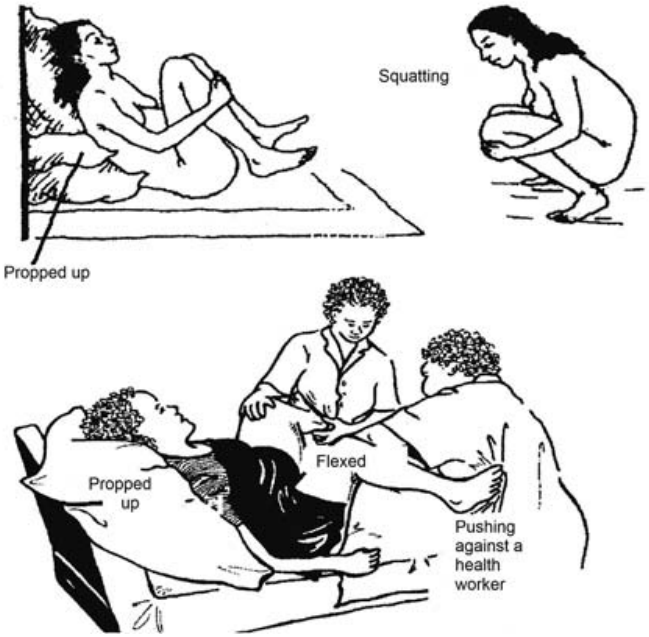


Figure A3.1 *Good positions during the second stage*.

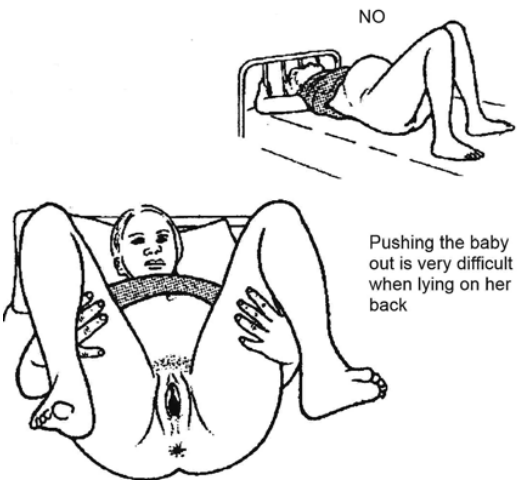


Figure A3.2 *Pushing in the wrong position.*

Basic anatomy to aid understanding of the birthing process

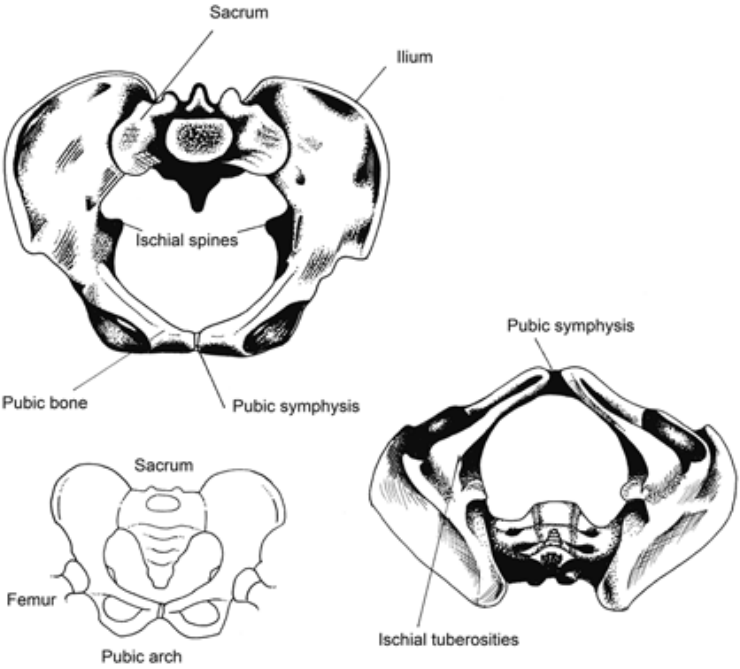


Figure A3.3 *Basic anatomy of the pelvis.*

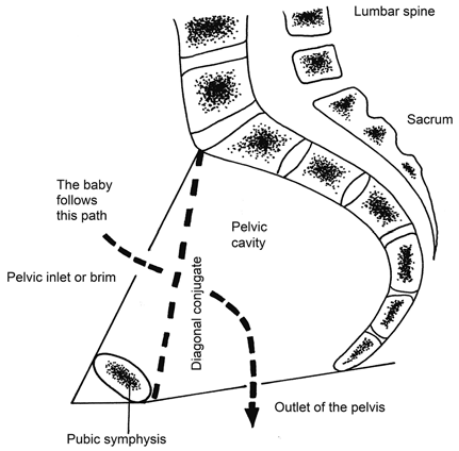


Figure A3.4 *The baby's birth path*.

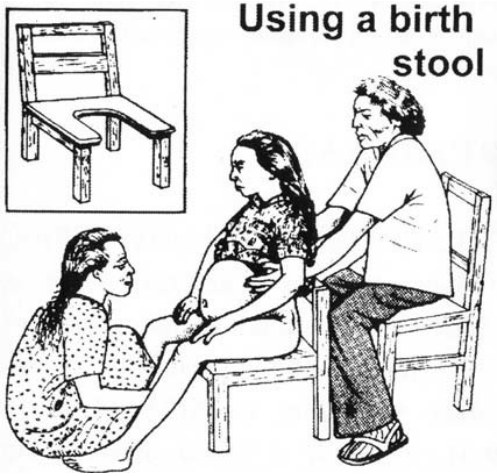


Figure A3.5 *Using a birthing stool.*

Figure A3.5 shows delivery on a birth stool. A Traditional Birth Attendant is delivering this mother's baby, and the husband is helping. Sitting up like this helps the uterus to contract, and it also makes it easier for the mother to bear down. In addition, when the mother opens her legs they act as pivots to help to increase the diameter of the pelvis.

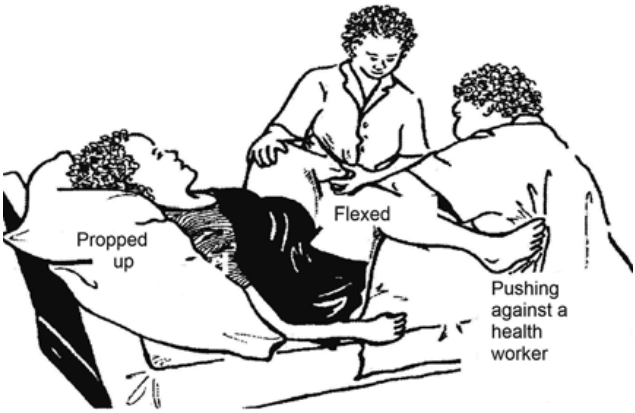


Figure A3.6 *The pushing position, pushing with healthcare worker support.*

Stages and phases of labour

Labour is divided into the first, second and third stages and in some countries a fourth stage.

The first stage is from the onset of painful contractions to full dilatation of the cervix and is divided into latent and active phases.

- The latent phase is cervical dilatation from 0 cm to 4 cm, with gradual shortening of the cervix.
- The active phase is cervical dilatation from an effaced 4 cm cervix to full dilatation, with good contractions. Progress should be at the rate of at least 1 cm/hour. **Latent phase of first stage of labour (0 cm to 4 cm cervical dilatation)**

In the latent phase of labour, contractions usually start off as irregular, establishing into regular painful uterine contractions. In the primigravida, this can take up to a few days to occur, but usually takes less time in the multigravida.

The well-being of the mother and fetus in the latent phase should be assessed without unnecessary interventions, and mobilisation should be encouraged. Adequate hydration and nutrition are important, and the woman should be enabled to empty her bladder as required. During this time, it is important to check the haemoglobin level and review the notes with regard to possible future problems with delivery. Ideally regularly, at least 1 hourly, check FHR immediately after contractions. Placental failure can occur in the latent phase.

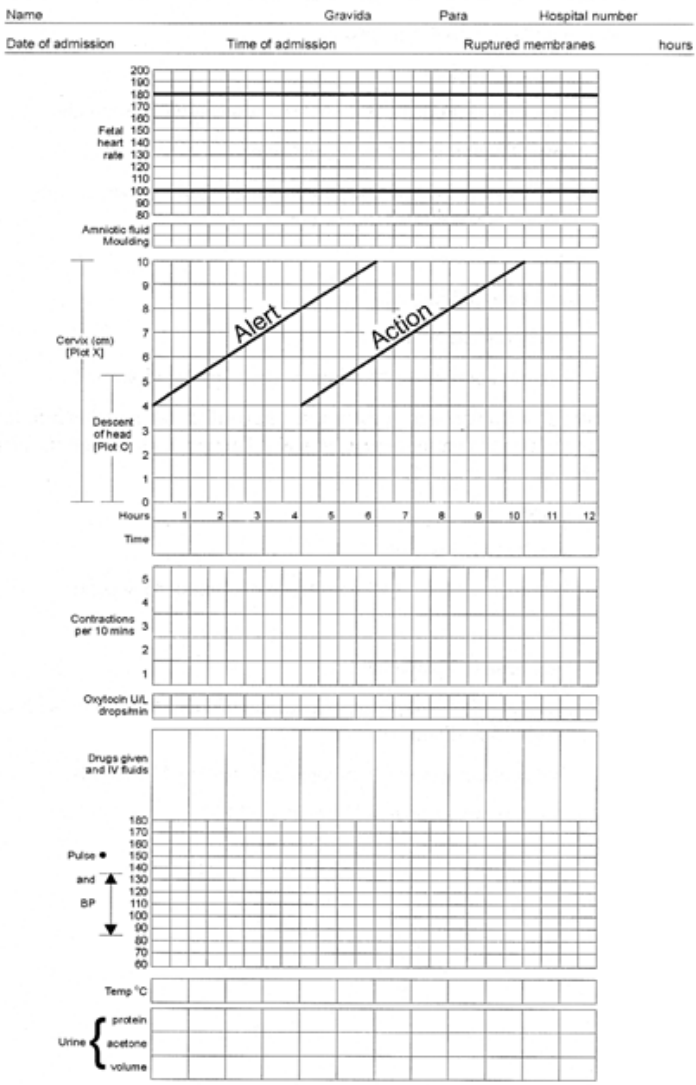
Active phase of first stage of labour

There should be regular painful contractions, and the cervix should efface and dilate at a rate of about 1 cm/hour from 4 cm to full dilatation (10 cm).

Vaginal examinations during labour must be recorded, and only done by those caring for and monitoring the mother. They should not be undertaken more than 4-hourly unless there is a reason for doing so. During such examinations, the use of Chlorhexidine/ Hibitane cream or similar disinfectant cream can help to prevent infections. Care should be taken when diagnosing active labour as misdiagnosis can lead to unnecessary medical intervention and risk to the mother and fetus. It should be noted that in multipara the cervix is often soft and easily stretchable to 4 cm and even beyond. This can be the case in the latent phase, and sometimes even before the onset of contractions.

Vaginal examination: this should be done no less than every 4 hours to assess cervical dilatation, descent of the fetal head, and moulding of skull bones. More frequent examination is only undertaken if indicated.

Unnecessary vaginal examinations in the latent phase can lead to life-threatening infections in the mother and baby.



Key to partogram

- Amniotic fluid: I = membranes intact, C = membranes ruptured, clear fluid, M = meconium-stained fluid, B = bloodstained fluid.

Figure A3.7 *The modified WHO partogram without latent phase. Alert line: starting at 4 cm of cervical dilatation, up to the point of expected full dilatation at the rate of 1 cm per hour. Action line: parallel and 4 hours to the right of the alert line.*

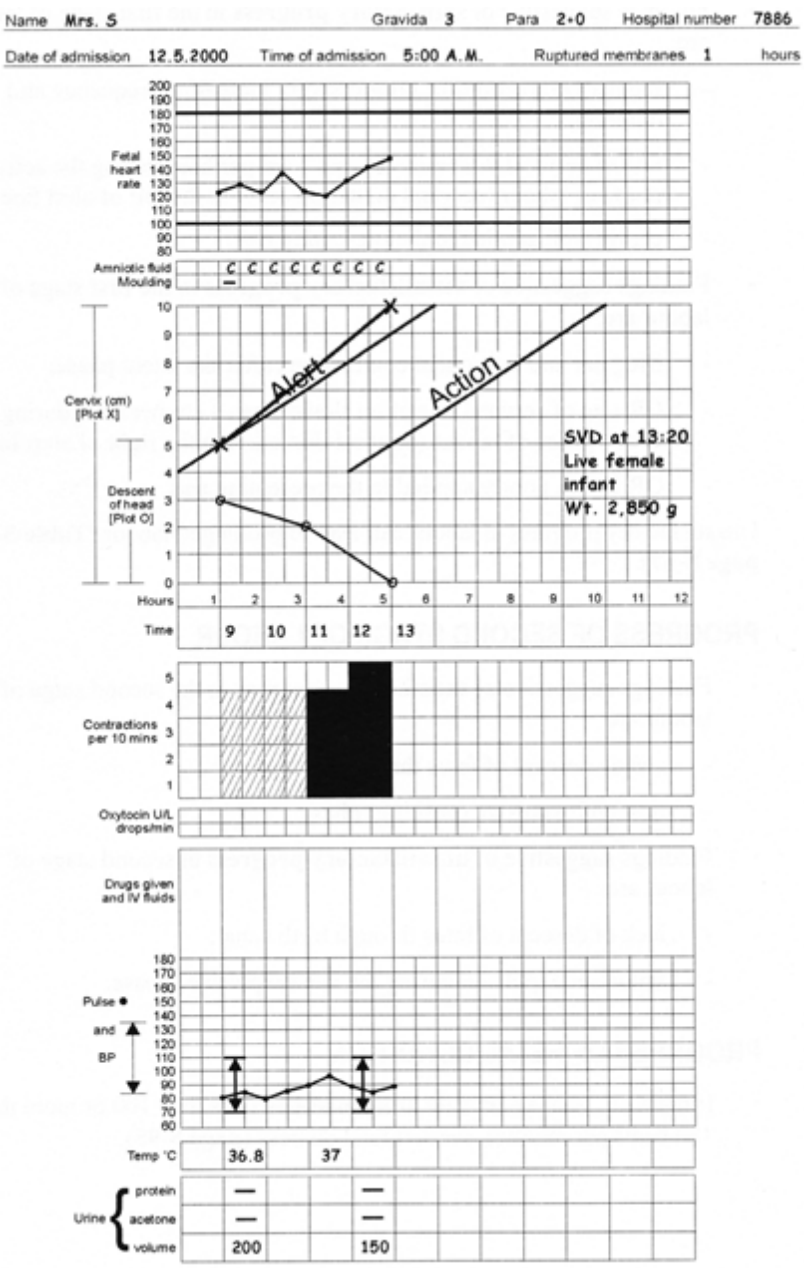


Figure A3.8 *Sample partogram showing normal progression of labour.*
Cervical dilatation: assess at each VE and mark with a cross ×. Begin at 4 cm.

The WHO partograph See Figures *A3.7* and *A3.8*
See World Health Organization (2008) *Managing Prolonged and Obstructed Labour* http://whqlibdoc.who.int/publications/2008/9789241546669_4_eng.pdf

The partograph is a graphic record of the progress of labour and relevant details of the mother and fetus. It was initially introduced as an early warning system to detect labour that was not progressing normally. This would allow for timely transfer to occur to a referral centre, for augmentation or Caesarean section as required. The partograph indicates when augmentation is needed and can point to possible cephalopelvic disproportion before labour becomes obstructed.

It increases the quality and regularity of observations made on the mother and fetus, and it also serves as a one-page visual summary of the relevant details of labour. The partograph has been used in a number of countries and has been shown to be effective in preventing prolonged labour, in reducing operative intervention, and in improving the neonatal outcome.

It is important to ensure that adequate supplies of the form are always available.

The WHO partograph begins only in the active phase of labour, when the cervix is 4 cm or more dilated (see below). However, it is a tool which is only as good as the health-care professional who is using it. There must be a team approach, and senior staff must oversee the care of high-risk patients. Ideally there should be one-to one care.

The observations that are recorded will document the following:

Maternal condition
Maternal vital sign observations are crucial in labour, in order to detect pre-eclampsia, haemorrhage (accompanied by a rise in heart rate, or, as it worsens, a fall in blood pressure) and sepsis (fever). A fall in blood pressure is usually a late and ominous sign. The pulse rate and respiratory rate are valuable early features of worsening maternal condition.

Fetal condition
The fetal heart rate should be measured every 15 to 30 minutes immediately after a contraction, for 1 minute, with the mother sitting or in the lateral tilt position.
The normal baseline fetal heart rate is 120–160 beats/ minute. The fetus's baseline heart rate should remain stable throughout labour. Fetal heart rate accelerations are healthy features, whereas decelerations may suggest fetal compromise. This applies particularly if the decelerations do not recover immediately after the contraction (this is described as a late deceleration). A baseline rate of > 160 beats/minute

(tachycardia) or < 110 beats/minute (brady- cardia) may indicate fetal distress, as can a rising baseline.

In a recently published medical journal article from Liberia, it has been found that it is feasible for pregnant women to undertake fetal heart monitoring during labour so that changes in FHR in relation to the end of every contraction are monitored. A decrease in FHR that persists after the end of a contraction, or continues after a contraction, is more likely to be pathological (Type 2 decelerations). WHO recommendations in place at the beginning this Liberian initiative specified FHR documentation on the partograph every 30 minutes in the first stage and every 5 minutes in the second stage of labour and not with every uterine contraction, as in the Liberian initiative. Moreover, in these earlier guidelines WHO had recommended that the FHR be listened to immediately following the end of a contraction ONLY during 1) the initial assessment of the mother during labour; 2) when malpresentation or malposition are present; and 3) when inducing or augmenting labour. However, during the implementation of the Liberian initiative, in February 2018, WHO updated its guidelines on intermittent FHR auscultation in labour, now recommending auscultation every 15-30 minutes during the first stage, and every 5 minutes during the second stage of labour stating that auscultation should begin during a contraction and continue for at least 30 seconds after the contraction has ended. These latest guidelines also recommend that if the FHR is not always within the normal range (110-160 bpm), auscultation should be prolonged to cover at least 3 contractions and also recommend recording the baseline FHR and the presence or absence of accelerations and decelerations. These updates in guidelines are welcome but, in our opinion, are quite complex, difficult to implement in facilities where there are few midwives, and do not concentrate on the most important time for intermittent auscultation, that is, at the end of **every** contraction. The Liberian approach which involved auscultation from the end of every contraction, was relatively easy to teach, convenient and feasible for individual mothers to undertake, and covered the most critical time for monitoring. For low resource settings, this approach may merit consideration by WHO and the wider international community.

Details of the observations and measurements documented on the partograph

Hours: this refers to the time elapsed since the onset of the active phase of labour (observed or extrapolated).

Time: record the actual time at 30-minute intervals.

Oxytocin: record the amount (in units) of oxytocin per volume of IV fluids, and the number of drops per minute, every 30 minutes when used.

Drugs given: record any additional drugs given.

Pulse: record every 30 minutes and mark with a dot (•).

Blood pressure: record every 4 hours and mark with arrows, unless the patient has a hypertensive disorder or pre-eclampsia, in which case record every 30 minutes. Temperature: record every 4 hours.

Urine measurements measure for protein, infection, ketones (where possible) and volume: ideally record every time urine is passed.

Maternal well-being: record pulse rate every 30 minutes, blood pressure and temperature 4-hourly, urine output and dipstick testing for protein, ketones (if available) and glucose after voiding, and record all fluids and drugs administered. If the findings become abnormal, increased frequency of observation and testing will be required, and intervention may be implemented.

Uterine contractions
For labour to progress satisfactorily there must be good contractions. They normally become more frequent and longer lasting as labour progresses.

Uterine contractions are assessed by palpation, usually hourly in the latent phase, and every 30 minutes in the active phase. The frequency is measured by the number of contractions felt in a 10-minute period, and the duration is measured from the start of the contraction until it passes off (e.g. 3 in 10 minutes, each lasting for 45 seconds).

Contractions are charted very 30 minutes by palpating the number of contractions in 10 minutes and their duration in seconds (< 20 seconds, 20–40 seconds, > 40 seconds). Frequency, duration and strength of uterine contractions (assessed by palpation): record every 30 minutes.

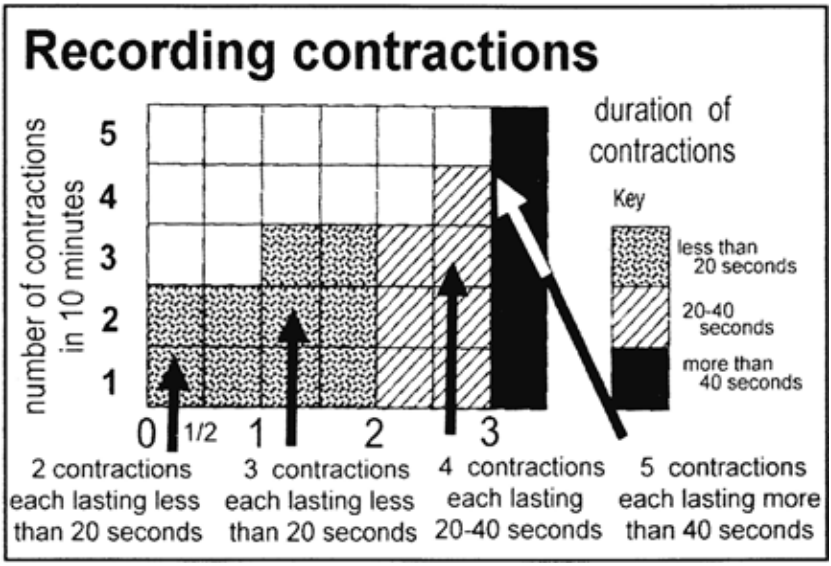


Figure A3.9 *How to record contraction frequency and length. The number of squares filled in records the number of contractions in 10 minutes. The shading shows the length of contractions.*

Fetal well-being WHO currently recommend that for fetal well-being the fetal heart rate (FHR) should be monitored for 1 minute every 15–30 minutes after a contraction in the first stage, and every 5 minutes in the second stage. If abnormalities are noted, urgent delivery can be considered.

The WHO *Birth Asphyxia Prevention Protocol*

1. if a possible FHR change (bradycardia or tachycardia) is detected the midwife immediately notifies a doctor or obstetric clinician on duty.

The obstetric team then undertakes the following:

1) ensures the mother is not lying flat on her back by providing left lateral tilt, examined the liquor if membranes had ruptured, and noted whether meconium staining of amniotic fluid was present.

2) provides additional inspired oxygen (when available)

3) secures an intravenous cannula and gives a bolus of either 0.9% saline or Ringer Lactate solution and where there was suspicion of ketosis, added a bolus of 50% dextrose to the IV infusion. Do not give pure 50% dextrose without dilution it causes vein damage.

4) If there is evidence of fetal distress (late decelerations, persistent bradycardia, persistent tachycardia, meconium stained liquor) then the mother was assessed by the obstetric clinician or doctor to manage any maternal obstetric problem that could be responsible for the fetal bradycardia/tachycardia and assess for urgent immediate delivery as follows:

4a) If the cervix is fully dilated and there were no contraindications, a vacuum delivery is undertaken.
4b) if the cervix is not fully dilated, then the woman is prepared for an emergency Caesarean section (CS) and taken to the operating theatre where she is re-examined. If the fetus was still alive and the cervix still not fully dilated, a CS is performed. An abdominal ultrasound scan was often helpful at this time, not only to check whether the fetus is still alive, but also related to other clinically relevant issues, such as to determine the lie and position of the fetus and confirm the position of the placenta.
5) Under either circumstance outlined in 4 above, a neonatal practitioner or midwife experienced in neonatal resuscitation, is immediately made available for when the baby is delivered. She/he would ensure that the equipment needed for resuscitation was available and functioning.

Membranes and liquor
Check every 30 minutes.
If the membranes are intact, write 'I'. If the membranes are ruptured:

- if liquor is clear, write 'C'
- if liquor is meconium-stained, write 'M'
- if liquor is absent, write 'A'
- if liquor is bloodstained, write 'BS'.

If liquor is absent, or if there is meconium staining of liquor, draining, fetal distress should be considered and monitored for closely (meconium staining is present in 15–30% of all pregnancies, with a higher prevalence after 41 weeks' gestation). Note meconium can be thick or thin. Thick meconium suggests fetal distress, and closer monitoring of the fetus is indicated

The progress of labour
1. Cervical dilatation and its measurement
Cervical dilatation is assessed by vaginal examination, which should be performed every 4 hours, unless there are indications to do so more frequently.

The cervical dilatation can be plotted on a partograph against time. When the patient is admitted in active labour, the dilatation is immediately plotted on the alert line, the first line drawn upwards on the graph illustrating a rate of 1 cm/hour from this first plot. If subsequent progress is satisfactory, the cervical dilatation will be on, or to the left of, this alert line in later vaginal examinations.

Always place first cervical dilatation on the alert line corresponding to dilatation value. That is, do not start partograph with X on the alert line at 0 hours unless dilatation is exactly 4cm at the time of the first vaginal examination.

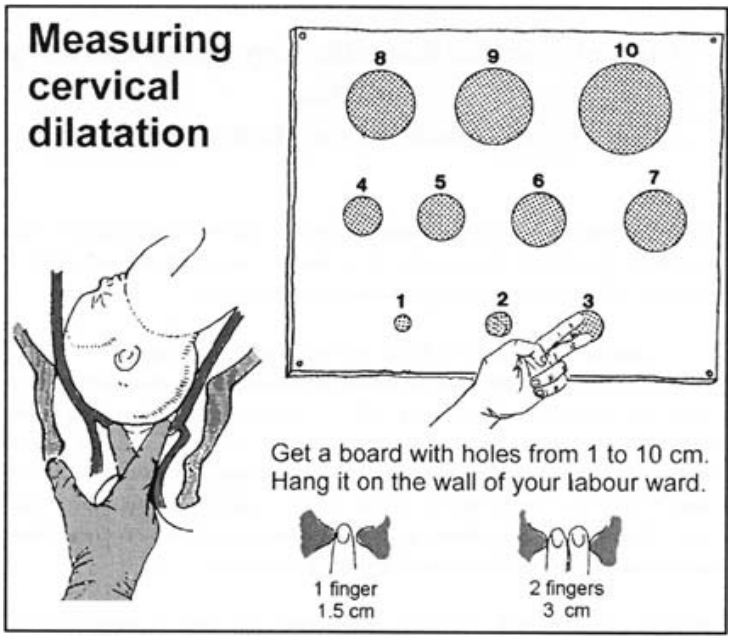


Figure A3.10 *Measuring cervical dilatation. A cervical dilatation board shows the diameter of the cervix from 1 cm to 10 cm.*

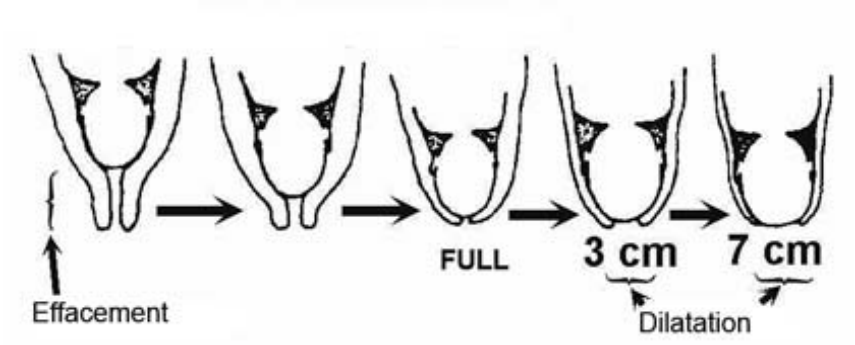


Figure A3.11 *Effacement and dilatation*.
Before the onset of labour, the cervix will usually be tubular. Effacement is the process whereby the cervix subsequently loses its length, to become flattened against the fetal presenting part.

In primigravid women, effacement occurs in early labour, followed by cervical dilatation. In multiparous women, the cervix commonly dilates before full effacement.

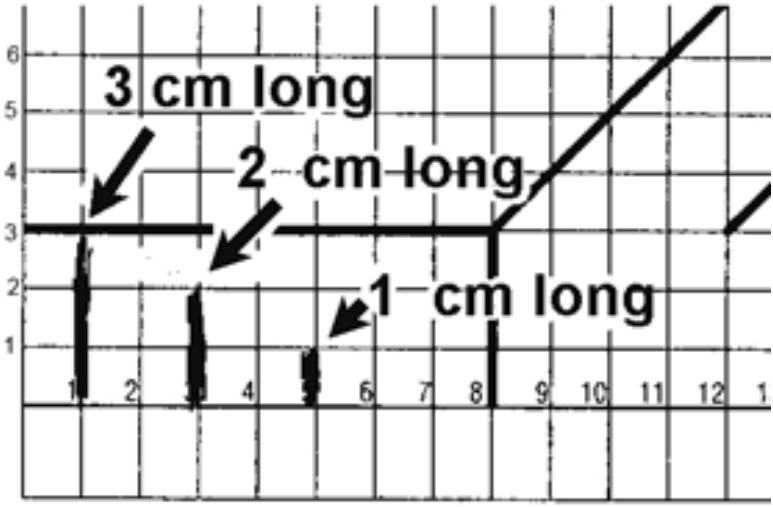


Figure A3.12 *Recording effacement: the length of the cervix. Effacement can be recorded by thickening a line with a pen as shown in the diagram, or 'percentage' effacement can be written in the squares.*

Diagnosis of the stages and phases of labour identified by changes in the cervix

Cervix not dilated = not in labour
Cervix dilated < 4 cm = first stage and latent phase
Cervix dilated 4cm up to 10cm = first stage and active phase (usually 1 cm/hour) and onset of fetal descent.
Cervix fully dilated (10 cm) with no urge to push = second stage (non-expulsive phase). The fetus continues to descend.
Cervix fully dilated (10 cm) with urge to push = second stage (expulsive phase). The fetus reaches pelvic floor. Following delivery of the baby = Onset of third stage.
Delivery of the placenta = End of third stage.

Bishop's Score: The early pre-labour/early labour changes that occur to the cervix can be quantified by using the Bishop's score, which assigns a score of 0 to 2 for each of the following characteristics: dilatation, effacement, consistency, position of cervix and station of the head (see below). It is useful both for assessing progress in the latent phase of labour, and for assessing the 'favourability' of the cervix for induction of labour. A patient with a favourable cervix has a Bishop score of 6 or

more and is likely to be easier to induce. It should also be possible to rupture the membranes by the time the Bishop's score is 6.

Characteristic and its score	0	1	2	3
Dilatation	Closed	1–2 cm	3–4 cm	5 cm or more
Effacement	>4 cm	3–4 cm	1–2 cm	Effaced
Consistency	Hard	Medium	Soft	–
Station of head	–3 or above	–2	–1/0	+1/+2
Position of cervix	Posterior	Mid	Anterior	–

2. Descent of the fetal head.
Dilatation of the cervix should be accompanied by descent of the head, although this may not occur until advanced labour. Sometimes descent does not occur until full dilatation, especially with the pelvis of African women.

Assessing fetal descent **by abdominal palpation**
This method involves measuring by fifths (20% increments) of the head palpable above the symphysis pubis (pelvic brim) as described above.

- 5/5: head entirely above the inlet of the pelvis (head totally free)
- 0/5: head deep in the pelvis.

Abdominal examination should always be performed immediately before vaginal examination and plotted on the partogram with the cervical dilation.

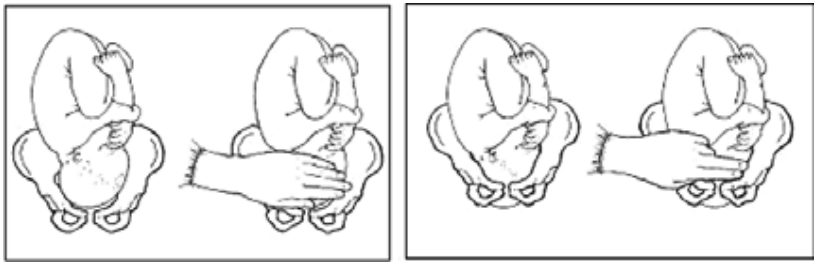


Figure A3.13 *Fetal head descent palpated abdominally showing 4/5 on the left and 2/5 on the right*

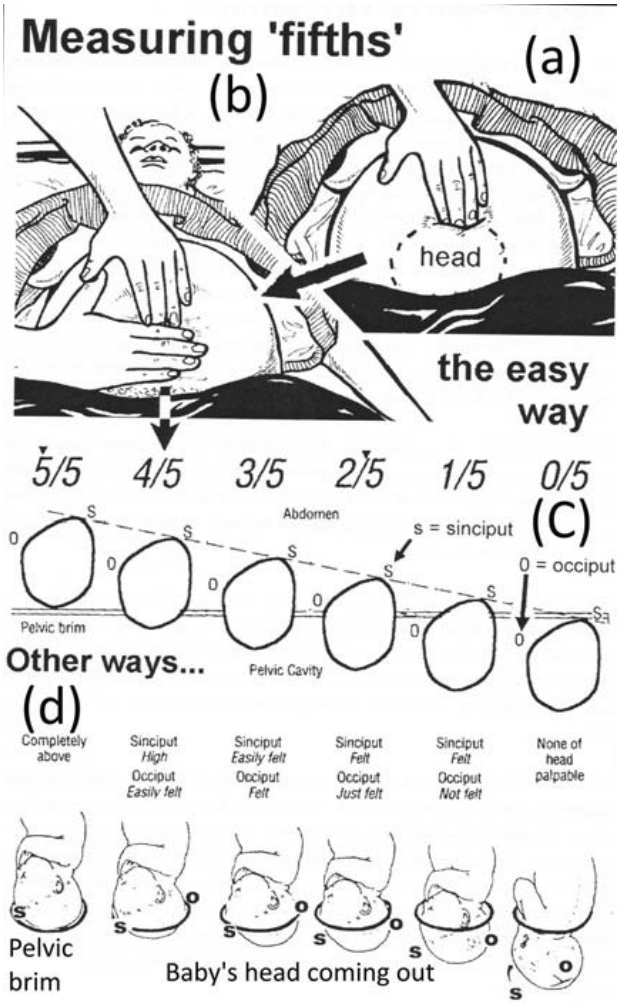


Figure A3.14 *Measuring descent of the fetal head abdominally 'fifths'.*

Assessing fetal descent **by vaginal examination**

This method measures the descent of the head past the mother's ischial spines. When the presenting fetal head is at the level of the spines, this is designated '0'. Figure A3.14a shows the occiput entering the brim of the pelvis on the left side, so the fetus is left occiput-lateral. Later drawings show the occiput moving round to the front so that in (d) it becomes anterior (OA). The mother was admitted soon after labour began. The baby's head is 3/5 palpable, it will soon engage in the pelvis and

has started to flex. The membranes are intact, and the cervix is 2 cm long (uneffaced).
In Figure ***A3***.14.b, the fetal head is now 2/5 palpable; it is more flexed and has just started to turn towards the front (anteriorly). The cervix is fully effaced but has not begun to dilate. The membranes are still intact.
In Figure ***A3***.14.c, the fetal head is now 1/5 palpable; the neck is more flexed and has turned a little more. The cervix is now 7 cm dilated, so the progress line has been transferred to the alert line on the partogram. The membranes are still intact. Until now the mother has been allowed to move and walk about. She has chosen to lie down for delivery.
In Figure ***A3***.14.d, the fetal head is 0/5 palpable, the occiput is anterior and the scalp is visible. The mother is almost fully dilated, so the first stage is almost over.

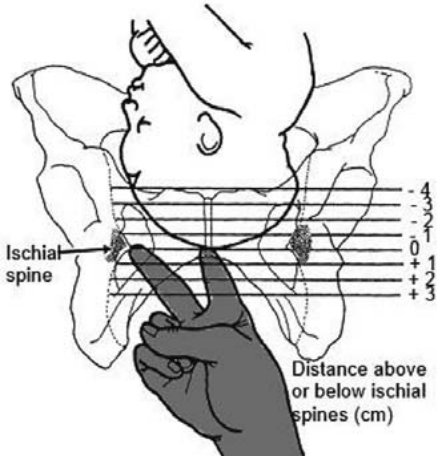


Figure A3.15 *Measuring the descent of the vertex using the ischial spines.*

Figure ***A3***.15 shows the use of the ischial spines to measure descent of the head. Feel the vertex with your index finger and feel for an ischial spine with your third finger. Is the vertex higher or lower than the ischial spines? You may only be feeling caput. Measuring fifths abdominally is more reliable but can be difficult, especially in obesity.

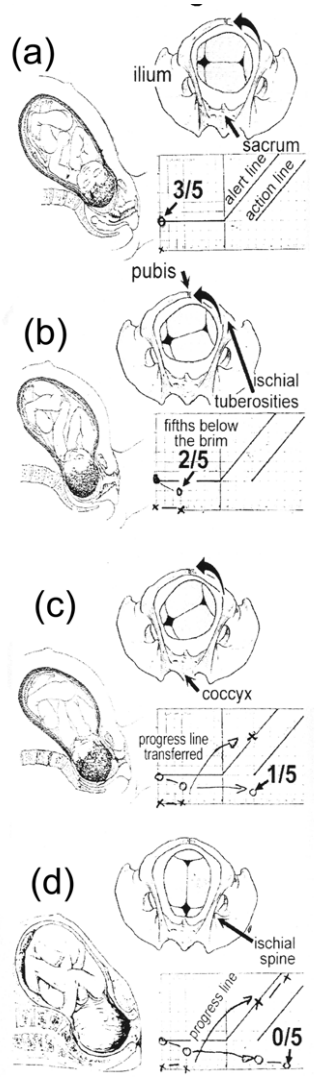


Figure A3.16 *Descending fetal head showing vaginal appearance to palpation.*

Alongside each picture of the fetus is a view of the head from below and a partogram to show the stage of the mother's labour.

Moulding of fetal skull bones (*see* Figure *A3.*17)

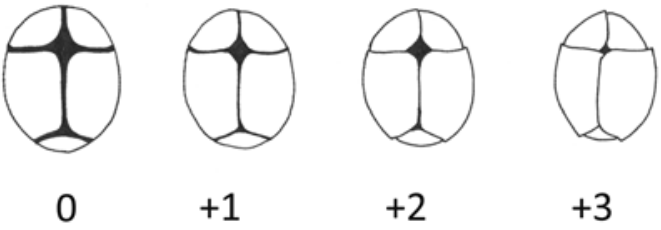


Figure A3.17 *Degrees of moulding of the bones of the fetal skull.*

Increasing moulding may be a sign of cephalo-pelvic disproportion, as the fetal skull bones overlap to aid passage through the maternal pelvis.

Key: 0 = bones are separated, and sutures can be easily felt,
+ = bones are just touching each other,
++ = bones are overlapping but can be reduced,
+++ = bones are severely overlapping and irreducible.

Descent assessed by abdominal palpation: this refers to the part of the head (which is divided into five parts) palpable above the symphysis pubis; recorded as a circle (O) at every vaginal examination. At 0/5, the sinciput (S) is at the level of the symphysis pubis.

Additional issues during management of the first stage of labour
Place an IV cannula early on in all high-risk patients.
If a fever (37.5 degrees C or more) develops give intravenous antibiotics (ampicillin 2 grams IV/IM 6-hourly plus gentamicin 80 mg IV/IM 8-hourly or 5 mg/kg IV/IM once every 24 hours).

If the first stage is prolonged, consider the following:

- malpositions or malpresentations
- pelvis too small or head too big
- contractions too weak
- membranes need rupturing
- dehydration, ketosis and/or exhaustion.

Delay in the first stage of labour

If progress is initially good, but then slows down or stops, there may be:

- malpositions or malpresentations
- obstructed labour
- an increased risk of shoulder dystocia.

Prolonged active phase (first stage) of labour If cervical dilatation crosses the alert line, this warns that labour is slow and there may be problems. If possible, transfer the patient to an obstetric unit practicing comprehensive EmOC. If the action line (4 hours to the right according to the WHO, or 2 hours to the right according to recent evidence from South Africa) is reached, the mother must be reassessed to ascertain the reason for lack of progress and further management determined.

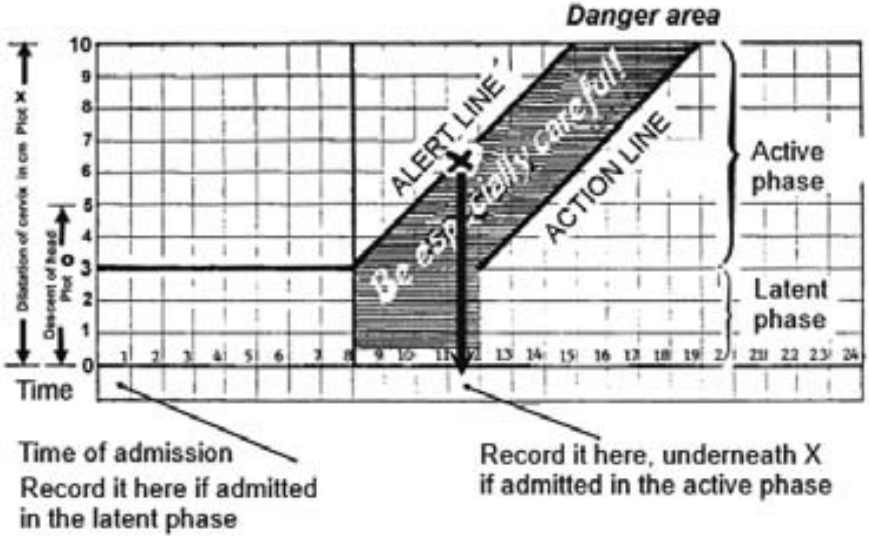


Figure A3.18 *The partogram showing the portion relating to cervical dilatation.*

The numbers 1 to 24 represent the number of hours since the mother was admitted, but only if she was admitted in the latent phase.

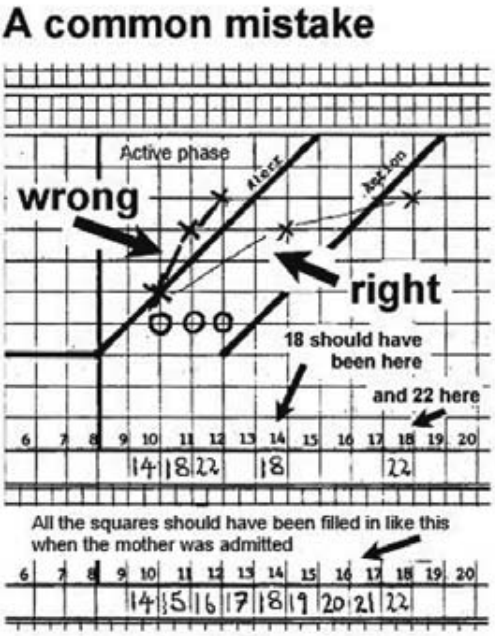


Figure A3.19 *Correct placement of data on the partogram.*
A common mistake is to put the next record ('x' and 'o') in the next square, and not to allow for the time that elapses between one observation and the next.

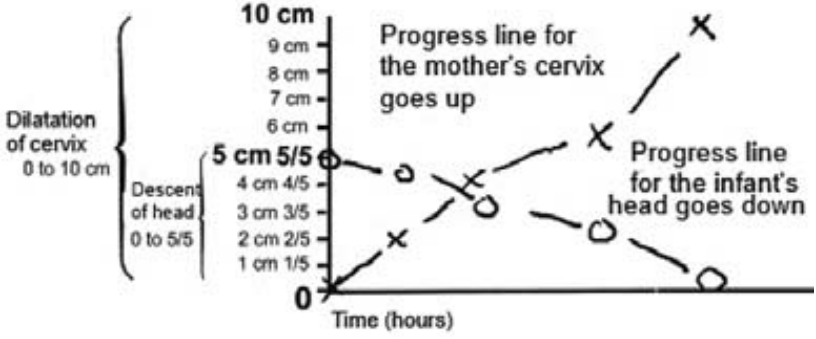


Figure A3.20 *Lines on the partogram.*

Other complications of the first stage of labour
Urgent help may be required to diagnose and manage cord prolapse (*see* Section A+25), placental abruption (*see* Section A+9) or ruptured uterus (*see* Section A+4).

Second stage of labour
This begins when the cervix is fully dilated. Fetal descent occurs, but initially there may be no urge to push. This is usually felt only when the fetal head reaches the pelvic floor. It may be helpful for the mother to stand up or squat during this time to assist pushing. She must not lie flat on her back.

Delivery of the baby may be allowed to take 2 hours from full cervical dilatation in the primigravida, and 1 hour in the multigravida, before there is cause for concern. The mother must never push if the cervix is not fully dilated. It may be a contributing factor in producing a dangerous cervical tear.

Pain control in labour must be provided (see above for advice on the use of IV Paracetamol).

During delivery, trauma to the perineum should be minimised. Routine episiotomy is not indicated but should be performed if significant perineal trauma is anticipated, or to aid more rapid delivery if indicated.

Anterior episiotomy/ reversal of genital mutilation may be required in some women (see Section A+29).

Episiotomy (Section E7) is recommended for the following:

- complicated vaginal delivery (breech, to make room for manoeuvres in shoulder dystocia, forceps and some vacuum extractions)
- scarring from female genital mutilation (see above) or poorly healed third- or fourth-degree tears
- fetal distress.

Sometimes contractions become less strong when the cervix becomes fully dilated. After confirming the well-being of the mother and fetus, mobilise the mother, hydrate her orally, including sufficient calories to help to prevent ketosis, and then wait for up to 1 hour for the head to descend. If the mother is unable to tolerate oral fluids, administer IV glucose and fluids. However, be alert for the possibility of cephalo-pelvic disproportion. After 1 hour encourage pushing, provided that the cervix is fully dilated.

Ensure that delivery of the head is controlled so that there is not a sudden release of pressure on it as it delivers. (This may damage the neonatal brain).

If there is fetal distress, or delivery has not occurred after 2 hours in a primigravida or 1 hour in a multigravida, assisted vaginal delivery should be considered. A ventouse or forceps may be considered so long as none of the head is palpable per abdomen. The cervix must be fully dilated.

During delivery of the baby

1. Ask the mother to pant or give only small pushes with contractions.
2. Control the birth of the head by placing the fingers of one hand against the baby's head to encourage flexion, and to ensure that the head does not deliver too quickly.
3. Support the perineum with your other hand as it distends, and the head is delivered.
4. Call the paediatrician/neonatal clinician (if available) if you consider that the baby might need resuscitation.
5. Once the head is delivered, ask the mother not to push.
6. Feel around the baby's neck for the umbilical cord:
7. If it is round the neck but loose, slip it over the baby's head.
8. If it is so tight round the neck that it is definitely preventing delivery of the baby's shoulders, double clamp it and cut it before unwinding it from the neck. Delivery can often be achieved with the cord left in place.
9. Allow the baby's head to turn spontaneously.
10. After the head has turned, place a hand on each side of the head and ask the mother to push gently without the need to wait for contractions.
11. Avoid tears by delivering one shoulder at a time. Routine traction of the baby's head in an axial direction should be used and should result in delivery of the anterior shoulder.
12. Lift the baby's head anteriorly to deliver the shoulder that is posterior.
13. Support the baby's body as it slides out.
14. After delivery of the baby, give the mother 10 units of oxytocin IM to reduce the risk of haemorrhage, but only do this if the possibility of a second twin has been excluded by earlier ultrasound examination or by abdominal palpation. Alternatively, 10 units of oxytocin plus 500 micrograms of ergometrine (called Syntometrine) IM can be given, **but never give ergometrine** if the mother has hypertension or pre-eclampsia or heart disease, as it can increase blood pressure and cause a cerebrovascular accident.
15. Dry the baby, cover with a dry clean towel and assess the baby (*see* Section A+20).
16. If the baby does not need resuscitation, place on the mother's abdomen for 1 to 3 minutes to provide a transfusion of placental blood to the baby, but keep warm (for details, *see* Section A+20).
17. Then cut the umbilical cord and place the baby in skin-to-skin contact with the mother, ensuring that the body and head are covered to keep the baby warm. The baby may seek to suck on the breast which should be encouraged.
18. If the baby needs resuscitation, cut and clamp the cord immediately, and proceed to

open the airway and breathe for the baby (*see* Section A+20).

19. If the mother is not well, ask an assistant or relative to care for the baby.
20. Always prepare for the need to resuscitate the baby, especially if there is a history of eclampsia, prolonged or obstructed labour, bleeding, preterm birth or infection. Always have a bag-valve-mask of the right size available next to the mother, and ideally on a Resuscitation platform, in case assisted ventilation is required.
21. If the head retracts on to the perineum during delivery (the turtle sign), this suggests shoulder dystocia (*see* Section A+5).

Active management of the third stage of labour

This is advised for preventing postpartum haemorrhage (PPH), and it consists of three possible interventions:

1) a prophylactic uterotonic drug after delivery of the shoulders of the baby and after ensuring that another fetus is not present in the uterus
2) controlled cord traction
3) uterine massage after delivery of the placenta.

Of these, a uterotonic drug (see above), is the most important, with oxytocin the first choice because it causes uterine contraction to prevent atony rapidly with minimal adverse effects. Atony is the most common cause of PPH (around 80-90% of cases). If oxytocin is unavailable, or does not work, other uterotonic drugs should be used, including ergometrine or misoprostol.

The safe use of oxytocin in the prevention and treatment of PPH

Single injection of high concentration of oxytocin as part of active management of the third stage of labour

For prevention of PPH as part of the active management of the third stage of labour, a bolus single injection of 10 IU is given IM.

An additional single injection of 5 IU can be given intravenously over 5 minutes if PPH has not been prevented by the IM injection given as part of the third stage of labour (see Section A+11). Warn the mother that a harmless flushing feeling may occur during this IV injection.

Infusion of oxytocin for prevention or STOPPING OF PPH

If there is a high risk of PPH or actual PPH a standard infusion of oxytocin is given as follows:

40 IU of oxytocin is put into 500 ml of 0.9% Saline or Ringer Lactate/Hartmanns and given as an IV infusion over 4 hours.

If you only have a 1 litre bag it is possible to empty 500 ml away leaving 500ml in which to place the 40 IU of oxytocin. Alternatively put 80 IU of oxytocin in 1 litre bag and then give at the same speed as the 40 IU in 500ml bag but stop after 4 hours.

40 IU of oxytocin is the same as 40,000 milliunits of oxytocin (40 times 1,000)
To give this solution over 4 hours it is necessary to calculate how many drops per minute of the solution should be administered.

500 ml given over 4 hours is 500 divided by 4 which equals 125 ml per each hour.

If the drop factor is 20 drops per 1 ml then each hour 125 ml will consist of 125 multiplied by 20 which equals 2500 drops in total per hour.

There are 60minutes in each hour and therefore 2500 divided by 60 = the number of drops per minute which is approximately 41 drops per minute.

Therefore, the giving set should be set up to flow at 41 drops per minute for the whole of the 4-hour infusion.

During this infusion for PPH the dose of oxytocin given in milliunits per minute is calculated as follows:

40,000 milliunits is given over 4 hours. This is equal to 10,000 milliunits each hour and to decide how much is given per minute, 10,000 is divided by 60 which is the number of minutes in each hour and this gives a Figure of 167 milliunits per minute.

167 milliunits per minute is much higher than the doses given for the induction or augmentation of labour (see below) which is why you need to understand the Figures and prescription you are administering.

It is not enough to know the number of drops per minute but that you must know the dose of oxytocin given in milliunits/minute.

All uterotonic drugs should be given within 1 minute of the complete birth of the fetus, to aid separation of the placenta by enhancing uterine contractions and reducing the risk of bleeding from an atonic (relaxed) uterus. **It is essential that you are certain there is not another fetus in the uterus before such drugs are given.**

Ensure that both oxytocin and ergometrine are protected from heat damage by close attention to the cold chain and their storage, otherwise they may not be effective.

Ideally oxytocin should be stored in a fridge. Oxytocin must never be frozen. Always store ergometrine in a fridge at 2–8°C. Misoprostol is not affected by ambient temperature.

Ergometrine is contraindicated in patients with heart disease, hypertension, pre-eclampsia or eclampsia, as it raises the blood pressure by vasoconstriction, with the risk of cerebrovascular accidents.

Early cord clamping and cutting (the second intervention listed above) as part of the active management of the third stage of labour is no longer recommended unless the infant needs resuscitation (see above).

Controlled cord traction (the third intervention listed above) is optional where delivery is undertaken by a skilled birth attendant but contraindicated if a skilled attendant is not available. It must not be undertaken if a uterotonic drug has not been given.

1) After the cord has been clamped, use cord clamp/ straight clamp to hold the cord close to the perineum.
2) Place the other hand just above the pubis and counter the uterus during traction of the cord to prevent it from inverting (*see* Figure ***A3***.21).
3) Keep slight tension on the cord and wait for a uterine contraction.
4) When the uterus becomes rounded or the cord lengthens, assume that the placenta has separated, and pull gently down on the cord to deliver the placenta. Do not wait for or expect a gush of blood before applying traction. Continue to apply counter traction on the uterus with your other hand.
5) If the placenta does not descend and deliver within 1 minute of cord traction the placenta is not separating. Therefore, stop traction, wait for the next contraction and repeat the process.
6) As the placenta delivers, the membranes can tear off. To avoid this, hold the placenta in two hands and gently turn it until the membranes are twisted.
7) Gently pull to complete the delivery.
8) If the membranes do tear, wearing sterile gloves gently examine the upper vagina and cervix and use a sterile sponge forceps to remove any fragments of membrane that are present.
9) If the cord is pulled off the placenta, uterine contractions may still push it out, but if this does not happen a manual removal may be needed (*see* Section A+11).
10) If the uterus is inverted, push it back immediately (*see* Section A+26).

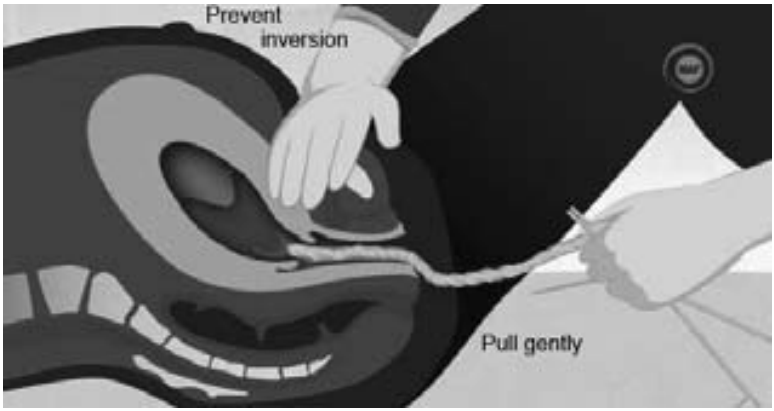


Figure A3.21 *Controlled cord traction for active management of the third stage being undertaken by a left handed professional.* Reproduced with the permission of Medical Aid Films, www.medicalaidfilms.org

In Figure A3.21 the operator's right hand is holding back the uterus while traction is applied to the cord.

Strong uterine massage (the fourth intervention listed above) should always be undertaken immediately after delivery of the placenta, until the uterus is contracted and remains so. Check the state of contraction of the uterus every 15 minutes for 2 hours and repeat the massage if at any time the uterus becomes soft and relaxed.

All postpartum mothers must be closely monitored to ensure that PPH does not occur. They should be examined every 15 minutes for the first hour after delivery, and then every 2-4 hours until 24 hours after delivery.

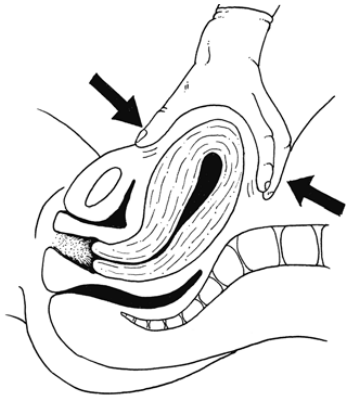


Figure A3.22 *Strong massage applied to cause uterus to contract.*

In order to prevent PPH during or after Caesarean section, oxytocin plus controlled cord traction is recommended in preference to manual removal of the placenta.

Expectant management of the third stage of labour if uterotonic drugs are not available

Unfortunately, it is not uncommon for hospitals to run out of uterotonic drugs. In this avoidable and dangerous situation, expectant/physiological management should be undertaken.

1) Place the baby on the mother's breast.
2) Leave the cord alone.
3) Observe for the following signs of placental separation:

a. the uterus becomes more rounded and contracted
b. there is lengthening of the cord at the introitus
c. the mother feels uncomfortable, feels a contraction and wants to 'bear down'.

4) Sit the mother upright
5) Encourage her to bear down with a contraction (only after separation of the placenta).
6) Catch the placenta. If membranes are dragging behind, gently twist a few turns and with slight traction and an up-and-down movement deliver the placenta plus the membranes.

   Most placentas separate within 1 hour after birth. If this does not happen, seek help. Controlled cord traction should not be undertaken prior to the separation of the placenta in the absence of uterotonic drugs.

7) **Monitoring after the placenta has been delivered by active or expectant management**

   This has sometimes been called the fourth stage of labour. The hour or two after delivery when the tone of the uterus is re-established as the uterus contracts again, expelling any remaining contents. These contractions are hastened by breastfeeding, which stimulates production of the hormone oxytocin.

   Monitor the patient's vital signs, blood pressure, pulse rate and volume, and the state of the uterus (is it contracted?) every 15 minutes for 2 hours after delivery of the placenta.

   Examine the placenta for completeness.

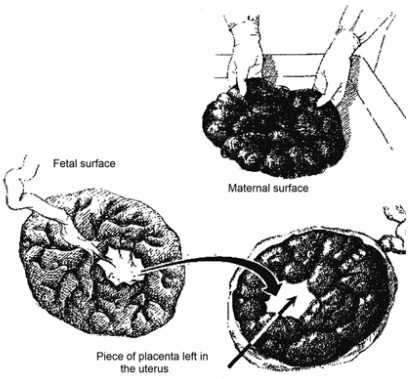


Figure A3.23 *Examining the placenta in a sink.* In this case the fetal and maternal surfaces show a piece missing, which has probably been left in the uterus.

Checking the placenta
Check that the placenta and membranes are intact. If they are not, there are retained products of conception which may pass spontaneously or that may need to be removed manually through the vagina.

Checking for tears
Examine the patient for tears in the cervix or vagina, and repair these as well as any episiotomy (*see* Section A+12, E7 and E8).

Skin-to-skin contact between mother and baby
If neither the mother nor the baby needs resuscitation, ensure that the newborn baby is placed in skin-to-skin contact with the mother for at least 1 hour after birth, and encourage and support the baby to attach to and suck on the breast. This approach recommended by the Baby Friendly Hospital Initiative (step 4) improves temperature control and respiratory function, increases milk production and helps to ensure weight gain for the baby.

Vitamin A for all recently delivered mothers High-dose vitamin A should be avoided during pregnancy because of the risk of birth defects. A single dose of 200 000 units should be given to all postpartum mothers within 6 weeks of delivery, when the likelihood of pregnancy is very low, and when infants benefit most from its presence in breast milk.

Involution of the uterus post delivery
Usually at umbilicus immediately post delivery , then 1 cm lower each day and in the pelvis by 10 to 12 days post delivery.

Section A4. Induction or augmentation of labour

This may be required if there is prolonged pregnancy, pre-labour prolonged rupture of membranes (PROM), placental abruption, or a hypertensive disorder. Ensure induction is indicated, as failed induction is usually followed by Caesarean section.

Prolonged pregnancy
This is defined as a pregnancy that continues for more than 14 days after the expected date of delivery. This is a particularly difficult management issue in low-resource settings, where the dates of the last menstrual period may not be recalled by the time of antenatal presentation, and where early ultrasound scanning during pregnancy is unlikely to have been performed.

Prolonged pregnancy is associated with fetal distress, poor progress in labour, shoulder dystocia and increased fetal, maternal and neonatal mortality.

If there is reasonable evidence that a patient is at or above 40 weeks' gestation, stretching and sweeping of the membranes in a suitably equipped healthcare facility can be helpful in starting off labour, and may thus avoid the need for formal induction of labour (see below).

Stretching the cervix and sweeping the membranes
First check the fetal presentation, ensure that the head is not high, and record the fetal heart rate. If there has been any antepartum haemorrhage this procedure must not be undertaken because of the risk of placenta praevia. (Unless it has been excluded by ultrasound scan).

The woman should empty her bladder.

A vaginal examination in the lateral tilt position using sterile gloves coated with an obstetric antiseptic cream (e.g. chlorhexidine) should be undertaken. If there is any evidence of vaginal infection or spontaneous rupture of membranes, a membrane sweep must not be performed.

The cervix should be assessed for effacement, whether it is soft or hard, and for dilatation. If there is no cervical dilatation or the head is not at a minimum of –3, then a sweep should not be undertaken.

If the cervix is closed but soft, it may be massaged until it allows the insertion of a finger. Once the cervical os is open (more likely post term), introduce a finger into the cervical os and pass it in a circle around the cervix. This should separate the membranes and result in the release of local prostaglandins, increasing the likelihood of the onset of labour within 48 hours.

The whole procedure is uncomfortable, but afterwards it should produce only slight pain or bleeding with irregular contractions. If pain or bleeding is marked, keep the woman under close observation in the healthcare facility.

The process can be repeated if labour does not start spontaneously after 36 hours.

The use of a Foley catheter to induce labour https://youtu.be/CV4yZNnav5s
An effective alternative to misoprostol is to use a Foley catheter to mechanically 'ripen' the cervix and induce labour. The Foley catheter tip is passed through the cervical os either during a sterile digital examination, or with the use of sterile/high-level disinfected speculum and forceps. The inflatable bulb is introduced beyond the internal cervical os and then inflated with 30ml of sterile water. The catheter tip is then left in situ for up to 24 hours to allow cervical ripening and contractions to begin. It may fall out in the interim if the cervix dilates adequately. Once removed, amniotomy and oxytocin can be commenced if needed. This method is particularly useful in women at high risk of rupture as it does not risk hyperstimulation.

Artificial rupture of membranes (ARM)
This is undertaken to either induce or augment labour. Induction of labour usually also requires uterotonic drugs. Slow progress in labour can often be corrected by ARM. However, in areas of high HIV prevalence, leaving the membranes intact for as long as possible may reduce the risk of perinatal transmission.

ARM risks infection and cord prolapse. It is contraindicated where placenta praevia is suspected or in the first episode of active herpes infection, or in vasa praevia. It is riskier with a high fetal head or polyhydramnios.

Procedure for ARM
ARM is best delayed until the cervix is 'favourable' as this will reduce the length of time the membranes are ruptured (and hence risk of chorioamnionitis) and limit the duration of any oxytocin infusion used. It is also likely to result in a reduced risk of failed inductions and thus unnecessary caesarian sections. A favourable cervix is one where softening, dilatation and effacement have started to occur, and corresponds to a Bishop's score of 6 or more.

It is therefore advised to 'ripen' the cervix with one of the following before ARM: misoprostol, a Foley catheter or an oxytocin infusion (all discussed below), whichever is considered the most appropriate.

1) Listen to – and note – the fetal heart rate.
2) Ensure that the woman has emptied her bladder.
3) Palpate the abdomen. If the presenting part is well descended, cord prolapse is less likely.

4) Ideally perform an ultrasound scan to identify the position of the placenta.
5) Wearing sterile gloves and with chlorhexidine obstetric cream on your fingers, examine the cervix, and note the consistency, position, effacement and dilatation. Confirm the fetal presentation.
6) With the other hand (again with obstetric cream) insert an amniotic hook or a Kocher clamp into the vagina.
7) Guide the clamp or hook along the fingers of your firsthand towards the membranes in the vagina.
8) Place two fingers against the membranes and gently rupture them with the instrument in the other hand. Allow the amniotic fluid to drain slowly around your fingers.
9) Check that no cord can be felt.
10) Note the colour (clear, yellow, greenish or bloody) and smell of the fluid. If thick meconium is present, suspect fetal distress. Some light bleeding may occur.
11) After ARM, listen to the fetal heart during and after a contraction. If the fetal heart rate is abnormal (less than 110 beats/minute or more than 160 beats/minute), suspect fetal distress.
12) If delivery has not occurred within 18 hours, give pro- phylactic antibiotics (IV ampicillin 1 gram 6-hourly plus gentamicin 80 mg IV/IM 8-hourly or 5 mg/kg body weight IV/IM once every 24 hours) in order to help to prevent infection in the baby and the mother. If there are no signs of infection in the mother after delivery, discontinue antibiotics.
13) If the liquor is foul smelling or there is a maternal fever or other indication of uterine infection/chorioamnionitis treat with the antibiotics as above but with the addition of metronidazole 500mg IV 8 hourly.
14) Regularly monitor vital signs.

The safe use of oxytocin in inducing and augmenting labour

Definitions

The drop factor of any giving set tells us how many drops are equal to 1ml of fluid.

Most standard giving sets in Liberia have a drop factor of 20 which means that 20 drops emerging from the giving set is equal to 1 ml of the fluid.

An ampoule of oxytocin in Liberia usually contains 10 IU (international units) in 1 ml. You can either half this ampule that is Insert 0.5ml (exactly half the ampule) of this solution of oxytocin 5 IU (5000 milliunits) in 500 ml of 0.9% saline or Ringer- lactate.

OR

you can insert the whole 10 units that is 10,000 milliunits IN 1000 ML (1 litre) OF 0.9% saline or ringer lactate.

The concentration of <u>both</u> of the above solutions is 10 milliunits in 1 ml.

You must know the dose of an oxytocin infusion given in milliunits/minute as well as drops/minute.

When prescribing oxytocin, usually the quantity given is described as either **MILLIUNITS per** minute when **given as an infusion** or as **individual IUs or international units** when the drug is given as a **bolus injection**.

1 IU (international unit) of oxytocin is the same quantity as 1,000 milliunits of this drug.
10 IUs is equivalent to 10,000 milliunits of the drug.

1) Safe administration of an oxytocin infusion to induce and augment labour

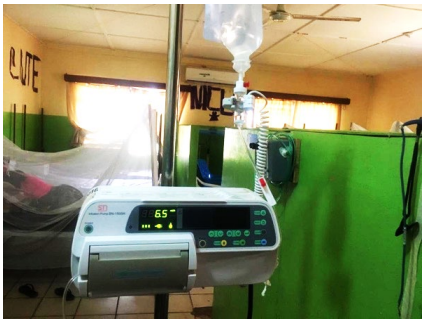
The infusion of oxytocin for augmentation or induction of labour
MUCH lower doses of oxytocin are used to augment or induce labour than are used in PPH (Post-Partum Haemorrhage) management or treatment.
In multigravida patient a maximum dose of **20 milliunits/minute** of oxytocin is used.
In **primigravida patient** a maximum dose of **40 milliunits/minute** of oxytocin is used

The drop factor of any IV giving set tells us how many drops are equal to 1ml of fluid. Most giving sets in Liberia have a drop factor of 20 which means that **20 drops emerging from the giving set is equal to 1 ml of the fluid**. Set the infusion rate with the flow controller below the chamber where the drops occur, and always count the rate over a full minute

A burette in-line IV giving set (*see* Figure A4.1) or an infusion monitor (Figure A4.2) based on electronically counting drops can help to prevent too much oxytocin being given.

Figure A4.1 *Burette for safer and more accurate administration of oxytocin.*

Figure A4.2 *Drip counter infusion monitor* (SN-1500H from Sino MDT Ltd)



An ampoule of oxytocin in Liberia usually contains 10 international units in 1 mL.

You can either half this ampoule : Insert oxytocin 5 international units (5000 milliunits) in 500 ml of Ringer- lactate or Hartmann's solution.
or you can insert the whole 10 units, that is 10,000 milliunits in 1000 ml (1 litre) of ringer lactate or normal saline

The concentration of both of the above solutions is 10 milliunits in 1 mL.

Providing you are using a giving set with a drop factor of 20 drops/1 ml, cautiously start infusion at 2.5 milliunits/minute (i.e. at 5 drops/ minute with a standard giving set with a drop factor of 20 drops/1 mL). The uterus must relax between contractions.

Increase infusion rate by 2.5 milliunits/minute (5 drops/ minute using a standard giving set with a drop factor of 20 drops/1 mL) every 30 minutes until a good contraction pattern is established – that is, contractions lasting more than 40 seconds, and occurring 3 times in 10 minutes. The uterus must relax between contractions.

Maintain this rate until delivery is completed.

Infusion rates for induction/augmentation of labour
Conversion chart of oxytocin from milliunits per minute to drops per minute
NB – assumes 5IU oxytocin in 500 ml 0.9% Saline or R/L OR 10 IU oxytocin in 1000ml 0.9% saline or R/L (10 milliunits per mL). And giving set drop factor rate at 20 drops per mL

Table A4.1 Conversion for drop factor 20 drops per mL

Oxytocin dose Milliunits/minute	Rate of infusion Drops/minute	Rate of infusion ml/hour
2.5	**5**	**7.5**
5	**10**	**15**
7.5	**15**	**22.5**
10	**20**	**30**
12.5	**25**	**37.5**
15	**30**	**45**
17.5	**35**	**52.5**
20	**40**	**60**

If there are not three contractions in 10 minutes, each lasting more than 40 seconds, with the infusion rate at 20 milliunits/minute (40 drops/minute if using a giving set with a drop factor of 20 drops/1 mL): THEN

In the multigravida, further increases may risk uterine rupture. The reason for this may be cephalo- pelvic disproportion or malposition. Therefore, consider Caesarean section. Do not use oxytocin 10 international units in 500 mL or 20 IU in 1000ml (i.e. 20 milliunits/mL) in multigravida.

In the primigravida, infuse oxytocin at a higher concentration (rapid escalation).
— Change to a more concentrated solution with oxytocin 10 international units (10 000 milliunits) in 500 mL of Ringer- lactate/Hartmann's or 0.9% saline at a concentration of 20 milliunits/mL. OR 20 IU OR 20,000 milliunits in 1000 ml (1 litre) of Ringer Lactate/Hartmanns or 0.9% saline at 20milliunits/ml (note that In both the 500ml and the 1000 ml bags the concentration of oxytocin is now 20 milliunits per ml)
— Give an initial infusion of 20 milliunits/minute (20 drops/minute if using a giving set with a drop factor of 20 drops/1 mL).
— Increase the infusion rate by 5 milliunits/minute (additional 5 drops/minute if using a giving set with a drop factor of 20 drops/1 mL) every 30 minutes until good contractions are established.
— If good contractions are **not** established at 40 milliunits/minute (40 drops/minute if using a giving set with a drop factor of 20 drops/1 mL), deliver by Caesarean section.

Thus, in multigravida a maximum dose of 20 milliunits/minute of oxytocin is used.
In primigravida a maximum dose of 40 milliunits/minute of oxytocin is used

NEVER use oxytocin 10 international units in 500 mL or 20 IU in 1000ml (i.e. 20 milliunits/mL) in multigravida.

If hyperstimulation occurs

If hyperstimulation occurs (i.e. any contractions lasting longer than 60 seconds or more than 4 contractions in 10 minutes), stop the infusion. The half-life of oxytocin is short (between 1 and 5 minutes), and therefore any hyper- stimulation should stop with appropriate titration of the dose given. If hyperstimulation resolves, restart oxytocin infusion at half of the last dose given.

Consider terbutaline, 250 micrograms subcutaneously if the uterus does not relax.

The partograph

Record on a partograph every 30 minutes:

- rate of infusion of oxytocin (note that changes in the woman's arm position may alter the flow rate)
- duration and frequency of contractions
- fetal heart rate: listen every 30 minutes, always immediately after a contraction; if less than 110 beats/minute, stop the infusion.

Monitor pulse, blood pressure and contractions every 30 minutes. Keep a fluid balance chart. Regularly reassess for contraindications.

Main indications for using oxytocin to induce or augment labour

1. Delayed cervical dilatation with arrest for > 2 hours due to weak and infrequent contractions <3 contractions in 10 minutes. *Consider medical causes of poor uterine contractions before starting an oxytocin infusion for examples dehydration, ketosis due to lack of glucose/dextrose.*
2. Post term pregnancy (however be careful in diagnosing this if uncertainty over dates)
3. Fetal post maturity (however, if fetal macrosomia is suspected this maybe a contraindication for induction (see below): Ultrasound scanning is essential in documenting fetal size).
4. If urgent delivery needed for example severe maternal disorders such as severe pre-eclampsia, abruption, chorioamnionitis, infected IUFD.
5. If ARM does not induce adequate contractions: if contractions are weak and infrequent after 1-4 hours after ARM begin oxytocin infusion. If there are frequent and strong contractions and no progress, look for a reason (especially obstructed labour).
6. If labour is induced because of severe maternal disease (e.g. sepsis, eclampsia), begin oxytocin infusion at the same time as ARM.
7. In PROM or PPROM where infection has developed and where ARM, with or without additional misoprostol, is not sufficiently rapid in inducing labour

8. If contractions fail to resume immediately after birth of a first twin (after ensuring second twin is vertical). Use same dose as for initial labour induction in a singleton pregnancy but it may be necessary to increase dose more rapidly than every 30 minutes (e.g. by 5 drops/minute every 10 minutes).

Main contraindications to using an oxytocin infusion to induce or augment labour

1. Possibility of obstructed labour: It is essential that obstructed labour is excluded before oxytocin is administered.
2. Two or more previous CS, or scar from myomectomy or traumatic rupture in the past
3. Extra care if one previous transverse CS, grand multiparity or overdistended uterus (twins or fetal macrosomia).
4. Previous classical CS. Provide a timely Caesarean section.
5. If labour has been progressing and then stops, especially in a multiparous woman, there is likely to be a reason for this secondary arrest, such as cephalo-pelvic disproportion or malposition. The use of oxytocin (rather than CS) in this situation is dangerous, as uterine rupture may occur. However, in low- resource settings this concern has to be balanced against the risks associated with CS (assuming that this procedure is even available without transfer). Secondary arrest in a multiparous woman should result (if possible and safe) in urgent transfer to a facility where CS can be undertaken.
6. Malpresentations (however, it may be helpful in OP or OT malpositions)
7. Placenta praevia
8. Wait at least for 4 hours before starting oxytocin if misoprostol has been given.

Main precautions when using an oxytocin infusion

1. Undertake frequent observations of vital signs including strength of contractions and FHR and ensure imminent rupture is not present. Use oxytocin with great caution, as fetal distress can occur from hyperstimulation and, rarely, uterine rupture can occur. Multiparous women are at higher risk for uterine rupture (see below).
2. If signs of imminent rupture, stop infusion and replace giving set
3. Ensure close proximity to an operating theatre in case CS needed.
4. Cervix should ideally be >3 to 4 cm dilated, effaced and membranes ruptured (either spontaneously or artificially). The harder and more closed the cervix and the higher the station the more difficult the induction.
5. Maternal risk is
   a) greatest where there is a scar in the uterus or CPD
   b) increased if the uterus is over-distended (grand multiparity, polyhydramnios, macrosomia, multiple pregnancy).

6. Carefully observe all women receiving oxytocin. Must not be left alone during the infusion
7. Ensure in the lateral tilt position.
6 Must be an interval of at least 30 minutes between increases in dose of infusion.
7 If labour has been progressing well and then stops there may be CPD or a malposition. This is especially true in multiparous women.
8 If a woman has undergone one previous CS, the use of oxytocin is associated with an increased risk of uterine rupture, and these patients must be delivered in a facility where immediate CS can be performed if required. Oxytocin may be used with great care and reduced in dose or discontinued when adequate contractions are present.
9 Great care is needed in grand multipara with > 4 pregnancies having occurred after 24 weeks gestation: risk of uterine rupture. Oxytocin must be used with great care and discontinued when adequate contractions are present.
10 Watch out for **hyperstimulation and if this** occurs (i.e. any contractions lasting longer than 60 seconds or more than 4 contractions in 10 minutes OR **no relaxation between contractions**), stop the infusion. The half- life of oxytocin is short (between 1 and 5 minutes), and therefore any hyperstimulation should stop with appropriate reduction of the dose given. If hyperstimulation resolves, re-start oxytocin infusion at half of the last dose given.
11 If hyperstimulation does not resolve with stopping oxytocin and there is fetal distress, consider terbutaline 250 micrograms subcutaneously.
12 *Prolonged oxytocin infusions* can cause a harmful fall in blood sodium concentration (hyponatraemia). Hyponatraemia is due to water retention and can cause fits (unlikely if diluted with 0.9% saline or Ringer-lactate and more likely with prolonged infusions). **Never give oxytocin infusion in 5% dextrose.** Monitor urine output carefully and, if possible, measure plasma sodium concentrations.
13 Hypotension, flushing and tachycardia and fetal distress due to tonic uterine contraction may occur if oxytocin is given as a bolus IV by mistake.
14 *If delivery is not urgent* and the woman has not entered labour after 8 hours stop the infusion and start again the next morning.

Further guidelines on the administration of oxytocin to induce or augment labour in the third trimester.

1. The individual effective dose of oxytocin varies greatly; therefore, all patients must be monitored carefully.
2. A reliable and secure IV cannula should be in place.
3. **Induction of labour** is a two-step process involving cervical effacement, early dilatation and induction of contractions which help dilate the cervix. Induction is better managed first with ARM, then misoprostol as this combination is usually

more effective (see details below). Oxytocin ALONE may be used if misoprostol is not available, Bishop's score is 6 or more, and ARM is not possible because head is too high but beware CPD in this last situation. Oxytocin needs IV infusion and very close monitoring of doses used but **its advantage is a short half-life compared with misoprostol.**

4. After labour has started augmentation of contractions is best managed with oxytocin rather than misoprostol.
5. For induction cautiously administer oxytocin in IV fluids (0.9% saline or Ringer-lactate), gradually increasing the rate of infusion until active labour is established (three contractions in 10 minutes, each lasting more than 40 seconds). Maintain this rate until delivery. The uterus must relax between contractions.
6. When oxytocin infusion results in an active appropriate labour pattern, maintain the same infusion rate until delivery.
7. The maximum infusion rate in a multigravida patient is 20 milliunits/minute of oxytocin. In a primigravida patient a maximum dose of 40 milliunits/minute of oxytocin is used (see above)
8. Monitor pulse, blood pressure, FHR and contractions every 30 minutes on a partograph: ideally with the aim of preventing birth asphyxia, monitor *FHR immediately following the end of each and every uterine contraction (see above)*
9. Note that changes in the woman's arm position may alter the flow rate. An *infusion rate monitor* electronically counting drops as used in the neonatal intensive care units of Liberia may be helpful.
10. Keep a fluid balance chart. Regularly reassess for reasons to review the continued use of oxytocin.

The use of oral misoprostol to induce labour in the third trimester (MCAI guideline)

Because of its stability at high room temperatures and low cost, misoprostol is increasingly being used to **induce** labour. Misoprostol is a powerful stimulator of uterine contractions after 24 weeks gestation and is long acting and **much lower doses must be used after 24 weeks** gestation **than in the first and second trimester**. Close monitoring of uterine contractions is essential, and **misoprostol must not be used if there has been a previous CS or other scar in the uterus**. **If this is the case, use oxytocin but with great care.**

Always have IV access when using misoprostol.

Preparation and prescription of Misoprostol

Misoprostol is available as 100 or 200 mcg tablets and can be given orally, as tablets (buccal or sublingual) or oral solution, or vaginally. The latest evidence suggest that oral misoprostol solution is the most reliable and appropriate.

1a) Making up an oral misoprostol solution: a single misoprostol tablet is dissolved in drinking water (200- microgram tablet in 200 mL of water or 100- microgram tablet in 100 mL of water), and therefore 20–25 mL of misoprostol solution is 20–25 micrograms.

Oral solutions should be used in women with ruptured membranes to avoid introducing infection through vaginal examination.

Solutions are stable for up to 24 hours but should then be discarded.

Side effects include diarrhoea, nausea, fever and chills.

1b) Buccal, tablets are placed between the cheek and gums and swallowed after 30 minutes.

1c) Sublingual tablets are placed under the tongue and swallowed after 30 minutes.

1d) It is possible to cut 100 microgram misoprostol tablets into quarters that are 25 micrograms in size. However, this is not accurate, and there is a danger of giving an incorrect dosage. The oral misoprostol solution described above is safer.

1e) Vaginal, tablets can be placed in the posterior fornix. However, **the vaginal route should be avoided if there is bleeding or infection present.**

The rectal route is not recommended except when managing PPH (see Section A+11).

Main indications for inducing delivery with misoprostol in the third trimester (MCAI Guideline)

1. Post term pregnancy in addition to ARM (however be careful in diagnosing post maturity due to uncertainty over dates)
2. Fetal post maturity with ARM (however, suspected fetal macrosomia is not an indication for induction: an ultrasound scan is essential in documenting fetal size).
3. If urgent delivery is needed for example severe pre-eclampsia, abruption, chorioamnionitis, infected IUFD.

Give 25 microgram every 2 hours until good contractions are obtained and **do not exceed a total dose of 150 microgram.** Alternatively, if oral dosing is not possible give 50 microgram vaginally (posterior fornix) every 6 hours until good contractions are obtained. **Do not exceed 150 microgram total dose unless delivery is urgent (see below).**

If misoprostol does not work, consider starting oxytocin but wait for at least 4 hours after the last dose of misoprostol has been given.

If there has been a previous Caesarean section (CS) or other cause for a uterine scar, misoprostol is contraindicated. However, in this situation careful use of oxytocin for induction could be attempted as it is short acting and safer.

Use of misoprostol in inducing delivery where there is severe pre-eclampsia or eclampsia

When induction of labour is urgent and delivery indicated within a short period of time (e.g. eclampsia) consider increasing the misoprostol dose to 50 micrograms orally every 4 hours (again with a total maximum dose of 250 micrograms that is 5 doses). This may increase the speed of the induction but may also increase the risk of hyperstimulation.

The recent Cochrane review recommends an oral dose of 20-25 micrograms and not more than 50 micrograms every 2 hours.

If vaginal delivery is not achieved within 12 hours (for eclampsia) or within 24 hours (for severe preeclampsia), deliver by CS.

If there are FHR abnormalities, consider CS.

When induction of labour is urgent, and delivery indicated within a short period of time (e.g. eclampsia) consider change to oxytocin.

Induction of labour in the third trimester where there is IUFD (MCAI Guideline).

The following drug regime is recommended by MCAI for women with an IUFD at 28 weeks' gestation or more

1. Start misoprostol 50 micrograms orally or vaginally every 4 hours to a total of 5 doses
2. If delivery has not occurred by the fifth dose of misoprostol, the patient should be reviewed by a doctor/obstetric clinician.
3. Subsequent options for management include continued use of misoprostol (usually after a period of 'rest' for 12 to 24 hours) or treatment with oxytocin.
4. For women with an IUFD at term (37 weeks and over) use the same induction of labour protocol as described above for inducing labour with a live fetus at term namely 25 micrograms of misoprostol every 2 hours up to a total of 150 mcg. Note: The evidence base for the optimum dose of misoprostol to be used in this scenario is poor, and it is recognised that higher doses of 50 micrograms every

4 to 6 hours (with a maximum total of 250 microgram), have historically been used. Recent evidence suggests that lower doses may be as effective, and it is with this in mind, as well as concerns about optimizing safety, that the above dose of 25 micrograms 2 hourly up to a total of 150 micrograms has been recommended.

Cord entanglement

It is unusual but possible for one or two tight coils of the umbilical cord to delay the delivery of the fetal body after the head has cleared the introitus. Rarely it may cause fetal distress or even IUFD.

Management

Do not cut or clamp the cord before the fetal body has been delivered. Clamping too early risks asphyxia of the baby.

The woman should be encouraged to push and assisted delivery (see below) may be needed to deliver the baby quickly.

The baby may need resuscitation – call for appropriate help.

After the fetal head has delivered and a tight cord is felt around the neck preventing delivery of the body

Wait for the baby to rotate and push baby's face towards the thigh of the mother towards which the baby's face is facing.

Encourage the woman to push, while keeping baby's face close to the maternal thigh so that the umbilical cord has more room to loosen..

When baby's body has emerged, unwind the cord from around the baby's neck and finish delivery as you would normally

This method of delivery can be used in any birth position including all 4's.

Section A5 Post-delivery and post discharge care for mothers and newborn babies

Discharge of mothers and their babies from hospital after uncomplicated deliveries

In high resource settings there is evidence of lower economic costs associated with early discharge (e.g. at 6 hours after delivery compared with 48 hours). However, there is no conclusive evidence for or against the policy of early postnatal discharge in resource-limited healthcare facilities. Care should be taken when extrapolating the results of studies from countries with good socio-economic conditions to communities where resources are scarce. Consideration should also be given to different settings even within the same country (e.g. urban versus rural settings), and the cultural contexts in which the trials are conducted.

Postnatal care for mothers and their babies in resource-limited settings

In resource-limited African settings, 50% of postnatal maternal deaths occur in the first week after birth, with the majority occurring in the first 24 hours. The two most important causes of postnatal maternal death are PPH and puerperal sepsis. Mothers who are HIV positive are most at risk.

One in four deaths in childhood occurs during the neonatal period. Birth asphyxia is the most common cause, and most commonly occurs on day 1. Preterm babies most commonly die during the first week of life, and neonatal sepsis is most common during the first 7 days, especially in low birthweight/preterm babies. The origins and markers of many long-term childhood development problems occur or are seen in the first 6 weeks of life.

Despite a lack of research, mothers and their babies should remain in hospital for at least 24 hours after birth in low- resource settings in order to ensure that breastfeeding is established and that any complications in the mother and baby are identified and treated. Those with high risk factors should remain in hospital for longer, and before going home all mothers should be trained to recognise danger signs in themselves and their babies.
The WHO has produced a landmark paper on postnatal care in Africa, and Tables 2.3.1 and 2.3.2 summarise their advice.

When and how many postnatal visits should occur?

The optimum number and timing of postnatal care (PNC) visits, especially in resource-limited settings, is a subject of debate. Although no large-scale systematic reviews have been conducted to determine this protocol, three or four postnatal visits have been suggested. Early visits are crucial because the majority of maternal and newborn deaths occur during the first week, most frequently on the first day, and this period is also the key time for promoting healthy behaviors. Each country should

make decisions based on the local context and existing care provision, including who can deliver the PNC package and where it can be delivered.

The following information is offered as a guide.

First contact
If the mother is in a healthcare facility, she and her baby should be assessed within 1 hour of birth and again before discharge. Encouraging women to stay in the facility for 24 hours, especially after a complicated birth, should be considered. If birth occurs at home, the first visit should target the crucial first 24 hours after birth.

Follow-up contacts
These are recommended at least at 2–3 days, 6–7 days and 6 weeks after birth.

Extra contacts
Babies who need extra care (LBW babies or those whose mothers are HIV-positive) should have two or three visits in addition to the routine visits.

Where should postnatal care be provided and by whom?
The supervision and integration of postnatal care packages is essential.

At the hospital
This is more likely if the mother gives birth in hospital, but even then women and babies do not necessarily receive an effective PNC contact before discharge from the health- care facility, and even if the mother comes to hospital for the birth, she may not return during the first few days after discharge. Where a waiting home is available, the mother and baby could remain there until it is considered safe for them to go home.

Through outreach services:
1 A skilled provider can visit the home to offer PNC to the mother and baby.
2 Home visits from a specially trained community health worker (CHW) linking to the hospital or other healthcare facilities for referral as required.
3 A combination of care in the healthcare facility and at
home. PNC may be provided in the hospital following childbirth, and at home during the crucial first 2–3 days, with subsequent visits to a healthcare facility or clinic at 6–7 days and 6 weeks after the birth, when the mother is better able to leave her home.

TABLE A5.1 Routine postnatal care (PNC): What, when, where and who?

What should be routine postnatal care?
Preventive care practices and routine assessments to identify and manage or refer complications for both mother and baby, including the following:
Essential routine PNC for all mothers
1 Assess and check for bleeding; check temperature.
2 Support breastfeeding, checking the breasts and advising how to prevent mastitis.
3 Manage anaemia, promote nutrition and insecticide-treated bed nets, and give vitamin A supplementation.
4 Complete tetanus toxoid immunisation, if required.
5 Provide counselling and a range of options for family planning.
6 Refer for complications such as bleeding, infections or postnatal depression.
7 Counsel on danger signs and home care.
Essential routine PNC for all newborns
1 Assess for danger signs, measure and record weight, and check temperature and feeding.
2 Support optimal feeding practices, particularly exclusive breastfeeding.
3 Promote hygiene and good skin, eye and cord care.
4 If prophylactic eye care is local policy and has not been given, it is still effective up to 12 hours after birth.
5 Promote clean dry cord care.
6 Identify superficial skin infections, such as pus draining from the umbilicus, redness extending from the umbilicus to the skin, more than 10 skin pustules, and swelling, redness and hardness of the skin, and treat or refer if the baby also has danger signs.
7 Ensure warmth by delaying the baby's first bath until after the first 24 hours, practising skin-to-skin care, and putting a hat on the baby.
8 Encourage and facilitate birth registration.
9 Refer the baby for routine immunisations.
10 Counsel on danger signs and home care.
Extra care for low-birthweight or preterm babies and other vulnerable babies, such as those born to HIV- infected mothers (two or three extra visits)
The majority of newborn deaths occur in LBW babies, many of whom are preterm. Intensive care is not needed to save the majority of these babies. Around one-third could be saved with simple care, including the following:
1 Identify the small baby.
2 Assess for danger signs and manage or refer as appropriate.
3 Provide extra support for breastfeeding, including expressing milk and cup feeding, if needed.
4 Pay extra attention to warmth promotion, such as skin-to- skin care or kangaroo mother care.
5 Ensure early identification and rapid referral of babies who are unable to breastfeed or accept expressed breast milk.
6 Provide extra care for babies whose mothers are HIV-positive, particularly for feeding support

Appropriate detection and management or referral is necessary to save the mother and the baby in the event of life-threatening complications.
Danger signs for the mother 1 Excessive bleeding. 2 Foul-smelling vaginal discharge. 3 Fever (above 37.5°C) with or without chills. 4 Severe abdominal pain. 5 Excessive tiredness or breathlessness. 6 Swollen hands, face and legs with severe headaches or blurred vision. 7 Painful engorged breasts or sore cracked bleeding nipples.
Danger signs for the baby 1 Convulsions. 2 Movement only when stimulated, or no movement even when stimulated. 3 Not feeding well. 4 Fast breathing (more than 60 breaths/minute), grunting or severe chest in-drawing. 5 Fever (above 37.5°C). 6 Low body temperature (below 35.5°C). 7 Very small baby (less than 1500 grams or born more than 2 months early). 8 Bleeding.

TABLE A5.2 Early identification and referral or management of emergencies for mother and baby

Further reading

World Health Organization. Reproductive Health Library of videos on YouTube: www.youtube.com/user/WHOrhl

World Health Organization and UNICEF. *Baby Friendly Hospital Initiative*: www.unicef.org.uk/babyfriendly; www.unicef.org/ newsline/tenstps.htm

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Section A+1 Severe anaemia in pregnancy (with and without heart failure)

Introduction

In normal pregnancy there is an increased total blood volume and a marked increase in plasma volume, so the haemoglobin (Hb) concentration falls. WHO defines anaemia as any Hb level below 11g/dl. However, in pregnancy normal haemodilution means that a cut-off value of 10g/dl may be more appropriate.

Pathological anaemia is mainly due to iron deficiency, associated with depleted iron stores before pregnancy and a poor diet.

Other major causes of anaemia in pregnancy are malaria, worm infestations and schistosomiasis. Where these latter conditions are endemic it is likely that they will cause anaemia in many pregnant women.

Folic acid is also an important component of nutrition in pregnancy and lack of folate before conception can lead to congenital abnormalities in the fetus.

Anaemic women are in danger when they enter labour and cope poorly with blood loss at delivery.

Diagnosis of anaemia

A microcytic hypochromic (low MCV, low MCH) picture suggests nutritional iron deficiency or chronic blood loss from worms and/or schistosomiasis. A low serum Ferritin level < 100 microgram/litre, if it can be measured, may give additional information. If the Ferritin level is normal (above 40 microgram/litre, consider the possibility of a haemoglobinopathy (e.g. Thalassemia trait). If ferritin level is raised >100 microgram/litre, do not give IV iron.

If anaemia is due to malaria, then a blood picture suggesting haemolysis would be present rather than the microcytic hypochromic picture resulting from iron deficiency.

Hb can be measured using either small drops of capillary blood or a venous sample. A paper chart method can be used in rural areas where clinics are held (see Figure A+1. 1). A portable battery- operated device for example the one from Prestige are also valuable https://www.prestigediagnostics.co.uk/hemometer (Figure A+1. 2)

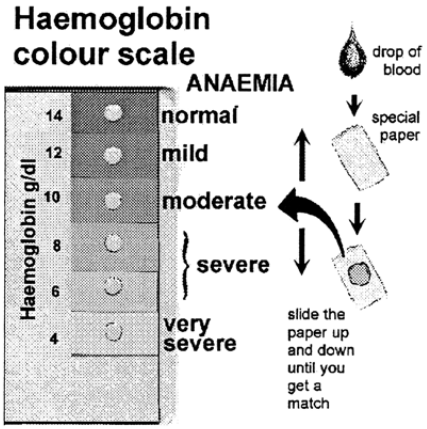


FIGURE A+1.1 WHO test strip with colour scale for measuring haemoglobin in a rural area.

Figure A+1 2 Prestige stick test hemometer

Prevention of anaemia in pregnancy

Oral iron supplementation is advised during all pregnancies. It is particularly important in the mother who is anaemic before pregnancy or who has a poor diet. The WHO recommends an iron supplement of 60 mg/day for mothers with adequate iron stores, and 120 mg/day for those women without adequate iron stores. Give ferrous sulphate or ferrous fumarate 120 mg by mouth *plus* folic acid 400 micrograms by mouth once daily throughout pregnancy.

Treatment of anaemia during pregnancy

If heart failure is not present, give ferrous sulphate 200 mg orally three times a day, vitamin C 1000 mg daily and folic acid 5 mg once daily. If vitamin C is not available, iron tablets may be taken with orange juice to aid absorption. The mother may take the tablets after meals rather than in the morning if she prefers to do so. Continue for 3 months postpartum.

WHO advises preventive chemotherapy (deworming), using single oral dose of albendazole (400 mg) or single dose of oral mebendazole (500 mg) as a public health intervention for pregnant women after the first trimester (ideally after 16 weeks' gestation), living in areas where both: (i) the baseline prevalence of **hookworm and/or *T. trichiura* infection** is 20% or more among pregnant women, and (ii) where anaemia is a severe public health problem, with a prevalence of 40% or higher among pregnant women, in order to reduce the worm burden of hookworm and *T. trichiura* infection. Do not give albendazole or mebendazole in the first trimester of pregnancy as it can cause congenital abnormalities. If there is anaemia,

ideally look for evidence of worms in the stools and treat if present. If a laboratory is not available to identify them, assume they are present.

In an endemic area for **schistosomiasis** urine or stool examination should be tested in women with anaemia and treatment with Praziquantel is given at a dose of 40 mg/kg in two divided doses given 4–6 hours apart on one day. Praziquantel is safe during pregnancy.

In areas where malaria is endemic, institute the standard four-pronged approach to malaria prevention and control during pregnancy (Section B8):

1) intermittent preventive treatment (IPTp)
2) insecticide- treated bed nets (ITNs), or preferably long-lasting insecticide-treated bed nets (LLINs)
3) indoor residual spraying (IRS) with insecticides
4) case management of new cases of malaria

Presentation of severe anaemia

Severe anaemia in pregnancy is present if haemoglobin levels are less than 7.0 g/dL or haematocrit < 20%.

If haemoglobin levels are less than 5 g/dL, pregnant women and their unborn babies are in very high danger and mothers need urgent blood transfusion (see Section C5).

Blood transfusion will also be appropriate in mothers with Hb between 5 and 7 g/dl who have cardiovascular instability

Severe anaemia (WHO <7.0 g/dl) can cause increased susceptibility to infection, disturbance of postpartum mental health and predispose to neonatal iron deficiency anaemia. It is linked to pre-term labour and low birth weight and possibly to abruption and increased PPH. Labour in the presence of severe anaemia is very dangerous.

The patient will be weak, with near white palms, soles of feet and tongue, and signs of heart failure are likely to be present the lower the Hb and the faster severe anaemia has developed.

In haemolysis (for example following severe malaria), the urine may be dark brown in colour and there may be signs of jaundice.

Treatment of severe anaemia

1. Blood transfusion (please see SectionC5 for details) including, when appropriate, partial exchange transfusion.

2. Intravenous iron treatment in the 2nd and 3rd trimester of pregnancy when heart failure is not yet present

Intravenous iron administration produces a larger and more rapid rise in haemoglobin levels, and is more effective in replenishing ferritin levels, so might be necessary for patients who cannot tolerate oral preparations or who are non-compliant, or if the anaemia is diagnosed late and rapid correction is required and there is a danger in waiting for oral iron to work: for example where there is a risk of haemorrhage during labour or delivery where the only alternative is blood transfusion. Therefore consider when Hb < 8.5 g/dl and not responding to oral iron.

Parenteral iron should be given IV since intramuscular injections are painful and may stain the skin.

Do not give parenteral iron during the first trimester.

The side effects of IV iron are much less common with iron sucrose or iron carboxymaltose than with iron dextran. Iron dextran must no longer be used with anaphylaxis occurring in around 1 in 200 patients.

There are two safe versions of IV iron: iron sucrose (Venofer) or iron carboxymaltose (Ferinject). No test dose is required as anaphylaxis is rare. However, adrenaline should still be immediately available.

Treatment with iron sucrose (Venofer). Dilute 10 mL of iron sucrose (200 mg) in 100 mL of 0.9% saline and infuse immediately after dilution. The first 10 mL (20 mg) should be given slowly over 10 minutes and the remainder over 1 hour. A fall in BP is possible if the iron infusion is given too quickly. IV infusions can be repeated weekly until the required rise in Hb levels is achieved, up to a maximum total dose of 1000 mg. Maximum single dose is 200mg (100mg if patient weighs < 45kg) and the maximum dose is 600mg/week

Treatment with Ferinject (Iron carboxymaltose). Supplied as a 50mg/ml solution with 500mg in a 10ml vial. Ferinject 500 mg can be administered as an undiluted solution by slow iv injection over 5 minutes or as an IV infusion of 1000 mg or up to a maximum of 15mg/kg body weight after being diluted in 250mls 0.9% saline and infused over 15 minutes. No monitoring is needed except a set of vital signs measured immediately prior to administration. Avoid leakage from IV cannula this as can lead to irritation and skin discolouration – stop immediately if this occurs. Patients should be asked to wait in the hospital for 30 minutes after administration.

Oral iron should be avoided for 5 days after the administration of IV iron injections. A follow up FBC should be performed at 2-3 weeks.

Contraindications for the use of parenteral iron

- Must not be given during the First Trimester
- Anaemia not attributed to iron deficiency.
- Evidence of iron overload or disturbances in metabolism of iron (raised ferritin level)
- Liver disease

3. Treatment of severe anaemia where there is heart failure

Give a high concentration of oxygen, bed rest and sit the patient upright (with lateral tilt as well if she is more than 20 weeks pregnant).

- Consider transfusion with packed cells if the haemoglobin concentration is less than 5.0 g/dL (with IV furosemide of 40 mg for each unit of packed cells). If blood cannot be centrifuged, let the bag hang until the cells have settled. Infuse the cells slowly and dispose of the remaining serum (*see* Section C5 on blood transfusion).
- Partial exchange transfusion may be helpful. Use a cannula in a large vein in the antecubital fossa, withdraw 10 to 20 mL of the patient's anaemic blood and infuse 20 to 40 mL of new blood (ideally packed red blood cells) over 5 minutes and repeat 5–10 times.

4. If labour occurs when severe anaemia is already present

- Deliver with the patient sitting up.
- Cross match ideally fresh live donor blood and have it available in case of postpartum haemorrhage (PPH).
- Avoid a prolonged second stage as this increases the risk of PPH.
- If there are signs of heart failure or maternal exhaustion shorten the second stage with a ventouse if possible.
- Manage the third stage actively (give oxytocin) and suture any tears without delay.

The mother is in great danger for at least 48 hours after delivery.
Prescribe iron and folate during the puerperium.

Section A+2. Pre labour rupture of membranes at term (term PROM) - clinical guideline for management

Definition
PROM at term is defined as rupture of the membranes prior to the onset of labour in women at or over 37 weeks' gestation.

Background
In approximately 8% of pregnancies at term the fetal membranes rupture before labour begins. 60% of these women will labour spontaneously within 24hours and over 91% within 48 hours. 6% remain pregnant beyond 96hours.

A meta-analysis of 12 studies in which early induction of labour (immediately or up to 12 hours after presentation with term PROM) was compared with expectant management (for variably between 24 and 96 hours before induction), showed no difference in rates of caesarean and operative births, secondary analysis showed lower rates of neonatal infection in the early induction group. Early intervention was associated with fewer maternal infections and with fewer neonatal care unit admissions.

Advice for women presenting with PROM
Women presenting with PROM at term should be advised that:

- the risk of serious neonatal infection, with PROM alone, is 1% rather than 0.5% for women with no risk factors and intact membranes
- 60% of women with PROM will go into labour within 24 hours
- Induction of labour is appropriate approximately 24 hours after PROM

Initial assessment
On initial contact a history should be taken, including the date and time of the suspected ruptured membranes.
If the woman reports any of the following, irrespective of planned place of birth, she should be advised to attend hospital:

1. there is vaginal bleeding
2. the liquor is green or offensive
3. she feels unwell or has a raised temperature
4. the fetal movements are reduced
5. presentation was not cephalic at the last antenatal visit
6. she has a history of group B streptococcus (GBS) carriage in this pregnancy or has a past history of a neonate affected by GBS
7. there are maternal complications
8. history of previous Caesarean section
9. she has a multiple pregnancy

If contractions have established, the mother should present at the unit where birth is planned.
Ongoing assessment

Section A+2 Pre labour rupture of membrane at term (term PROM) – clinical guideline for management

The woman should be seen by a midwife and reviewed, as soon as practical, ideally within 12 hours of rupture of membranes.
The following assessment should take place:

1. Confirm PROM from the woman's description and visulisation of the liquor (There is no reason to carry out a speculum examination if there is no uncertainty).
2. Confirm diagnosis with a sterile speculum examination if no liquor has been seen.
3. Avoid digital vaginal examination in the absence of good contractions
4. Auscultate the fetal heart and enquire about fetal movement pattern
5. Perform maternal observations including temperature and pulse rate and respiratory rate and BP.
6. Please recommend the women takes her temperature four hourly (if she has not got a thermometer advise to purchase one) if at any point she feels feverish or unwell to return the hospital.

New or existing infection risk factors
If there are signs of infection advise admission to hospital, for immediate induction of labour and a broad-spectrum antibiotic (e.g. co-amoxiclav or a cephalosporin and metronidazole) should be commenced.

If there is known GBS carriage in this pregnancy or a past history of a neonate affected by GBS, give IV benzyl penicillin and induce labour with oxytocin.

If the fetal heart auscultation reveals fetal distress or the liquor is meconium stained, refer acutely for senior review and a decision regarding immediate delivery or induction of labour.

Ongoing management without risk factors
If there are no infective or other complications requiring immediate induction of labour, the woman should be advised to come into hospital for induction of labour 24 hours post rupture of membranes, irrespective of time of day when this occurred.

During the 24-hour period prior to induction of labour the woman should be advised to:

1. Check her temperature every 4 hours, during waking hours, and report a raised temperature of over 37.4ºC or if feeling unwell, any change in colour or smell of her vaginal loss or any concern about her fetal movement pattern.
2. Avoid sexual intercourse

Expectant management
It the woman chooses not to accept induction of labour at 24 hours, she should be informed of the increased risk of infection and advised that delivery must take place in hospital. She will be informed that she will be advised to remain in hospital for 12 hours post delivery, for maternal and newborn observation

1. The woman should be advised to check her temperature every 4 hours, during waking hours, and report a raised temperature of over 37.4ºC or if feeling unwell, any change in colour or smell of her vaginal loss or any concern about her fetal movement pattern.

2. Advised that a fetal heart rate and fetal movement assessment should be undertaken, by a midwife, every 24 hours.
3. Advised that a date and time for induction of labour can be arranged, by her midwife, should she request it.
4. Advised that if induction of labour is not requested by 72 hours, she should be reviewed by a senior obstetrician for further discussion

Well baby born to a well woman
A baby born to a woman with pre-labour rupture of the membranes (more than 24 hours before the start of labour) should remain in hospital and be closely observed for the first 12 hours of life.

The observations should be recorded at 1 hour, 2 hours and then every 2 hours until the baby is 12 hours old. The observation must be commenced in the delivery setting and continued on transfer to the post natal ward.
These observations include:

- Temperature
- Respirations
- Grunting
- Heart rate
- Colour and circulation
- Neuro

The observations must be scored and must be responded to appropriately.

Section A+3. Prolonged and obstructed labour

Prolonged and obstructed labour

It helps to reduce prolongation of labour if mothers in labour are allowed to sit upright, or in a lateral or semi-upright position, **never flat on their backs**. They should be encouraged to stand and be mobile in the first stage of labour for as long as is comfortably possible. The benefits of this include the assistance of gravity in the descent of the baby, the avoidance of pressure on the inferior vena cava (IVC), with all of the effects of compression on the circulatory dynamics, and possibly a reduction in the pain of contractions.

Recognition of prolonged or obstructed labour and early referral

Remember the three P's: Power (too little), Passenger (too big) and Passage (too small).

Prevention of prolonged labour

- Good antenatal care is essential, so that the presentation of the fetus is known (and ideally confirmed by ultrasound examination) before the onset of labour. If the presentation is abnormal, the mother must be transferred to hospital as soon as she goes into labour.
- Use of the modified WHO partograph.
- Optimal nutritional state in the mother.
- Absence of anaemia in the mother.
- Adequate fluids and glucose during labour.
- Ensuring adequate bladder emptying.
- Emotional support.

Risks associated with slow progress in labour

For the mother these include the following:

- infection
- uterine rupture
- fistulae
- death.

For the baby they include the following:

- infection
- insufficient oxygen supply to the brain, and traumatic injury
- stillbirth
- neonatal death
- permanent brain damage.

FigureA+3.1 *Cervical dilatation over time.*

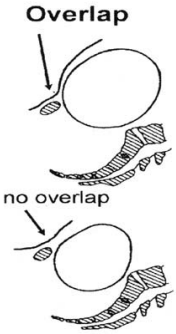


Figure A+3.2 *Obstruction of the fetal head's descent*

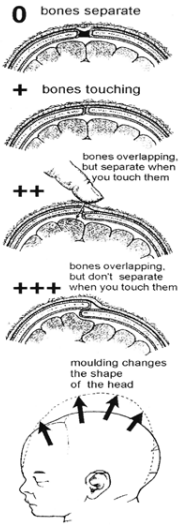


Figure A+3.3 *Development of increasing moulding of skull bones of fetus in labour. Increasing moulding is a sign of cephalo–pelvic disproportion.*

Main causes of slow progress in labour

These include the following:

1. poor-quality uterine contractions malpresentations and malpositions
2. disproportion between the size of the baby and the size of the pelvis;
3. it is important to exclude causes in 1. before diagnosing this.

All three of these causes require urgent transfer to hospital.

Bandl's ring

A Bandl's ring may be seen in obstructed labour. It is often a late sign and is important because it precedes uterine rupture. A Bandl's ring is a depression between the thickened upper segment and the thinned lower segment. A distended bladder sometimes forms a third swelling.

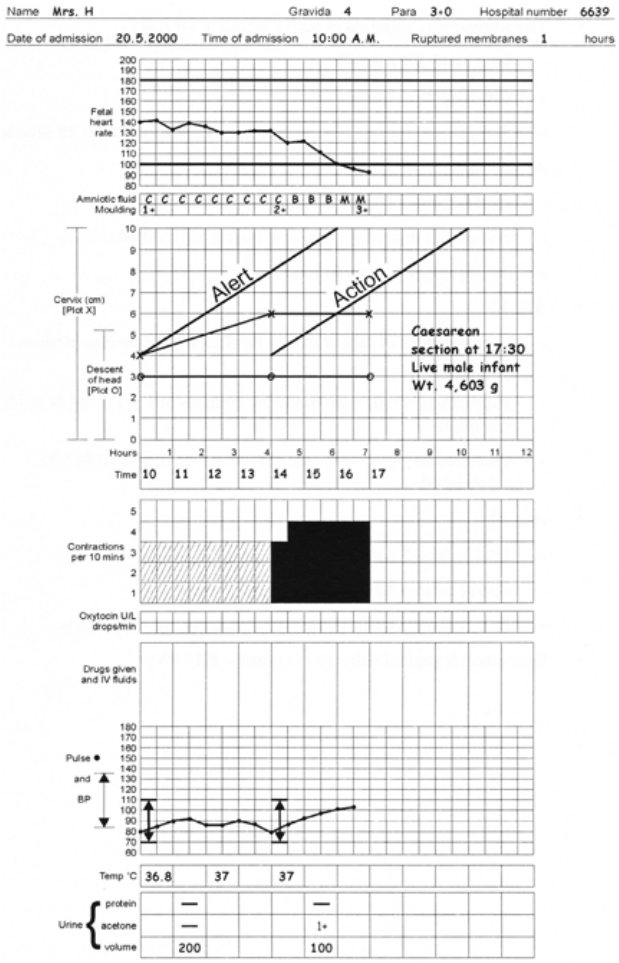
Moulding of the fetal head

Moulding should be assessed at the sagittal suture (not the lambdoid). During descent of the fetal head, the fetal skull bones move closer together. Moulding is described in terms of degrees. First degree (+) occurs when the bones touch, second degree (2+) occurs when the bones overlap but are reducible, and third degree (3+) is irreversible overlapping of the bones.

Moulding, especially 3+, may suggest cephalo-pelvic disproportion, and should be looked at in conjunction with other clinical signs of obstructed labour.

Partogram in obstructed labour

Figure A+3.4 shows the partogram for Mrs H, a mother who was admitted in active labour at 10 am. This partograph shows an example of obstructed labour.



At 10 am: The fetal head is 3/5 palpable, the cervix is dilated to 4 cm, three contractions occur in 10 minutes, each lasting for 20–40 seconds, clear amniotic fluid is draining, there is fetal head moulding.

At 2 pm: the fetal head is still 3/5 palpable, the cervix is dilated to 6 cm and to the right of the alert line, there is a slight improvement in contractions (three in 10 minutes, each lasting for 40 seconds), there is second-degree moulding.

At 5 pm: the fetal head is still 3/5 palpable, the cervix is still dilated to 6 cm, there is third-degree moulding, the fetal heart rate 92 beats/minute.

Caesarean section was performed at 5.30 pm.

Note: The partogram for Mrs H is characteristic of obstructed labour. There is arrest of cervical dilatation in the active phase of labour, with no descent of the fetal head. The presence of meconium and a falling fetal heart rate suggest fetal distress. All of these features, plus moulding of the fetal skull bones, point to cephalo-pelvic disproportion. Oxytocin was rightly withheld, as Mrs. H was multiparous, and this drug would therefore have increased the risk of uterine rupture in this patient.

Diagnostic issues in obstructed labour

The mother

1) The patient may be dehydrated, tachycardic, ketotic (urine positive for ketone bodies, breath smells of ketones), febrile and exhausted, and there may be infected vaginal secretions.
2) The bladder may be distended with retained urine, or it may be oedematous.
3) Abdominal examination may reveal haemoperitoneum from a ruptured uterus. Blood may not appear vaginally, due to the impacted fetal head, which may make assessment difficult.
4) If a ruptured uterus is suspected, a laparotomy should be performed (see below).
5) Abdominal examination may suggest distended bowel from sepsis and ileus.

The fetus

1) The lie and relationship of the fetus to the pelvis must be assessed.
2) Despite visible caput at the introitus, 60% of the fetal head may still be palpable abdominally.

TABLE A+3.1 Diagnosis of unsatisfactory progress of labour

Cervix not dilated No palpable contractions/infrequent contractions	False labour
Cervix not dilated beyond 4 cm after 8 hours of regular contractions	Prolonged latent phase
Cervical dilatation to the right of the alert line on the partogram	Prolonged active phase
Secondary arrest of cervical dilatation and descent of the presenting part in the presence of good contractions	Cephalo-pelvic disproportion
Secondary arrest of cervical dilatation and descent of the presenting part with large caput, third- degree moulding, cervix poorly applied to the presenting part, oedematous cervix, ballooning of the lower uterine segment, formation of a retraction band, and maternal and fetal distress	Obstruction
Less than 3–4 contractions in 10 minutes, each lasting from less than 40 seconds to 1 minute, with 1 minute of relaxation between contractions	Inadequate uterine activity
Presentation other than vertex with occipito-anterior	Malpresentation or malposition
Cervix fully dilated and the woman has the urge to push, but there is no descent	Prolonged expulsive (second stage) phase

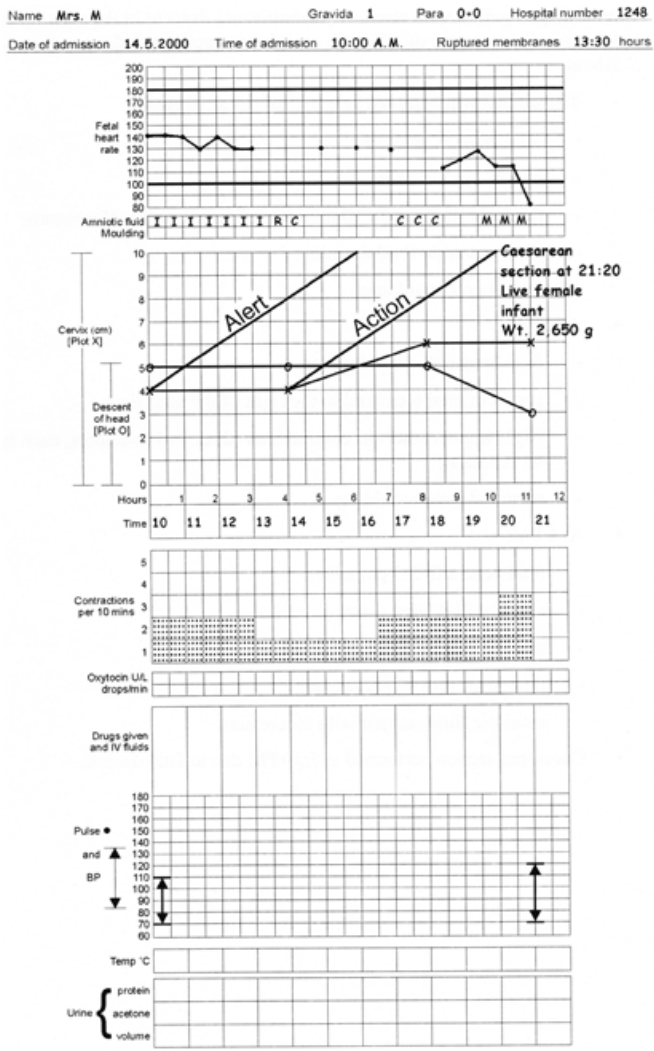


Figure A+3.5 *Partogram showing prolonged active phase of labour.* The cervix in the primigravida whose partogram is shown was 4 cm dilated on admission. Her contractions were ineffective at two in 10 minutes, decreasing to one contraction in 10 minutes. Her membranes ruptured 3.5 hours later, but her cervix dilated only a further 2 cm in 4 hours, with no further dilatation in the subsequent 3 hours. Fetal distress developed, with meconium and a falling fetal heart rate. Caesarean section was performed. It would have been advisable to start an oxytocin infusion at 13.30 hours, or at least by 15.30 hours.

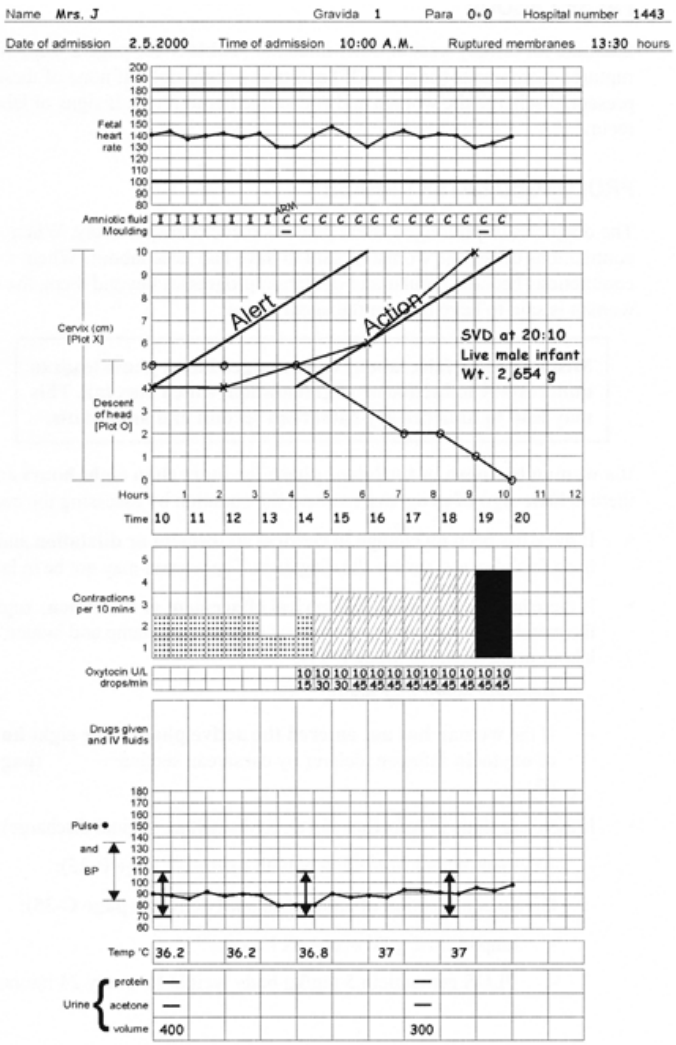


Figure A+3.6 *Partogram showing inadequate uterine contractions corrected with oxytocin.*
The primigravida whose partogram is shown started an oxytocin infusion at the time of membrane rupture, which increased the efficacy of contractions. She progressed to a spontaneous vaginal delivery. The fetal heart rate was satisfactory throughout.

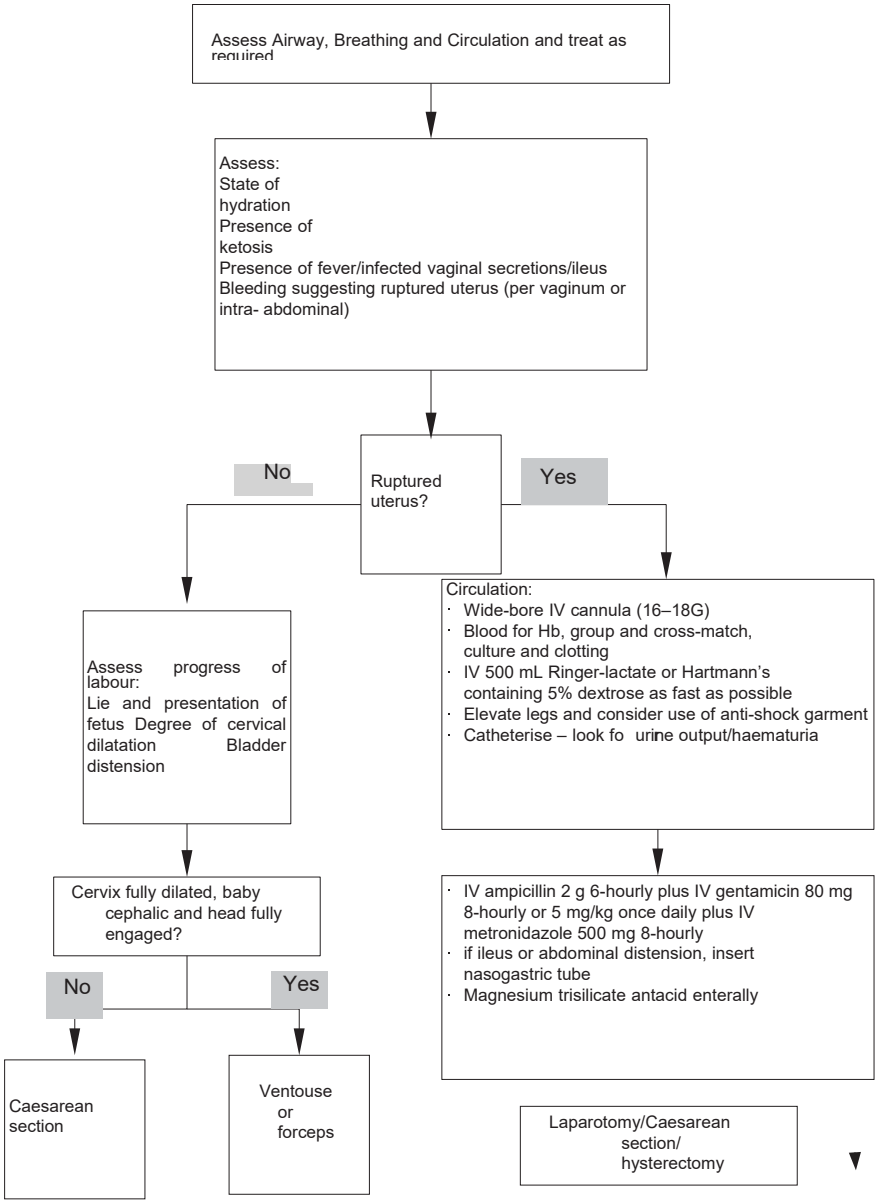


Figure A+3.7 *Pathway of care in obstructed labour.*

Emergency treatment for obstructed labour

1. Assess ABC and resuscitate if required.
2. Place a wide-bore IV cannula (14- to 16G).
3. Place the mother in the left lateral tilt or recovery position.
4. Send blood for haemoglobin, grouping and cross-matching, and electrolytes if possible.
5. Give 1 litre IV of Ringer-lactate or Hartmann's solution containing 5% or 10% glucose over 1 hour as an infusion, or as rapidly as possible if the patient is shocked. Then reassess.
6. Catheterise the patient to decompress the bladder, measure urine output and look for haematuria.
    a. The presence of haematuria may suggest uterine rupture.
    b. The catheter may be kept *in situ* for up to 6 weeks to prevent or minimise the formation of a vesico-vaginal fistula.
7. Give IV ampicillin (2 grams 6-hourly), gentamicin (80 mg IV/IM 8-hourly or 5 mg/kg body weight IV/IM once every 24 hours) and metronidazole (500 mg 8-hourly). Cefuroxime (1.5 grams 8-hourly, if available) can be given instead of ampicillin plus gentamicin.
8. Measure the pulse rate, respiratory rate, capillary refill time (CRT), blood pressure, temperature and urine output frequently.
9. If uterine rupture has been excluded, shock may be due to hypovolaemia, sepsis or both.
10. If there has been recent food intake, or abdominal distension is present, the stomach should be emptied using a nasogastric tube, and then 10 mL of magnesium trisilicate oral suspension should be given to reduce the acidity of the gastric contents.

Overcoming slow progress in labour

1. If the cervix is fully dilated and there is cephalic presentation and no signs of obstruction, instrumental delivery (ventouse or forceps) can avoid the need for Caesarean section. However, if the cervix is fully dilated and there is obstruction, instrumental delivery can make Caesarean section very difficult by causing further impaction of the fetal head.
2. If the cervix is not fully dilated, in the primigravida with cephalic presentation, give an oxytocin infusion.
3. If the cervix is not fully dilated, with abnormal presentation, perform a Caesarean section.
4. If a ruptured uterus is suspected, a laparotomy must be performed. Caesarean hysterectomy may be required.
5. Urgent referral is required if the above measures are not possible. Stabilise the mother's ABC before transfer if necessary

Reasons for fetal death in obstructed labour

1. Strong contractions with inadequate relaxation between contractions (sometimes made worse by inappropriate use of oxytocin) interfere with placental exchange.
2. In breech presentation, the head may be trapped by an incompletely dilated cervix or may not enter the pelvis because of disproportion.
3. Ascending infection, amnionitis and severe intrauterine infection caused by prolonged ruptured membranes and labour, and/or unsterile vaginal examinations.
4. Ruptured uterus.

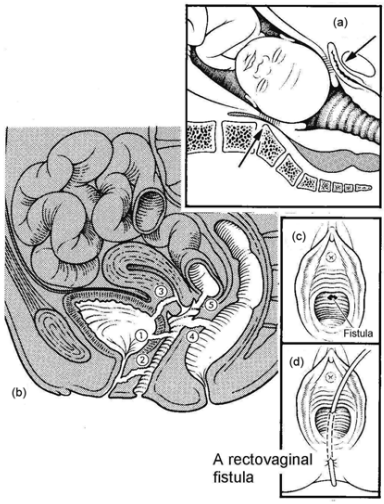


Figure A+3.8 *Mechanism and anatomy of vaginal fistulae. The arrows show where this mother's cervix, rectum and bladder are being pinched between the baby's head and the mother's spine and pubis. (a) The baby's head can press the mother's vagina and bladder against the symphysis pubis or the sacrum. This can make the tissues necrose (die) and cause a fistula. (b) The fistula can be in various places: 1, between the bladder and the vagina; 2, between the urethra and the vagina; 3, between the bladder and the cervix; 4, between the rectum and the vagina (recto- vaginal fistula); 5, between the vagina and the small gut. (c) A vesico-vaginal fistula. (d) A catheter has been placed in a recto- vaginal fistula.*

Risks of Caesarean section in obstructed labour

These include the following:

1. intra-operative haemorrhage
2. post-operative shock
3. generalised peritonitis
4. the hazards of general or regional anaesthesia
5. rupture of the uterine scar in subsequent pregnancies
6. wound infection
7. pelvic abscess
8. visceral damage, especially to the bladder; it may be difficult to pass a catheter with a very impacted fetal head, and the bladder is often oedematous.
9. The management of uterine rupture in this setting depends on its site and extent.

With a straightforward anterior rupture without extension, uterine repair (plus possible bilateral tubal ligation, with consent) may be most appropriate and safe.

10. If infection is present before a Caesarean section is performed, dangerous complications can follow. In one series of 107 Caesarean sections, performed in 156 patients with intrapartum infection, the following complications occurred:
    - post-operative shock: 18 patients (17%)
    - generalised peritonitis: 70 patients (65%)
    - mortality: 13 patients (12%).

Section A+4 Rupture of the uterus *(also see Section A+11 under APH)*

Rupture of the uterus is life-threatening to both mother and baby.

Causes

A previous Caesarean section scar may dehisce during labour. However, obstructed labour, even without a uterine scar, particularly in a woman of high parity, may cause uterine rupture.

It may be caused by inappropriate use of oxytocic drugs, especially in multiparous women, or in the presence of cephalo-pelvic disproportion. No woman who is receiving an oxytocin infusion should be left alone. Ideally, always use a burette giving set **or infusion drop monitor** to administer IV oxytocin to avoid dangerous over-dosage. In the absence of a burette, refer to the progressive oxytocin dosage, and use as described in Section A4, making sure to slow or stop once labour is well established.

Uterine rupture may be caused by violence or trauma during pregnancy, sometimes as a result of domestic violence (*see* Section A+30).

Risk factors for uterine rupture

These include the following:

1. malpresentation and malposition
2. previous Caesarean section, especially if uterotonic agent are used, or if a classical Caesarean section scar is present
3. previous uterine surgery (e.g. myomectomy), or uterine perforation at the time of surgical management of miscarriage, termination of pregnancy or manual removal of the placenta. Perforation may have been unrecognized at the time,
4. the multiparous woman who has delivered normally before and has a significantly larger baby or a malposition in the current pregnancy, and has prolonged labour

Symptoms and signs

1. Uterine rupture usually presents with hypovolaemic shock, but vaginal bleeding can be concealed. The baby is usually dead.
2. Around 50% of ruptures occur at or near full dilatation.
3. There is a change in the nature of the pain, from severe intermittent pain to a constant dull ache.
4. Vaginal bleeding may or may not be present.

5. There is maternal shock due to blood loss with or without vagal stimulation, as well as dehydration, exhaustion, and ketoacidosis in cases of prolonged obstructed labour.
6. Abdominal distension occurs
7. There is tenderness to palpation, the fetal parts may be very easily palpated (unless the rupture is posterior), and there is absence of fetal heart sounds.
8. On vaginal examination, the presenting part may be high or impacted.
9. Uterine rupture may be preceded by the appearance of Bandl's ring (*see* Figure A+4.1).

Suspect rupture in a patient with any of these above findings.

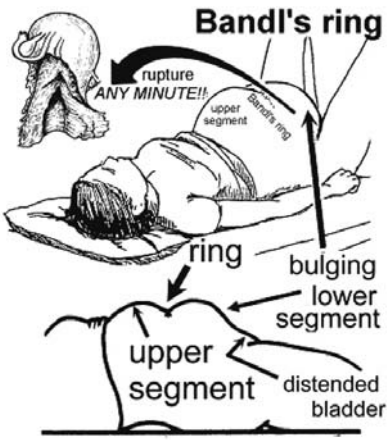


Figure A+4.1 *Bandl's ring in obstructed labour. Uterine rupture may be imminent*

Primary assessment and resuscitation CABC (control bleeding ABC)

Call for help, especially for a surgeon, an anaesthetist and theatre staff, as urgent laparotomy may be required. Put the patient in the left lateral position.

Airway especially if the patient is unconscious

- If the airway is not open, use an airway-opening manoeuvre and keep it open. Consider an airway adjunct such as an oropharyngeal airway or intubation.
- The oropharynx may need gentle suctioning under direct vision but be careful to avoid inducing laryngospasm.
- The recovery position should be adopted to minimise the risk of aspiration of vomit (*see* Figure A+4.2).

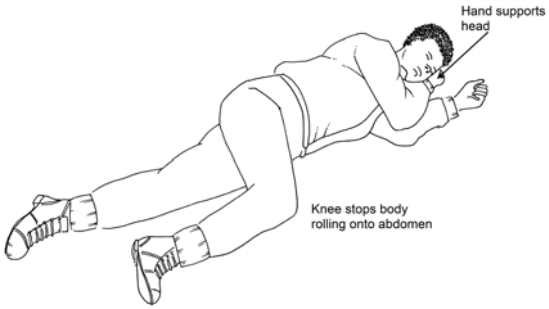


Figure A+4.2 *The recovery position.*

Breathing

- If there is spontaneous breathing, give a high concentration of oxygen via a face mask with reservoir. Give 100% oxygen (mask with reservoir and flow rate of at least 6 litres/minute) regardless of the mother's oxygen saturation. This increases fetal oxygen delivery as well as improving maternal tissue oxygenation.
- If the patient is apnoeic or hypoventilating, provide chest inflations with bag-valve-mask-reservoir ventilation and high-flow oxygen.

Circulation

Evaluate the pulse rate and volume, respiratory rate, peripheral circulation (capillary refill time) and blood pressure.

If signs of life are absent, initiate CPR, using manual displacement of the uterus, with the patient on a firm surface.

If the patient shows signs of shock, support the circulation as described below.

1. Ensure lateral tilt is in place (use a pillow or towel to maintain this)
2. Insert a 14- to 16G IV cannula and take 20 mL of blood for a full blood count, cross-matching (4 units = 2 litres and, if possible, obtain fresh blood for transfusion from immediate donors) and measure blood clotting. Do a whole blood clotting time (WBCT) test if laboratory analyses are not available.
3. Elevate the legs whilst awaiting blood for transfusion.
4. If there are sufficient helpers available, consider placing the leg segments (1,2, and 3) only of an anti-shock garment to gain time whilst awaiting blood transfusion and laparotomy. **Do not apply the pelvic or abdominal segments (4 and 5) of the garment and do not stop other vital activities to arrest the bleeding whilst placing the leg segments of the garment in place.** (Section A+11)

5. Once the leg segments are in place, it is not necessary to elevate the legs.
6. Give 500 mL to 1 litre of Ringer-lactate or Hartmann's solution by rapid IV bolus.
7. Reassess, and if shock is still present, give blood (if available) (500 mL as rapidly as possible after warming) or another 500 mL to 1 litre of Ringer-lactate or Hartmann's solution.
8. If the patient is ketotic from prolonged obstructed labour, add 50 mL of 50% glucose to the second litre of Ringer- lactate or Hartmann's solution.

Emergency treatment

1 Obtain consent for laparotomy and hysterectomy.
2 Place a second large bore IV cannula.
3 Perform urgent laparotomy under general anaesthesia.
4 The type of operation will depend upon the size and site of rupture, and the degree of haemorrhage.
5 Give IV prophylactic antibiotics (ampicillin 2 grams or cefuroxime 1.5 grams plus metronidazole 500 mg).

The rupture may extend anteriorly towards the back of the bladder, laterally towards the uterine arteries, or into the broad ligament plexus of veins, leading to massive haemorrhage.

Posterior rupture may occur. It may be associated with uterine malformations but has occurred in patients who have had a previous Caesarean section or uterine trauma, or after rotational forceps.
Fundal rupture has been documented, and a detailed history usually elicits previous surgical management of miscarriage, termination of pregnancy or manual removal of the placenta.

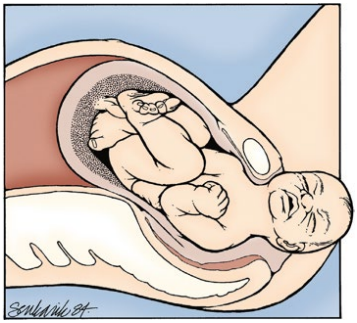
Total or subtotal hysterectomy will be necessary where it is not possible, or is judged unwise, to carry out repair of the uterine trauma. Subtotal hysterectomy is a simpler procedure than total hysterectomy and has a reduced risk of ureteric or bladder damage.

The choice of uterine repair depends on the site of the injury. In one series of 23 cases of ruptured uterus, hysterectomy was undertaken in 15 cases (65%) and repair in the other 8 cases. Five successful further pregnancies were reported without repeat rupture (all delivered by Caesarean section). In another Middle Eastern series of 11 cases of uterine rupture, 8 patients had uterine repair, and all became pregnant again and were delivered by Caesarean section

Section A+5 Shoulder dystocia

Shoulder dystocia is caused by impaction of the fetal shoulders against the maternal bony pelvis. Special manoeuvres are required to deliver the shoulders, following delivery of the fetal head. The reported incidence is between 0.15% and 2% of all vaginal deliveries. Shoulder dystocia carries a significant risk to the baby due to hypoxia, fetal fractures of the clavicle and humerus, and fetal injuries to the brachial plexus. The problem lies at the pelvic brim where the anterior shoulder gets caught, while the posterior shoulder has usually entered the pelvis. Treatment therefore aims to encourage the anterior shoulder into the pelvis, or if this fails, either rotating the posterior shoulder round into the anterior position or delivering the posterior arm first. Traction on the head when the anterior shoulder is caught above the pelvic brim will not work and is dangerous.

Completion of delivery should occur within 5 minutes of the delivery of the head. The longer the delay, the greater the risk of hypoxic injury to the baby.



Actions should be taken as rapidly as possible if the fetus and mother are to survive. Practice with the pelvic manikin is helpful and review the videos.

Postpartum haemorrhage is common after shoulder dystocia, and there is a risk of serious vaginal and perineal lacerations.

Risk factors for shoulder dystocia

Antepartum risk factors include the following:

1 fetal macrosomia
2 maternal obesity
3 diabetes
4 prolonged pregnancy
5 advanced maternal age
6 male gender
7 excessive weight gain
8 previous shoulder dystocia
9 previous big baby.

Intrapartum risk factors include the following:

10 prolonged first stage

11 prolonged second stage

12 oxytocin augmentation of labour

13 assisted delivery.

These risk factors often do not help in the prediction of individual cases of shoulder dystocia. Therefore, the practice of emergency drills is essential for good management of the unexpected case.

Slow progress in labour, particularly in the multiparous patient or in the woman with a past history of a big baby or difficulty delivering the shoulders, should alert one to the possibility of shoulder dystocia.
During delivery, signs include the following:

- difficulty delivering the face and chin
- head retractions between contractions: the turtle sign
- head bobbing
- the delivered head becomes tightly pulled back against the perineum (turtle sign).

As soon as the situation is suspected, a plan of action should be initiated.

Management of shoulder dystocia

If risk factors are present, try, if possible, to have an experienced obstetrician present in the second stage of labour. However, 50% of cases are unexpected.

Be prepared for the problem, including postpartum haemorrhage, which may follow.

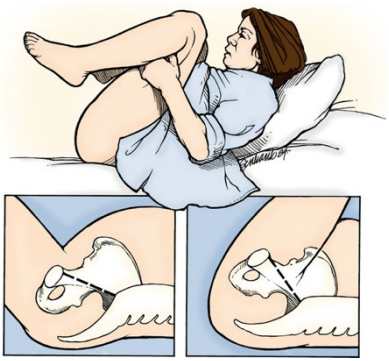
Try each manoeuvre for 30–60 seconds only: if it does not work, move on. Try to recognise it early on and before applying any traction to the head, which can delay helpful procedures and cause Erb's paralysis as a result of traction on the brachial plexus.

The following acronym is helpful:
HELPERR: H = Help
E = Evaluate/Episiotomy
L = Legs (McRoberts)
P = Pressure (suprapubic)
E = Enter (posterior arm and Wood's screw)
R = Rotate (on to all fours)
R = Repeat

1. Call for help. This condition needs the most experienced team and extra helpers.
2. Include a nurse or midwife trained in neonatal resuscitation
3. McRoberts manoeuvre (legs) (*see* Figures A+5.1 and A+5.2). Bring mother's buttocks to the edge of the bed. Both thighs are sharply flexed, abducted and rotated outwards, ideally by two assistants. Each assistant holds the leg in the region of the thigh and flexes the leg until the thigh lies parallel to the anterior abdominal wall. This will reduce the angle between the sacrum and the lumbar vertebrae to help to free the impacted shoulder. If two assistants are not available, the mother may be placed in the all fours position (see below).

Figure A+5.1 *McRoberts manoeuvre, showing how important it is to fully flex both legs on to the mother's abdomen so that the thighs lie parallel to the anterior abdominal wall*

Figure A+5.2 In McRoberts manoeuvre,



with only one assistant the left leg is held flexed against the abdomen by a nurse, and the mother holds her right leg in this position.

4. If McRoberts manoeuvre does not free the shoulders, suprapubic pressure with moderate traction (not fundal pressure). Suprapubic pressure is applied to reduce the diameter between the shoulders and push the anterior shoulder

underneath the symphysis pubis. It aims to reduce the diameter between the shoulders and rotate the shoulders into a wider diameter of the pelvic brim so there is more space for them to pass underneath the symphysis pubis It is important to know where the fetal back lies, so that pressure is applied in the right direction (i.e. from the fetal back forwards towards the fetal chest). If you are unsure of the position of the back, confirm it by vaginal examination. Pressure should be applied to the back of the shoulder with the heel of the hand, and sometimes a rocking movement may be helpful. Strong traction and fundal pressure should be avoided.

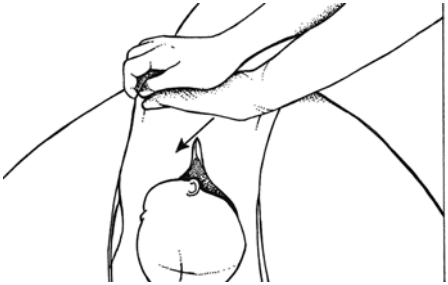
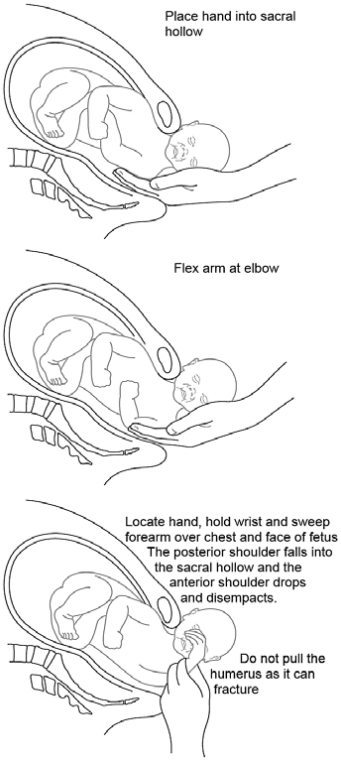


Figure A+5.3 *Suprapubic pressure*.

5. Once both McRoberts manoeuvre and suprapubic pressure are in place, moderate traction can be applied while discouraging maternal efforts (which can increase the impaction of the shoulders). Apply moderate traction only (harder pulling can make impaction worse and cause Erb's paralysis).
6. Most often, the combination of McRoberts and correctly applied suprapubic pressure works in allowing the shoulder to descend. However, if the above two procedures do not work, consider an episiotomy. A medio-lateral episiotomy is recommended to allow more room for manoeuvres such as delivering the posterior shoulder, allowing the operator to use the sacral hollow, and reducing vaginal trauma.
7. Deliver the posterior arm and shoulder. **Stop the suprapubic pressure** and insert a hand up to the fetal axilla and hook the posterior shoulder down. Traction on the posterior axilla then brings the posterior arm within reach. Run your index finger or middle finger, or both, along the back of the fetal humerus, then flex the elbow at the antecubital fossa, which will disengage the arm, which can then be brought down (hold the hand and sweep it across the chest). Sometimes it comes out directly lying alongside the head, and sometimes it comes out with an element of rotation anteriorly.
This creates space for the anterior shoulder to pass under the symphysis pubis and reapplying suprapubic pressure may assist, or the fetal body can be rotated 180° to bring the other shoulder posterior and out of the pelvis.

Figure A+5.4 *Delivery of the posterior arm. Reproduced with permission from Macdonald S, Magill-Cuerden J (ed.) Mayes' Midwifery: a textbook for midwives. Elsevier Health Sciences; 2010. © Elsevier*



8. Internal rotational manoeuvres (Rubin's and Wood's screw manoeuvres). These measures are rarely required.

Rubin's manoeuvre. The operator inserts the fingers of one hand vaginally, positioning the fingertips behind the anterior shoulder. The shoulder is then pushed towards the fetal chest.

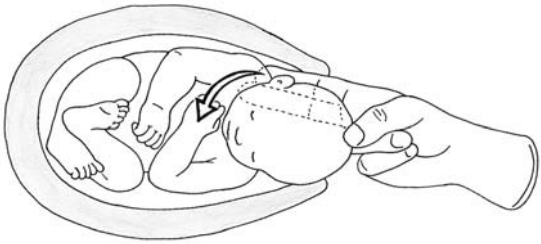


Figure A+5.5 *Rubin's manoeuvre.*

Wood's screw manoeuvre. If Rubin's manoeuvre is unsuccessful, the fingers of the opposite hand may be inserted vaginally to approach the posterior shoulder from the front of the fetus. The combination of these two movements may allow rotation of the shoulders and aid delivery. If delivery of the posterior shoulder or arm is not successful, try to rotate the posterior shoulder 180-degrees in a corkscrew fashion (clockwise or anticlockwise) to bring it to an anterior position, from which the delivery can continue as normal (this rotation releases the impacted anterior shoulder that ends up in the posterior pelvis). It is important not to twist the fetal head or neck during this manoeuvre.

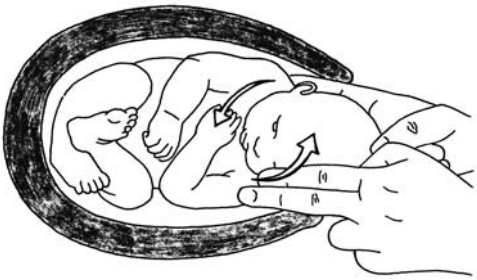
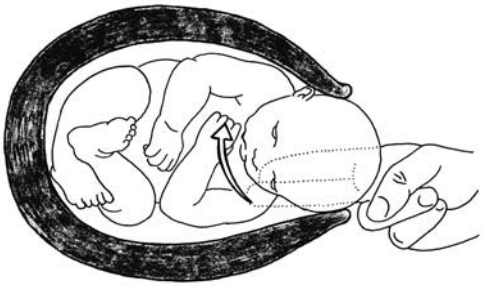


Figure A+5.6*Wood's screw manoeuvre.*

Figure A+5.7 *Reverse Wood's screw manoeuvre.*



9. All fours position. This is another procedure that can be useful if no help is available. The mother quickly positions herself evenly on hands and knees (Gaskin's manoeuvre). In many cases this alone relieves the dystocia. In addition, it can assist with the delivery of the posterior arm. The other manoeuvres described above can also be performed with the mother in this position. Early on try to deliver the posterior

shoulder from this position. Sometimes pushing one leg forward into the 'starting of a race' position can open up the pelvis from this position.

Figure A+5.8 The all-fours position for shoulder dystocia (the method to use if you have no one to assist you). Guide the head downwards so that the posterior shoulder which has now become upwards with the adoption of the all-fours position is delivered.

10. Symphysiotomy. If the baby is still undelivered, symphysiotomy could be considered (see Section E.9)

11. Finally, and if all the above manoeuvres fail, and the fetus is still alive, take the mother to the operating theater for CS and perform the Zavanelli procedure to push the baby back into the uterus using a completely sterile procedure. This is a dangerous procedure. Intravenous antibiotics must be given.

12. If the fetus is dead (confirmed by ultrasound scan), it is safer to undertake a destructive procedure. Cleidotomy is division of one or both clavicles with strong scissors (ideally embryotomy scissors) to reduce the diameter of the shoulders.

13. Always prepare for a PPH after delivery following a shoulder dystocia by having an intravenous line put in place by an assistant (not you as this will waste time when manoeuvres above should be being undertaken) and an oxytocin IV infusion (40 IU in 500ml 0.9% saline or RL) already prepared.

14. The baby, if alive, will usually need resuscitation and so ensure experienced helper available.

15. Check the vagina and perineum for trauma, and repair accordingly.

Section A+6 Ruptured ectopic pregnancy

Introduction

An ectopic pregnancy is defined as the implantation of the fertilised ovum outside the uterus, usually within the Fallopian tube. When it is a few weeks old it ruptures the tube, resulting in bleeding into the peritoneal cavity. If the fetus is expelled ('tubal abortion') it leaves from the fimbrial end of the Fallopian tube with blood collecting as a haematoma, usually at about 8 week's gestation.

If the Fallopian tube ruptures, there is generally severe abdominal pain, with or without shock, depending on the amount of bleeding. Rupture usually occurs from 8 weeks' gestation onwards, but the timing can vary depending on the exact site of the pregnancy and the rate of growth of the pregnancy tissue. As a result, rupture is possible before 8 weeks and beyond 12 weeks' gestation.

Cause of ectopic pregnancy

This is not known, but associated factors include the following:

- pelvic inflammatory disease leading to salpingitis (especially as a result of gonococcus, chlamydia or TB infection)
- if pregnancy occurs with an intrauterine contraceptive device in place (a rare occurrence)
- previous tubal surgery resulting in tubal ligation or tubal re-anastomosis
- previous ectopic pregnancy
- previous intra-abdominal infection (peritonitis).

Sites of implantation

Implantation in the Fallopian tube is most common (over 90% of cases), usually at the ampulla. Less common but more dangerous is implantation at the interstitial end. The pregnancy can also rarely implant on the bowel, pelvic peritoneum, cervix or ovary.

History

The classic clinical triad of ectopic pregnancy is pain, amenorrhea, and vaginal bleeding; unfortunately, only about 50% of patients present with all 3 symptoms. About 40-50% of patients with an ectopic pregnancy present with vaginal bleeding, 50% have a palpable adnexal mass, and 75% may have abdominal tenderness. In one case series of ectopic pregnancies, abdominal pain presented in 98.6% of patients, amenorrhea in 74.1% of them, and irregular vaginal bleeding in 56.4% of patients.

These symptoms overlap with those of spontaneous abortion; a prospective, consecutive case series found no statistically significant differences in the presenting

symptoms of patients with unruptured ectopic pregnancies versus those with intrauterine pregnancies.

In first-trimester symptomatic patients, pain as the presenting symptom is associated with an odds ratio of 1.42, and moderate to severe vaginal bleeding at presentation is associated with an odds ratio of 1.42 for ectopic pregnancy. In one study, 9% of patients with ectopic pregnancy presented with painless vaginal bleeding. As a result, almost 50% of cases of ectopic pregnancy are not diagnosed at the first prenatal visit.

Patients may present with other symptoms common to early pregnancy, including nausea, breast fullness, fatigue, low abdominal pain, and recent dyspareunia.

Painful fetal movements (in the case of advanced abdominal pregnancy), dizziness or weakness, fever, flu-like symptoms, vomiting, **fainting**, or cardiac arrest have also been reported. Shoulder pain may be reflective of peritoneal irritation.

Clinicians should have a high index of suspicion for ectopic pregnancy in any woman who presents with these symptoms and who presents with physical findings of pelvic tenderness, enlarged uterus, adnexal mass, or tenderness.

A useful saying is that any women of childbearing age with abdominal pain has an ectopic pregnancy until proven otherwise.

Approximately 20% of patients with ectopic pregnancies are hemodynamically compromised at initial presentation, which is highly suggestive of rupture. Fortunately, using modern diagnostic techniques, most ectopic pregnancies may be diagnosed before rupture.

Clinical presentation: symptoms and signs

- Abdominal pain that is lower abdominal (which tends to be unilateral), due to distension of the tube and peritoneal irritation from blood in the abdominal cavity. Rupture results in generalized abdominal pain, often associated with distention, guarding and rebound tenderness (peritonism).
- Shoulder tip pain caused by blood irritating the diaphragm.
- Rectal pain or perineal discomfort caused by the presence of blood in the pouch of Douglas.
- Diarrhoea is an atypical symptom and can rarely be the main presenting complaint.
- **Hypovolaemic shock** occurs as soon as sufficient blood has been lost. Often there will be **fainting** or a feeling of faintness that requires the patient to lie down.
- A fast and weak pulse (heart rate exceeding 100 beats/minute).
- Hypotension (a late sign after much blood has been lost: systolic pressure < 90

mmHg).

- Vaginal bleeding, which can be similar in quantity to a normal menses (75%):
  usually dark, and not heavy
  may be irregular.
- Signs and symptoms of early pregnancy are unusual. They include tiredness, nausea and/or vomiting (especially in the early morning), breast swelling and urinary frequency.
- Anaemia if there is chronic slower bleeding.

In all women and girls of reproductive age with diarrhoea and/or dizziness or fainting, urgently do a pregnancy test and consider the possibility of ectopic pregnancy.

Abdominal examination reveals muscle guarding and rebound tenderness and possibly fever. A differential diagnosis is appendicitis. There may be abdominal distension with shifting dullness if there is free blood in the abdomen.

Pelvic examination: **caution must be exercised when performing a bimanual vaginal examination if an ectopic pregnancy is possible, because of the risk of rupture during and due to the examination.** Vaginal examination may show general pelvic tenderness, sometimes with a mass in the fornix, or increased tenderness on one side. There may be cervical excitation, bluish discoloration of the vagina and cervix and/or slight uterine enlargement.

Diagnosis

Consider this diagnosis, in particular if any anaemia, shock or abdominal pain is greater than expected for the amount of vaginal bleeding. Check whether the woman or girl has any risk factors for an ectopic pregnancy.

Differential diagnosis: threatened miscarriage, acute or chronic pelvic inflammatory disease (PID), torsion or rupture of an ovarian cyst, acute appendicitis or peritonitis. Tip test: Tilt the head down. If there is blood in the peritoneal cavity it will irritate the diaphragm; this is manifested as shoulder tip pain. This test is useful if it gives a positive result, but a negative result does not exclude haemorrhage.

Do a pregnancy test in all potentially fertile women and girls with abdominal pain, fainting or shock. If they are unable to provide a urine specimen, consider using a urinary catheter to obtain one.

Ultrasound examination

If there is a positive pregnancy test but no intrauterine pregnancy is seen on the ultrasound scan, an ectopic pregnancy is likely. The likelihood of ectopic pregnancy increases if free fluid and/or an echogenic mass is seen.

Culdocentesis is not recommended, as it may delay surgery and introduce infection.

Abdominal paracentesis

Place patient on her side. Insert a needle with syringe attached in right or left lumbar area of the abdomen (see Figure A+6. 1). If blood is obtained the diagnosis is confirmed. It may then be possible to use a blood donation kit to remove a unit of blood and immediately transfuse it into the patient. **Check first that the liver is not enlarged if inserting needle in R lumbar area.** Insert blood transfusion needle in the same area as the initial needle that produced blood.

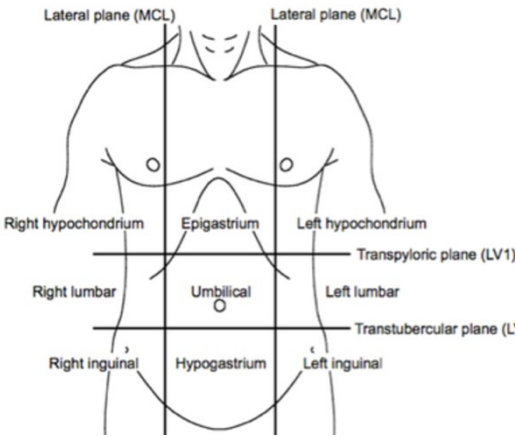


Figure A+6. 1 Lumbar sites for abdominal paracentesis

Primary assessment and resuscitation of shocked patients

Call for help. A surgeon and anaesthetist must be urgently requested, and the operating theatre must be prepared. Urgent laparotomy is the key to successful management.

Provide a high concentration of oxygen through a face mask with reservoir bag for patients with adequate spontaneous respiration.

Elevate the legs. MCAI does not advise using the anti-shock garment in this situation as the most important action is to undertake urgent laparotomy.

Gain IV access. Use a short wide-bore IV cannula if possible (14- to 16-G). External jugular vein access is a good option if peripheral access is impossible.

Long saphenous vein cut-down may also be considered, and, if the operator is adequately trained, central venous access ideally via the internal jugular vein can be extremely helpful, or the intra-osseous route if this is possible.

If sufficient helpers are available try to obtain two vascular access sites in order to give large volumes quickly, and in case one line is lost.

Take blood for cross-matching of 4–6 units, full blood count, renal function tests (if available) and blood clotting.

Give 500 mL to 1 litre of Ringer-lactate/Hartmann's solution or 0.9% saline by rapid bolus while awaiting whole blood for transfusion.

Remember that young healthy women and girls can lose a lot of blood before they become shocked, especially if it is a slow leakage rather than a sudden large loss of blood.

The concept of targeted crystalloid fluid resuscitation is important in management. Here the initial boluses of IV crystalloids required to treat shock would only be given to keep the vital organs (especially the brain, heart and kidneys) perfused before blood and, most important of all, surgery have become available. The administration of too large a volume of IV crystalloid fluids by increasing blood pressure and damaging the coagulation system could increase bleeding by disrupting early clot formation.

If a targeted crystalloid fluid resuscitation approach is adopted when giving boluses to patients who are in shock due to bleeding, before blood becomes available **and here, of most importance, early surgical intervention,** only the amount needed to keep the blood pressure at a level sufficient to perfuse the vital organs would be given. There is no clear evidence to indicate the precise blood pressure that should be achieved in a woman in shock due to a ruptured and bleeding ectopic pregnancy. However, adequate perfusion of vital organs may best be indicated by a radial pulse that can be palpated and an alert conscious level.

Our personal practice is to start with IV boluses of 500 mL of crystalloid or ideally blood and reassess after each bolus always aiming for **urgent surgical intervention** and whole blood transfusion. Several boluses of crystalloids may be required before these actions are possible.

Emergency treatment

If the diagnosis is ruptured ectopic pregnancy with shock, order blood for transfusion and immediately prepare the operating theatre. Obtain a surgeon urgently and proceed to urgent laparotomy while resuscitation is under way. Do not wait for blood.

At laparotomy, perform salpingectomy. Repair of the tube carries a major risk of future ectopic pregnancy and should not be undertaken in resource-limited settings.

Auto-transfusion

If blood is unquestionably fresh and free from infection, it can be collected after the abdomen has been opened and transfused.

When the woman is on the operating table prior to surgery and the abdomen is distended with blood, it is also sometimes possible to insert a needle through the abdominal wall and collect the blood in a donor set (see under abdominal paracentesis earlier).

Alternatively, open the abdomen and proceed as follows:

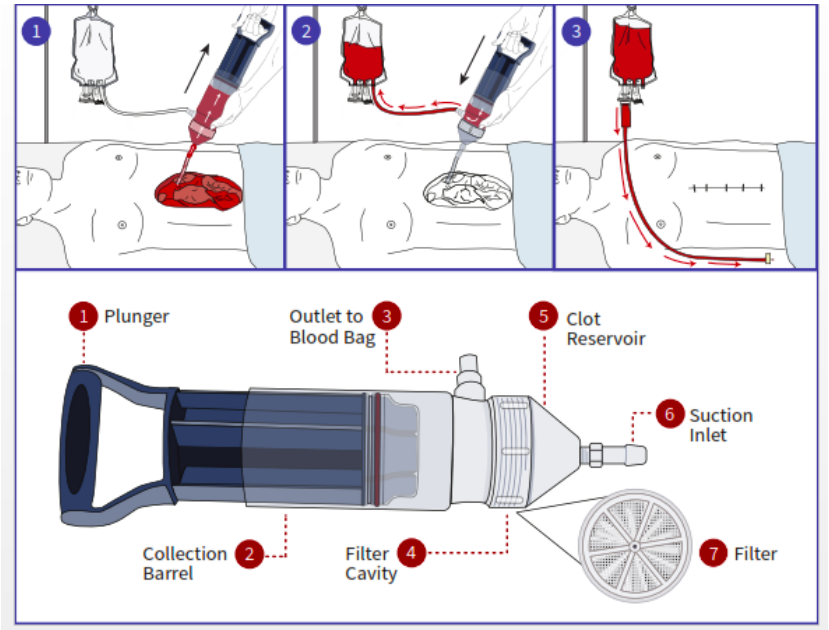
- Scoop the blood into a basin and strain it through gauze to remove all clots.
- Clean the top portion of a blood donor bag (containing anticoagulant) with antiseptic solution and open it with a sterile blade.
- Pour the mother's blood into the bag and infuse it through a filtered giving set in the usual way.
- If a donor bag with anticoagulant is not available, add 10 mL of 0.3 molar sodium citrate to each 90 mL of blood.

Hemafuse, a device manufactured by Sisu Global Health and under investigation, is an electricity free autotransfusion device that lets health workers re-use a patient's own blood, in a sterile way, when they're haemorrhaging (see Figure A+6.2). The Hemafuse, is a large handheld syringe, which doesn't require electricity. Using the device, blood is suctioned out of the body cavity where it's pooled into a chamber, then pushed through a filter, which traps clots and bits of tissue, into a blood bag where it can be re-transfused. The process takes about 10 minutes and only requires one health worker, not a team.

Advanced obstetric uses for the device include ruptured ectopic pregnancy, ruptured uterus and emergency hysterectomy.

The full-scale production model of the Hemafuse currently costs around $3,000 including 50 filters; the cost of a transfusion will be approximately $60 per patient, much less than the $250 that a bag of blood typically costs.

Figure A+6.*2 The Hemafuse device for autotransfusion*



Advice post salpingectomy for ruptured ectopic pregnancy

If the other tube was macroscopically normal, there is a good chance of a further successful pregnancy.

The risk of a recurrent ectopic is 10% or more; that is 10 times the background risk, therefore an early ultrasound scan is recommended (if available) as soon as a new pregnancy is suspected.

Offer family planning advice.

Consider treatment of pelvic inflammatory disease for the patient and her partner if there was intra-operative evidence of pelvic infection and no clear history of previous treatment.

Section A+7. Miscarriage and abortion

Types of miscarriage

Consider miscarriage or induced abortion in any woman or girl of reproductive age if more than 1 month has elapsed since her last menstrual period, and one or more of the following is present: bleeding, lower abdominal pain, partial expulsion of products of conception, dilated cervix, or smaller uterus than expected for gestation.

Spontaneous miscarriage

This is the loss of a pregnancy before fetal viability (28 weeks' gestation in low-resource settings). It occurs in at least 15% of pregnancies. The stages of spontaneous miscarriage may include the following

1. threatened miscarriage: pregnancy may continue
2. inevitable miscarriage: pregnancy will not continue and will proceed to incomplete or complete miscarriage
3. incomplete miscarriage: products of conception are partially expelled.
4. complete miscarriage: products of conception are completely expelled.
5. missed miscarriage: is not associated with symptoms but found incidentally on routine ultrasound scan or when ultrasound is performed to investigate a pregnancy that is not growing as anticipated. The time from fetal demise to expulsion from the uterus varies widely and it is not uncommon for a miscarriage to remain *in situ* for many weeks.
6. Miscarriages can be complicated by infection (*see* below).

Threatened miscarriage

Here there is light vaginal bleeding but no abdominal pain. On examination, there is a soft uterus corresponding in size to the date of the last menstrual period, and the cervix is closed.

Ideally in the presence of bleeding the viability of the pregnancy should be assessed by sonicaid/Pinnard stethoscope (if gestation permits) or by ultrasound. However, if the bleeding is light and self-limiting and ultrasound is not easily available then a conservative approach can initially be followed. Advise the woman to avoid strenuous exercise and sexual intercourse, but bed rest is not necessary. Follow her up in the antenatal clinic. If the bleeding continues, assess for fetal viability, and if the equipment is available perform an ultrasound scan. There is no medication that can prevent progression to a miscarriage.

Inevitable miscarriage

This can be diagnosed clinically by the findings of an open internal cervical os and/or the passage of products of conception per vagina. If in doubt the diagnosis should be confirmed by ultrasound.

Incomplete miscarriage

Here there is a history of significant bleeding (greater than menstruation), often with passage of clots and fetal tissue and varying degrees of lower abdominal pain secondary to uterine contraction. Bleeding can vary in severity and the cervix may be open or closed. Often the bleeding has reduced and almost stopped in which case, a complete miscarriage is an important differential diagnosis.

Diagnose by visualisation or palpation of products of conception in or through the cervical os, or by visualisation of retained products of conception on ultrasound.

Management of miscarriage

There are three broad methods for managing miscarriage:

1 *Expectant*: No medical or surgical intervention is made but the patient is monitored for spontaneous resolution. This relies on ready access to emergency treatment and careful follow-up and is therefore not commonly used in resource-poor settings.
2 *Medical*: Medication is used to expedite or induce expulsion of the retained products of conception. In resource-poor settings this is generally used only for later mid-trimester miscarriages (below).
3 *Surgical*: The uterus is surgically evacuated of the products of conception.

Surgical Management

A. If the duration of pregnancy is 12 weeks or less, or fetus is 12 week size or less, this is the preferred management method where access to care and follow-up are restricted.

If the cervix is unfavourable, and therefore likely to be difficult to dilate, then consideration should be given to:

1 'ripening' the cervix with misoprostol 200 to 600 micrograms around 3 to 24 hours prior to the procedure
2 Using medical induction as for gestations of more than 12 weeks (below).
3 Expectant management – especially if the patient appears to be contracting and is otherwise stable
4 Performing the surgery under optimal conditions: in an operating theatre with local anaesthetic, the availability of a general anaesthetic, and with an experienced practitioner available.
5 If the cervix is open and/or some products have already been expelled, a sponge forceps can be used to remove products of conception if they are visibly protruding through the cervix. Exploration of the uterus can then be performed to

ensure evacuation is complete.

B. If the cervix is open and/or some products have already been expelled sponge forceps can be used to remove products of conception if they are visibly protruding through the cervix. A manual evacuation of the uterus can then be performed to ensure evacuation is complete.

Manual vacuum aspiration (MVA) (*see* Figures A+7.1, A+7.2 and A+7.3) is the preferred method of evacuation. Evacuation by curettage should only be used if MVA is not available.

If evacuation is not immediately possible and there is significant bleeding, give oxytocin 10 IU IV over 5-10 minutes, ergometrine 200–500 micrograms IM *or* misoprostol 200 micrograms orally, sublingually or rectally.

Proceed to evacuation as soon as possible.

C. Miscarriage beyond 12 weeks' gestation, so called late miscarriage

The patient may present with bleeding, pain, loss of liquor, or a history of having already expelled the fetus before arrival.

The examination may reveal an effacing and/or dilated cervix, bulging membranes, or fetal parts. The cervix may also be closed and the patient relatively asymptomatic despite a finding of fetal death on ultrasound. Ultrasound may reveal fetal cardiac activity despite evidence of an inevitable miscarriage.

Management of late miscarriage can be divided into Expectant and Medical management. Surgical management is reserved for retained placental tissue after fetal expulsion and the rare cases where life-threatening haemorrhage occurs and delivery is not rapidly achievable by any other means.

Expectant management is most appropriate when the miscarriage is progressing on its own.

Medical management includes oxytocin, misoprostol or mifepristone if it is available.

Surgical management most often for retained placental tissue is either by Manual Vacuum Aspiration/curettage or, after 24 weeks a manual removal of the placenta is

sometimes required. It is very important that a retained placenta, which can cause chronic vaginal bleeding, is recognised.

Expectant management

This is best reserved for patients where the delivery/miscarriage process is clearly ongoing and is likely to occur spontaneously without medical intervention. Spontaneous miscarriage will generally result in expulsion of the complete fetus and placenta (this is also usually the case between 12 weeks' and 16 weeks' gestation). These may be expelled together within the gestational sac or separately after rupture of the fetal membranes.

If the delivery is urgent due to the woman's medical condition, the patient must be monitored closely to ensure the labour is progressing so that it can be medically augmented promptly if required.

Medical management

If spontaneous delivery is not expected or is delayed, then delivery can be expedited medically. If chorioamnionitis is suspected, then delivery is urgent and induction should be started without delay and the patient treated appropriately with intravenous Antibiotics and other measures as indicated during the process.

The patient needs to be assessed for evidence of infection, bleeding or other associated disorders and treated accordingly. The following investigations should be performed as a minimum: blood group and cross match, Hb, malaria RDT +/– malaria smear, urine analysis for possible infection.

If there are no signs of labour and especially if the cervix is unfavourable, then the use of mifepristone is beneficial (if available) but can be omitted. If the delivery is urgent then either the interval between mifepristone and misoprostol treatment can be reduced or they can be administered together.

1) Obtain intravenous access.
2) Give misoprostol 100 micrograms vaginally or orally every 3 hours up to a total of 5 doses. Oral administration is advised following initial vaginal installation of the first dose of misoprostol and assessment, especially, in the presence of ruptured membranes, to reduce the risk of ascending infection. A sterile technique must be followed whenever vaginal assessments are performed.
3) Only if available, mifepristone 200 micrograms can be given orally **instead of misoprostol**.
4) Observe the patient in hospital for a period of 36 to 48 hours.

5) Review by a doctor or obstetric clinician if delivery has not occurred within 3 hours of the final dose.
6) Note: The dose of misoprostol should be reduced to 50 micrograms every 3 hours up to a total of 5 doses beyond 24 weeks' gestation in women at higher risk of perforation e.g. grand-multipara and after previous Caesarean section.
7) If mifepristone or misoprostol are not available, infuse oxytocin, 40 units in 1 litre of IV fluid (Ringer-lactate/Hartmann's solution or 0.9% saline) over 4 hours until expulsion of the products of conception occurs.
8) Following delivery, oxytocin 10 IU intramuscular should be given and the patient monitored for bleeding.
9) If the placenta is not expelled with or immediately following the fetus, retained tissue is likely even if the placenta is eventually expelled. Have a low threshold for exploration and evacuation.
10) Where gestation is around 24 to 27 weeks it may be safer to remove the placenta manually as after a term pregnancy. If manual removal is not possible then MVA/curettage can be used.

Complete miscarriage

Evacuation of the uterus is not needed. Observe closely for evidence of bleeding and follow up the woman in the clinic.

Safe evacuation of retained products

1 Explain the procedure and the reasons for undertaking it and obtain consent.
2 This must be a surgically aseptic procedure, with the use of sterile gloves and gown.
3 Apply antiseptic solution (such as 0.5% chlorhexidine) to the vagina and cervix (especially the os) by first inserting a high-level disinfected or sterile speculum into the vagina and then using a sterile or high-level disinfected sponge forceps with a cotton or gauze swab and giving three applications of antiseptic.
4 Where possible perform the procedure in the operating theatre. This is especially indicated if there is a risk of heavy bleeding (e.g. molar pregnancy, suspected coagulation disorder), if the procedure is poorly tolerated by the patient, or if the cervical os is difficult to dilate or difficult to access.
5 Even when bleeding is not heavy, give oxytocin 10 units IM or ergometrine 200 micrograms IM before MVA to make the uterus firmer and reduce the risk of perforation.
6 Prepare the MVA syringe by closing the pinch valve and pulling back on the plunger until its arms lock. In the case of large amounts of retained products (e.g. molar pregnancy), prepare two or three syringes.
7 Bimanually examine the uterus to assess whether it is anteverted or retroverted prior to instrumentation and to access its size.
8 Provide an oral analgesic, paracetamol 1 gram, and if the cervix is not dilated

sufficiently to pass the MVA catheter, prepare 20 mL of 0.5% lignocaine **(without adrenaline)** with a 3.5 cm long 22- or 25-gauge needle to perform a paracervical nerve block.

9 Using a Cusco's or Sims' speculum or vaginal retractor, visualise the cervix. You will need an adequate light source.

10 If the cervix is insufficiently dilated for the MVA catheter to be passed, perform a paracervical nerve block following slight traction applied to the cervical lip to identify the junction between the cervix and the vaginal wall where injections of lignocaine are to be made. Inject 2 mL of lignocaine just under the epithelium (no deeper than 3 mm) at 3, 5, 7 and 9 o'clock positions. **Ensure that the needle is not in a vein with each injection by drawing back the needle before injection, as IV injection of lignocaine is dangerous and can cause convulsions and cardiac arrest.** Wait 2 minutes and check that the cervix is anaesthetised by pinching it gently with forceps. If the pinch is felt, wait for another 2 minutes.

11 Grasp the lip of the cervix with the sponge forceps and apply gentle traction. Cervical dilatation with Hegar dilators is only needed where the cervical os is not dilated and is firm. Slowly introduce the dilators (the smallest one first) into the cavity, checking carefully whether the uterus is anteverted or retroverted, until the resistance felt on passage through the closed internal os is released and the dilator is felt to pass through it into the uterine cavity. Usually a dilatation of 10–12 mm is sufficient. Ensure that the cervix is not torn or a false passage created by the dilators.

Figure A+7.1 Manual vacuum aspiration kit including cannulae of different sizes.

Figure A+7.***2*** *Inserting the MVA cannula.*

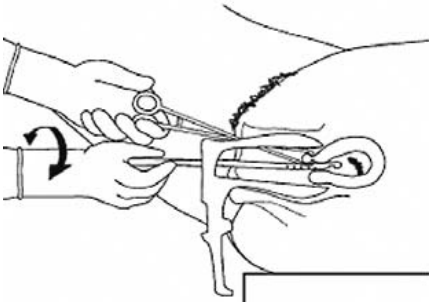
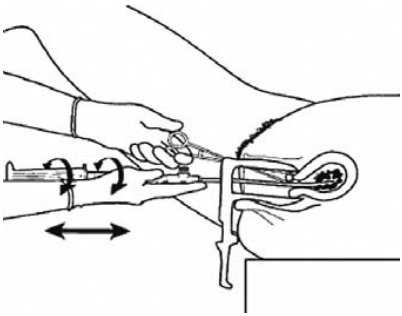


Figure A+7.***3*** *Evacuating the uterine contents.*



12. Pass the MVA cannula gently with a rotating movement through the cervix into the uterine cavity just beyond the internal os.
13. Slowly push the cannula into the uterus until it touches the fundus. Measure the depth by dots visible on the cannula and then withdraw the cannula by about 0.5 cm. Note the depth of the cavity and do not pass instruments beyond this. The risk of uterine perforation is higher in cases complicated by sepsis, or in a postpartum uterus with retained products of conception (*see* Section A+11). Also be aware that as it is evacuated the uterus generally contracts and thus the cavity will be smaller by the end of the procedure. Attach the prepared MVA syringe to the cannula and release the pinch valves, allowing the vacuum to transfer to the cannula and the inside of the uterus.
14. Evacuate the uterine contents by gently rotating the syringe from 10 to 12 o'clock and moving the cannula back and forth within the uterus. Do not allow the cannula at this stage to be withdrawn past the cervical os into the vagina, as the vacuum will be lost. If the vacuum is lost or the syringe is more than half full, empty it and then re-establish the vacuum. Do not hold the syringe by the plunger arms while the vacuum is present, as they may become unlocked and the plunger will then slip back into the syringe, pushing materials back into the uterus.

15. To ensure that all products of conception have been removed, check that red or pink foam but no tissue is seen in the cannula. The uterus will have a 'gritty' feel when the cavity is empty, and haemostasis should be achieved. The uterus may contract around the cannula. Always examine the syringe contents after the procedure.
16. An absence of products of conception in a patient with signs of pregnancy or a positive pregnancy test and continued bleeding suggests three possibilities:
1.the miscarriage was complete before evacuation
2. the products are still in the uterus (in which case evacuation needs to be repeated), or
3. there is an ectopic pregnancy. Be very careful about the third possibility.

If MVA is not available and a curette is used, undertake the procedure up to Step 11 above. Apply the curette with firm but controlled movements in all four quadrants of the uterus (anterior wall, left lateral, posterior wall and right lateral). The uterus will have a 'gritty' feel when the cavity is empty, and haemostasis should be achieved. If there is ongoing bleeding, ensure that the cavity is empty with additional gentle curettage.
17. IV antibiotics should be given as a single dose unless there are signs of sepsis, in which case a full course of antibiotics should be given (*see* Section A+14). All patients should be treated prophylactically for *Chlamydia trachomatis* with either Azithromycin 1 g orally stat or doxycycline 100 mg orally twice daily for 7 days.
18. Anti-D immunoglobulin prophylaxis, if available and affordable, should be given to women with a Rhesus- negative blood group. In well-resourced countries, a dose of 250 IU of anti-D immunoglobulin is given before 20 weeks' gestation, and 500 IU after 20 weeks' gestation.
19. Give paracetamol, 500 mg to 1 gram orally, if needed for pain.
20. If an unsafe induced abortion is suspected, examine the woman for signs of infection and uterine, vaginal, bladder or bowel injury, and thoroughly irrigate the vagina with sterile Ringer-lactate or Hartmann's solution to remove any herbs, local medications or caustic substances before MVA is undertaken (see below).

Follow-up and management after a miscarriage, especially where evacuation has occurred

Uncomplicated evacuations may not require follow-up. The patient should be encouraged to eat and drink and be mobile. She should be aware of the potential complications of miscarriage that include retained tissue (sometimes requiring repeat evacuation), infection and haemorrhage. She should be advised to seek help if there are any symptoms suggestive of these complications, such as ongoing bleeding beyond 2 weeks, very heavy bleeding at any time, severe abdominal pain, offensive-smelling vaginal secretions, fever or malaise. Rigors or fainting potentially indicate severe complications, and the woman must return immediately to the hospital if these symptoms occur.

Family planning must be discussed, and the woman advised to avoid pregnancy for at least 3 months.

In the case of mid-trimester miscarriages (>12 weeks' gestation), consideration should be given to the cause of the miscarriage as it is less common at this time and more likely to be secondary to a treatable factor. As a minimum, malaria (where endemic), syphilis and urinary tract infection should be excluded or treated.

Uterine perforation

Uterine perforation may occur following evacuation of the uterus in either a medical or non-clinical setting. The risk of complications, such as infection, perforation, and damage to visceral organs, such as bladder and bowel, is high where procedures are performed in abusive non-clinical settings, and in such cases a laparotomy will be required along with high- dose intravenous antibiotics (*see* below for details).

In most perforations where only the uterus has been damaged, the hole will heal spontaneously. Keep the woman under close observation for at least 48 hours.

Symptoms and signs of perforation when it has occurred in a non-medical setting

These include severe abdominal pain, vaginal bleeding, weakness, and dizziness or fainting. On examination of the abdomen there will be guarding, rebound tenderness or a rigid abdominal wall. Frequently there will be signs of septic shock (*see* Section C6).

Abortion *where there* ***is the deliberate termination of pregnancy before the fetus is viable.***

Unsafe abortion is a procedure performed by individuals who lack the necessary skills and/or in an environment that does not meet minimal medical standards. It may be attempted by 'medically' inducing the abortion or by 'surgically' expelling or removing products. The terms medical and surgical are used loosely here as 'medicines' used include highly toxic herbs as well as over-the counter medicines taken in overdose.

Likewise, 'surgical' is used to describe anything from unskilled use of routine surgical instruments to self- insertion of sticks or other objects into the uterus to disturb the pregnancy. Unsurprisingly, complications following unsafe abortion are common and unsafe abortion is a major contributor to maternal mortality.

Septic abortion or miscarriage

Introduction

Septic abortion or septic miscarriage is defined as abortion/miscarriage complicated by infection. Sepsis may result from infection if organisms rise from the lower genital tract following either spontaneous miscarriage or induced abortion. Sepsis is more likely to occur if there are retained products of conception and evacuation has been delayed. Sepsis is a frequent complication of unsafe abortion involving instrumentation.

Diagnosis

Consider the possibility of septic abortion in any woman or girl with a history of termination of pregnancy or attempted termination. Presentation is typically with some of the following symptoms and signs: lower abdominal pain, prolonged vaginal bleeding, tender uterus, foul-smelling vaginal discharge, purulent cervical discharge, fever (37.5 degrees C or greater and malaise.

Ruptured ectopic pregnancy is an important differential diagnosis.

A. Treatment if shock is present

If septic shock is present, this will be shown by some of the following signs and symptoms:

- fast, weak pulse exceeding 100–110 beats/minute)
- rapid breathing (> 30 breaths/minute)
- pallor (especially of the inner eyelid, palms or around the mouth)
- capillary refill time > 3 seconds (except where vasodilatation is present)
- sweatiness with cold or warm (vasodilated) skin
- anxiety, confusion or unconsciousness
- low blood pressure (systolic pressure < 90 mmHg is a late sign)
- reduced urine output (< 30 mL/hour).

Resuscitation then proceeds as described below.

Call for help including a nurse anaesthetist

Provide a high concentration of **oxygen** through a face mask with a reservoir bag if there is adequate spontaneous respiration.

For patients with inadequate ventilation, respiration should be supported with oxygen via a bag-mask, and experienced senior help (nurse anaesthetist) summoned.

Gain IV access.

1. Use a short, wide-bore (16- to 18-gauge) IV cannula.

2. The external jugular vein is a good option for access if peripheral access is difficult due to shock. Long saphenous vein cut-down or intraosseous needle access may also be considered (Section E13)
3. If there is sufficient staff present try to obtain two vascular access sites to give large volumes quickly, and in case one line is lost.
4. Elevate the legs by raising the foot of the bed.
5. Give O negative blood if available and a fresh donor blood transfusion may be particularly important especially if severe sepsis is producing disseminated intravascular coagulopathy.
6. Give an initial rapid IV/IO bolus of 500 mL to 1 litre of Ringer-lactate/Hartmann's solution or 0.9% saline if shocked and whilst awaiting blood for transfusion. It is essential that the bolus is given as rapidly as possible.

Give antibiotics after taking specimens for culture if facilities are available (blood cultures, and urine)

All patients, whether shocked or not, must be given the following antibiotics without delay:

- Ampicillin 2 grams IV every 6 hours
- *plus* Gentamicin 80 mg IV/IM 8-hourly or 5 mg/kg body weight IV/IM every 24 hours
- *plus* Metronidazole 500 mg IV every 8 hours.

All of these should be continued until the woman has been fever-free for 48 hours.

B. Treatment if shock is not yet present

Patients who do not appear to be shocked on first examination, must still be frequently observed for the early signs of shock during the first 6–12 hours. The frequency of observations can then be reduced. Start antibiotics as soon as possible and ideally **24 hours** before attempting manual vacuum aspiration (MVA).

C. Management after treating sepsis

The patient may also need the following:

D. MVA to remove infected products of conception. This is preferable to curettage, because perforation may already have occurred, or could easily do so because of the friable nature of the uterine wall. Give 5 to 10 units oxytocin IM immediately before MVA to make uterus contract making perforation less likely.

E. Hysterectomy after stabilisation if the infection cannot be controlled.

Further reading:

1. Liberia Ministry of Health (2019). National guidelines for Comprehensive Abortion Care: safe abortion for legal indications and post-abortion care (First Edition). Monrovia, Liberia: Ministry of Health.
2. https://www.sccm.org/SurvivingSepsisCampaign/Home

Section A+8 Molar pregnancy

A molar pregnancy (also called a hydatidiform mole) is one where an abnormal fertilised egg implants in the uterus. The cells that should become the placenta grow too quickly and take over the space where the embryo would normally develop.

The term 'hydatidiform mole' means a fluid-filled mass of cells. The word *mole* means a mass of cells; and *hydatid* means containing fluid-filled sacs or cysts. Those cells are called trophoblasts. That's why molar pregnancy is sometimes also called 'trophoblastic disease'.

About one in 600 pregnancy pregnancies is molar.

Molar pregnancies might be ***partial*** or ***complete***.

In a ***partial mole***, two sperms fertilise the egg instead of one. There is too much genetic material for the baby to be able to develop.
In a ***complete mole***, one (or even two) sperm fertilises an egg cell that has no genetic material inside. There are not enough of the right chromosomes for the fetus to be able to develop.
In a very small number of cases, molar cells can become cancerous and spread into other parts of the body. This is called an *invasive mole*. If an invasive mole is not treated, it can develop into choriocarcinoma.

Symptoms and signs of molar pregnancy?
Some women don't have any specific symptoms of molar pregnancy. Most of the specific symptoms are due to very high levels of the pregnancy hormone human chorionic gonadotrophin (hCG) produced by the placenta. The usual symptoms of pregnancy and miscarriage are also present.
Signs and symptoms are mainly:

- Missed monthly period/s and a strong positive pregnancy test
- Feeling very nauseous and/or vomiting
- Vaginal bleeding that's different from usual. The blood may contain small fluid-filled cysts (like tiny grapes)
- Symptoms as with those of a miscarriage, include pain and vaginal bleeding
- However, clinical signs of pregnancy are exaggerated. The uterus increases in size more rapidly than normal, vomiting is often, but not always, severe and constant, there may be pre-eclampsia in the early part of the second trimester, and BHCG levels are very high.

- Additional symptoms and signs that are typically present include heavy bleeding, a dilated cervix, a uterus larger than dates and softer than normal, and partial expulsion of products of conception that resemble grapes.
- MVA is required to evacuate the uterus (with anti-D prophylaxis in Rhesus-negative women if available and affordable).

Diagnosis
Most cases of molar pregnancy are diagnosed during routine testing after evacuation of retained products of conception.

In pregnancy
- A blood test, to measure BhCG levels (this might be done more than once over a few days). These levels are raised in molar pregnancy.
- An ultrasound scan.

If a molar pregnancy is thought to be possible, MVA to remove any pregnancy tissue will be needed. There is a higher risk of heavy bleeding, and therefore it is essential to crossmatch blood for transfusion prior to MVA.

The diagnosis can be confirmed by laboratory examination by the pathologist when examining the evacuated mole under a microscope. This may be done after a miscarriage, termination of pregnancy or ectopic pregnancy.

Complete hydatidiform moles also have a characteristic appearance on an ultrasound scan so this, and the fact that no developing fetus is seen in a scan, can allow the diagnosis to be suspected.

Treatment may be a medical evacuation. However, MVA is the best way to remove as much of the molar tissue from the uterus as possible. In most cases MVA will be enough to remove the mole permanently. Try and avoid Dilatation and Curettage (D&C), MVA is better less chance of persistent mole.

However, even a tiny amount of mole tissue left in the body can grow and spread via the blood stream and this can happen up to many months after apparent cure. BhCG circulates in the mother's blood and hCG is excreted in her urine. These can be readily measured in the laboratory from blood or urine samples. They are useful in helping with the diagnosis of the condition, but even more useful in helping decide when a patient is cured. When there is no disease in the body, the level of BhCG in the blood and hCG in the urine is low. When there is a lot of disease the level is high. As the disease resolves the levels fall gradually. These tests are important because it is possible to monitor how the disease is progressing. Therefore,

monitoring by urine samples for a period of around six months is appropriate. The intervals between samples can become longer if the hCG levels remain low.

However, if the level stays high or starts to rise expert help will be needed.

In up to 10% of patients, chemotherapy is required to eliminate any remaining disease if invasive molar tissue remain as shown by hCG hormone levels do not reduce or remain the same. In some cases of invasive mole, chemotherapy may need to be repeated over weeks or months.

Chemotherapy is *extremely* effective, both in complete and partial mole and for the very few women who develop choriocarcinoma.

All women who are diagnosed with molar pregnancy should be followed up to check that their hCG levels drop back to normal. The hCG levels are tested every two weeks on samples of blood and/or urine. In most women, the hCG levels drop fairly quickly. Chest X-ray and ideally liver function tests are also helpful.

With a complete mole
If hCG drops to normal within eight weeks, follow up for a total of 6 months from the date of the miscarriage. If it takes longer than eight weeks, then follow up should continue for 6 months from your first normal test result.

With a partial mole
Here follow up should occur until 4 weeks after the hCG returns to normal. If hCG level doesn't fall to normal or starts to rise, then further investigation and treatment will be needed.
With an invasive mole
The chances of having an invasive mole or choriocarcinoma, are very small. But if present requires expert management.

All Patients will be advised not to get pregnant while in follow-up. If chemotherapy is needed, usually there is a need to wait a year after treatment before trying for another pregnancy.

Molar pregnancy doesn't affect fertility. Many women go on to have healthy babies after a molar pregnancy.
The chance of a patient having a second molar pregnancy is around 1 in 100. If the patient has had two molar pregnancies, the chance of a third is around 1 in 7.5.

Section A+9 Antepartum haemorrhage (APH)

Introduction

Antepartum haemorrhage (APH) is defined as bleeding from the uterus or vagina occurring after potential fetal viability (defined as from 24–28 weeks' gestation). The main causes of APH are placenta praevia, placental abruption, ruptured uterus, disseminated intravascular coagulopathy (DIC), vasa praevia, and usually less seriously, bleeding from coincidental cervical or vaginal lesions.

TABLE A+9.1 Causes of major (> 500 mL) or massive (> 1500 mL) antepartum haemorrhage.

Diagnosis	Symptoms	Clinical signs	Treatment
Placental abruption	Severe constant abdominal pain If the abruption occurs in a posterior placenta, there can be severe constant backache Light or heavy vaginal bleeding (or non-visible bleeding in concealed abruption) Reduced or absent fetal movements Dizziness Shortness of breath Confusion.	Shock Tense and tender uterus on abdominal examination Fetal distress or absent fetal heart rate	Call for surgical and anaesthetic help Give oxygen Left lateral tilt or recovery position if unconscious Crossmatch 4 units of blood (ideally fresh blood) and freeze-dried plasma if available; Transfuse prior to delivery if possible, to try to correct any blood clotting abnormality IV fluid boluses and/or blood transfusion for shock If bleeding significant and/or signs of massive haemorrhage, deliver the fetus and placenta by caesarean section unless vaginal delivery is imminent. If patient stable, patient may be induced with close observation

Diagnosis	Symptoms	Clinical signs	Treatment
Placenta praevia	Vaginal bleeding that may be light or very heavy Bleeding can be precipitated by intercourse or digital vaginal examination No pain	Soft uterus Presenting part may be higher than expected. Malpresentation is more common Fetus may be distressed, non-viable or uncompromised with normal movements and normal fetal heart rate pattern Ultrasound will show placenta praevia Shock may be present, depending on how heavy the bleeding is and for how long it has been ongoing	Call for surgical and anaesthetic help Treat shock if present, including the lateral tilt or recovery position (see above) **Do not undertake digital vaginal examination,** as this can puncture the placenta and precipitate massive bleeding which may be fatal If preterm and not bleeding too heavily, admit for bed rest in a hospital where CS is immediately available and only undertake Caesarean section if there is a further bleed or when patient reaches 37 weeks' gestation Crossmatch 4 units of blood, ideally fresh blood

Diagnosis	Symptoms	Clinical signs	Treatment
Ruptured uterus	Continuous abdominal pain Vaginal bleeding that may be light or heavy History of a previous Caesarean section or other surgery or major trauma to the uterus History of prolonged obstructed labour	Shock (especially an increasing heart rate) Tense, distended and tender abdomen Easily palpable fetal parts Bandl's ring Absent fetal movements and heart sounds Malpresentation – transverse lie Signs of cephalo-pelvic disproportion Scar from previous surgery Haematuria	Call for surgical and anaesthetic help Treat shock if present Crossmatch 4 units of blood and ideally fresh Prepare operating theatre for laparotomy while resuscitating patient Stop oxytocin infusion if running

Diagnosis	Symptoms	Clinical signs	Treatment
Coagulation failure Including DIC	Heavy vaginal bleeding that is not clotting and bleeding from other sites	Bleeding from sites in addition to the vagina for example IV cannula sites Signs of other conditions that may be responsible, such as: placental abruption pre-eclampsia or eclampsia (high blood pressure and proteinuria) retained dead fetus septicaemia, including intrauterine sepsis incompatible blood transfusion amniotic fluid embolism	Fresh blood transfusion Blood products such as platelets, fresh-frozen plasma and cryoprecipitate if available Antibiotics if appropriate
Vasa praevia (placental blood vessels lying in the membranes and in front of the fetal head)	Vaginal bleeding that is light Bleeding can be precipitated by labour or artificial rupture of membranes No pain	Fetal distress or death	If diagnosed by ultrasound before labour, plan for Caesarean section

Diagnosis

Important points in history taking include the following:

- *Is the bleeding provoked or unprovoked?*

  Bleeding due to placenta praevia is likely to be unprovoked. However, bleeding may be precipitated by intercourse or vaginal examination.

Abruption is more likely after abdominal trauma.

Intercourse may cause bleeding from cervical or vaginal lesions.

- *Is the bleeding painful or painless?*

  Bleeding due to placenta praevia is usually painless.

  Bleeding due to placental abruption is initially painless, but as it continues contractions will occur and eventually become tonic with constant severe pain and a woody feel to the uterus.

  If the placenta is posterior there maybe constant severe backache.
- Is it fresh or old blood?
- Is the bleeding light or heavy?

Management of all patients with an APH

1. Place in the lateral tilt position, assess and manage ABC
2. Perform an abdominal examination: assess uterine tone, tenderness, presence of contractions, auscultation of the fetal heart.
3. Do a speculum examination: assess for vaginal and cervical lesions, and severity of bleeding. If the placental site is unknown an ultrasound scan should be performed first. If not possible, caution must be taken as bleeding from a placenta praevia may be exacerbated by vaginal speculum assessment.
4. **Under no circumstances undertake a digital vaginal examination in case the diagnosis is placenta praevia or vasa praevia**
5. Monitor vital signs frequently. **Blood loss may be concealed**
6. Insert a venous cannula.
7. Send blood for urgent haemoglobin, grouping and cross-matching, whole blood clotting test. Look for a potential donor of fresh blood.
8. Crossmatch 4 units if there is major (> 500 mL) or massive (> 1500 mL) haemorrhage or if the bleeding is rapid; group and save if there is loss of < 500 mL and the bleeding is not ongoing.
9. Perform a Kleihauer test, if available, if the woman is Rhesus negative or if there is major abdominal trauma.
10. Place a urinary catheter.
11. Monitor the fetal heart rate.

If the patient is shocked, proceed to resuscitation (see below).

Resuscitation for massive bleeding associated with an APH: CABC

In any patient with vaginal bleeding and known, or possible, placenta praevia, a digital vaginal examination must NOT be undertaken. If bleeding is painless, an ultrasound scan should be used to confirm the placental site.

Remember that young healthy women can lose a lot of blood before they become shocked, especially if it is a slow trickle rather than a sudden large loss.

The aims of resuscitation and treatment are as follows:

- to treat or prevent shock and disseminated intravascular coagulation, and thereby maximize maternal survival.
- to achieve fetal survival if viable.

CABC (Control bleeding, Airway, Breathing, Circulation)

1. **Call for experienced obstetric and anaesthetic assistance and ensure that the operating theatre is ready**
2. Provide high-flow oxygen by face mask with reservoir bag for adequate spontaneous respiration regardless of SpO_2. This increases fetal oxygen delivery as well as improving maternal tissue oxygenation.
3. If ventilation is inadequate, especially when there is a depressed conscious level (P or U on the AVPU scale), airway and breathing should be supported by bag-valve-mask inflations with high-flow oxygen, and experienced senior help should be involved, including an anaesthetist.
4. Remember to put the patient in the left lateral tilt position, or recovery position if unconscious, to minimise the effects of compression of the inferior vena cava or aorta. Lateral tilt can be achieved by using a pillow, blanket or rolled up towel. A wedge may be used during obstetric procedures. Assistants can also manually displace the uterus (see Figure A+9.1).
5. Elevate the legs.
6. If there are sufficient helpers available, consider placing the leg segments (1,2, and 3) only of an anti-shock garment to gain time whilst awaiting blood transfusion. **Do not apply the pelvic or abdominal segments (4 and 5) of the garment and do not stop other vital activities to arrest the APH whilst placing the leg segments of the garment in place.** (Section A+11).
7. Once the leg segments are in place, it is not necessary to elevate the legs.
8. Monitor the maternal heart rate, maternal pulse volume, respiratory rate and blood pressure and reassess regularly. Check the fetal heart rate. Aim to keep the maternal heart rate at <110 beats/ minute and the systolic blood pressure at 100 mmHg or more.
9. Recognise the signs of hypovolaemia. These include the following:
   1 tachycardia (Normal heart rates in a pregnant mother at rest are 60–90 beats/minute)
   2 tachypnoea due to acidosis and anxiety (normal respiratory rates in a pregnant mother at rest are 15–20 breaths/minute)
   3 cold, pale, sweaty and possibly cyanosed skin. Capillary refill time > 3 seconds

4 alteration of mental state: confusion or unconsciousness

5 Urine output less than 30 mL/hour

6 narrowed pulse pressure with weak volume peripheral pulse

7 hypotension (this is a late sign) (Normal blood pressure in a pregnant mother at rest is 95/60 to 135/85 mmHg).

Healthy women and girls who are pregnant can maintain a normal blood pressure when large volumes of blood are lost. Most, but not all, will demonstrate tachycardia if they are bleeding significantly, but bradycardia may also be observed when shock is advanced or there is vagal stimulation by for example clots in the cervix.

9. Restore circulating volume

Figure A+9.1 Left lateral tilt (on the left) and manual displacement of uterus (on the right)

Gain IV access and take blood for full blood count, group and cross-matching (aim for 4 units) and blood clotting measurement. Identify immediate potential donors who have a compatible blood group.

- Use a short wide-bore IV cannula if possible, either 14G (usually orange) or 16G (usually grey).
- External jugular vein access is a good option if peripheral access is impossible.
- Long saphenous vein cut down may also be considered.
- If IV access is not possible, consider intra-osseous needle insertion (*see* Section E13).
- Try to obtain two vascular access sites to give large volumes quickly, and in case one line is lost. Do not waste time, and as soon as the first IV cannula is in place, give an IV fluid bolus unless blood for transfusion is available in which case give blood first.
- Take blood for cross-matching (ideally 4–6 units), full blood count, renal function tests (if available), and blood clotting.

10. If shocked and blood is not yet available, give an initial IV bolus of 500 mL to 1 litre of Ringer- lactate/Hartmann's solution or 0.9% saline as fast as possible using a three-way tap and 20- to 50-mL syringes to push in as rapidly as possible. If reassessment of the circulation shows little or no improvement, then a further 500 mL should be given and followed by blood transfusion as soon as this is available. (A normal female adult has a circulatory blood volume of 5 litres, and during pregnancy this increases by 40% to 7 litres.)

11. Tranexamic acid can be of benefit in patients with continued bleeding. The loading dose is 1 gram over 10 minutes followed by an IV infusion of a further 1 gram over 8 hours. The slow IV bolus dose is given by injecting 1 gram of tranexamic acid slowly or adding it to a 100-mL bag of 0.9% saline and letting it run through over about 10–20 minutes (the exact timing is not crucial). The 8-hour infusion is given by injecting 1 gram of tranexamic acid into a 500-mL bag of 0.9% saline and giving it over 8 hours (approximately 60 mL/hour).

12. Ensure adequate blood transfusion; the best way to resuscitate the fetus is to resuscitate the mother. Inadequate transfusion is common, especially in cases of placental abruption where blood loss may be underestimated.

13. If shock is accompanied by a bradycardia of less than 60 beats/minute (e.g. in a patient with a ruptured uterus), consider giving atropine 500–600 micrograms as a single IV injection.

14. Urinary catheterisation is needed for measurement of hourly urine output. Aim for urine output of more than 30 mL/ hour.

When the patient is stable, move her to a place where there is adequate space, light and equipment to continue resuscitation and treatment.

15. *Fetal assessment*

When the mother has been resuscitated:

- listen for fetal heart sounds. Subsequently monitor the FHR regularly. If contractions are occurring, the most important time for doing this is immediately following the end of every contraction: listen for approximately one minute
- if significant haemorrhage has occurred and the fetus has reached a gestation which is considered viable after birth in the prevailing circumstances, consider immediate delivery but only if this is safe for the mother.

16. *Anaesthetic issues*

Cardiovascular instability and DIC are contraindications to spinal anesthesia. However, in low resource settings, general anaesthetic may be difficult.

- Rapid sequence induction agents with minimal peripheral vasodilator action, such as Ketamine, 1–2 mg/kg, should be considered.
- Adrenaline and atropine should be readily available in case cardiovascular collapse occurs on induction. Ventilation with high oxygen concentrations may be needed until the bleeding is controlled.

- Volatile agents have been associated with increased blood loss due to their relaxant effects on uterine muscle. Anaesthesia should be maintained with IV agents (usually ketamine) if uterine atony is a problem.
- If spinal anaesthesia is used, compensatory lower limb vasoconstriction is abolished, so profound hypotension may occur. IV fluid boluses and vasopressors need to be ready if hypotension occurs

17. *Summary of the delivery options (for more details depending on the cause see below)*
Induce labour if the fetus is dead, there is no placenta praevia, the mother is stable, and there is no significant ongoing blood loss.
18. Urine output should be monitored hourly and CS considered if labour does not become established fairly quickly. The longer the dead fetus remains *in utero*, the greater the likelihood of development of DIC.
19. Expect and be prepared for massive PPH, whether the baby is delivered vaginally or by CS.
In cases of APH with massive bleeding do not wait too long to undertake obstetric hysterectomy.
It is often APH that weakens and PPH that kills, because APH uses up clotting factors and platelets, leaving the woman in danger if PPH follows soon afterwards.

If no safe operating theatre facilities for CS are present, give oxygen, transfuse fresh blood and transfer the patient as soon as she is safe and stable. Ensure that IV fluids are in place, catheterise the patient, and ensure that she is nil by mouth.

Blood products for managing shock in APH
- Fresh whole blood is preferable for managing APH.
- Use cross-matched blood where available except in an immediately life-threatening emergency, when group-specific blood should be used, as cross-matching may take up to an hour.
- The patient's blood group should already be established earlier in pregnancy, to facilitate the provision of blood when it is needed.
- All large-volume infusions should be warmed. If only blood from a refrigerator is available, a good way of warming blood is to place the cold bag under the clothes of a relative next to their skin until the blood is warmed.
- The patient should also be kept warm, as hypothermia will exacerbate poor peripheral perfusion, acidosis and coagulation abnormalities.
- Inflated pressure bags are effective for giving blood and other fluids quickly (*see* Section C6)

Because of a predisposition to blood clotting disorders when APH is present, measure the WBCT as follows:

- *If laboratory clotting tests are not available, transfer 2 mL of venous blood into a small dry clean plain glass test tube (approximately 10 mm x 75 mm).*
- *Hold the tube in your closed fist to keep it warm (+ 37°C).*
- *After 4 minutes, tip the tube slowly to see if a clot is forming. Then tip it again every minute until the blood clots and the tube can be turned upside down.*
- *Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down indicates a blood clotting disorder (coagulopathy)*

Suspect and aggressively treat blood clotting disorders using **warmed fresh donor blood.** If available, give platelets (if the platelet count is < 50,000 × 10^9), fresh-frozen plasma (15 mL/kg) and cryoprecipitate as appropriate. Freeze-dried plasma is being used in the military in adverse conditions, as it is shelf stable for 2 years and easily reconstituted with sterile water within minutes. It would be a very useful addition to the emergency stores

Management of the different causes of APH

Placenta praevia

Placenta praevia is an abnormally situated placenta in the lower uterine segment which is either fully covering the cervical os (Total Placenta Praevia) or where the leading edge of the placenta is less than 20 mm from the cervical os (Partial Placenta Praevia). It presents with painless bleeding, often with no precipitating factor but sometimes following sexual intercourse. Bleeding is painless, may be heavy and is bright red. It occurs in around 1 in 200 pregnancies. Bleeding is more likely if the placenta is anterior rather than in a posterior position.

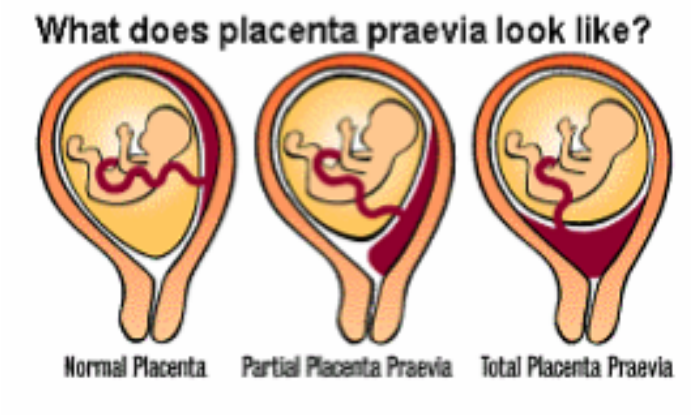
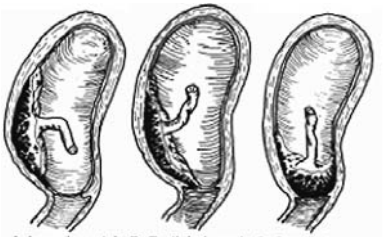


Figure A+9.2 *Increasing levels of low implanted placentas.*

Prevention and protection: major issues regarding partial or complete placenta praevia

1. Early detection of placenta praevia is very important to prevent serious bleeding.
2. Any bleeding during pregnancy, especially when a mother is known to have a low-lying placenta (see below), must immediately be investigated by an ultrasound scan.
3. Placenta praevia should also be suspected later in pregnancy if the fetus is transverse or breech.
4. Any mother with placenta praevia diagnosed during the third trimester (after 28 weeks) must **have immediate access** to an obstetric unit with facilities for Caesarean section (within a few minutes for transfer to the hospital).
5. If any vaginal bleeding occurs, even if small in volume, they must be **immediately admitted to hospital**.

Figure A+9.3 Placental positions



6. As soon as labour begins in a patient with placenta praevia the placenta will begin to separate as the cervix opens, causing bleeding from the maternal circulation. Bleeding can be massive and can rapidly lead to shock if it is not treated promptly. Ideally it should be prevented by an elective CS (see below).
7. All mothers known to have a partial or complete placenta praevia must be admitted to hospital as soon as they reach 36 weeks' gestation OR have any bleeding OR as soon as any painful contractions indicating the onset of labour occurs. (Patients with placenta praevia almost always bleed at the start of labour). An elective CS will be performed at between 36- and 37-weeks' gestation; but earlier if there is any bleeding.
8. Any mother with a partial or complete placenta praevia must be advised to absolutely avoid penetrative sexual intercourse.
9. **Never allow a digital vaginal examination to be undertaken on a patient with known or suspected placenta praevia, as it can precipitate massive vaginal bleeding.**
10. Careful speculum examination can help to exclude bleeding from the cervix or vagina but, if placenta praevia is known to be present, then undertake with extreme caution, ideally in the operating theatre.
11. During CS in a case of placenta praevia, there is a high risk of PPH. If this cannot be controlled obstetric hysterectomy may be needed, especially if there is an associated placenta accreta (see below). Always have sufficient blood for transfusion cross matched and available at the time of the CS. Some fresh blood will be ideal in this situation.

Management of a low-lying placenta detected in the second trimester of pregnancy

A placenta is considered to be low-lying when it is in the lower part of the uterus near, or over, the internal cervical os. Most low-lying placentas are near but not covering the cervical os. If the placenta is not covering the cervix at 20 weeks of pregnancy, it is unlikely that there will be a problem at a later stage.

However, as pregnancy progresses, the uterus grows, particularly stretching the lower part of the uterus, so the placenta moves with the growing uterus away from the cervical os. This stretching movement during the third trimester can pull the placenta away from the uterine wall and cause bleeding (APH).

A low-lying placenta in early or mid-pregnancy will usually have moved higher by late pregnancy and only 1 in 200 women will have partial or complete placenta praevia at the end of their pregnancy. However, if a previous CS has been undertaken in an earlier pregnancy, the placenta is less likely to move upwards as the pregnancy continues and also bleeding is more likely.

At an early antenatal ultrasound scan at around 18-21-weeks the placenta's position should be recorded. If the placenta is low, another scan is required later, usually at about 28-32 weeks. In Liberia, it is safer to re-scan at around 28 weeks as dates may be uncertain and also action must be undertaken if partial or complete placenta praevia rather than a low-lying placenta is identified. If the leading edge of the placenta at the 32 weeks' gestation scan is neither covering the os or is 20mm or more from cervical os (the entrance to the cervix) then partial or complete placenta praevia is not present and a vaginal delivery is safe.

> However, if there is any doubt about the placental position, especially when CS has been undertaken in a previous pregnancy, then elective CS is probably safer

If the transabdominal scan is unclear (at 28-32 weeks), a transvaginal ultrasound scan (if available) may be more accurate in diagnosing the position than a scan taken from the abdomen.

Placental abruption *(many thanks to Yinka Oyelese and Anthony M. Vintzileos, BMJ Best practice 2019)*

Placental abruption refers to the premature separation of a normally situated placenta. The bleeding may be concealed or revealed or mixed. Abruption may be partial or complete. (If complete, the fetus will be dead).

Abruption may result from a variety of different causes including:
• Direct abdominal trauma, as in a road traffic accident or through Intimate Partner Violence, may cause separation of the placenta.
• Indirect trauma may also shear the placenta off the uterine wall.

• Cocaine use causes vasospasm that may lead to placental separation.

Placental abruption complicates about 0.3% to 1% of births. The main risk factor for placental abruption, is a previous abruption. Increased maternal age, maternal hypertension/pre-eclampsia and trauma also increase the risk. The incidence is higher in black women compared with white women. Women who have preeclampsia, abruption, or intra-uterine growth restriction have an increased risk of developing any of these complications in a subsequent pregnancy.

The characteristic initial symptom is vaginal bleeding, but the blood loss may be concealed. Generally, 80% have revealed bleeding and 20% concealed bleeding. A large placental abruption can occur without any visible vaginal blood loss (concealed haemorrhage). Initially, the uterus may be soft, but as abruption extends, contractions will occur and eventually become tonic with constant severe pain and a "woody and tense" feel to the uterus. At this stage there will usually be shock, severe abdominal pain, and tenderness over the uterus. It may be difficult to palpate fetal parts, the uterus may be large for dates, and there may be signs of fetal distress or intrauterine fetal death. It is possible for large bleeds to be asymptomatic and even small bleeds can occasionally result in fetal death.

Disseminated intravascular coagulation (DIC) is a common complication.

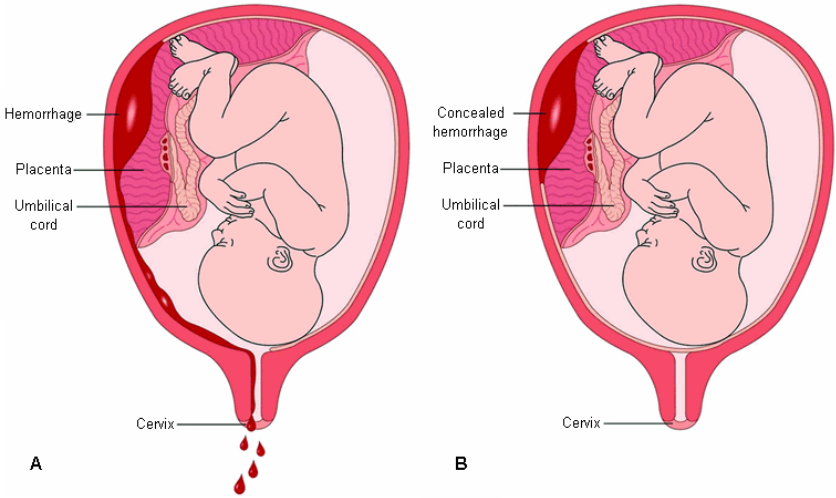


Figure A+9. 4 Revealed (A) and concealed (B) haemorrhage

Blood loss is invariably underestimated. Young healthy women will compensate and maintain their blood pressure until they lose around 40% of their circulating volume.

Key diagnostic factors

1.) vaginal bleeding (common)

a) Abruption classically presents with bleeding associated with abdominal pain, as compared with the painless bleeding of placenta praevia.

b) Bleeding is concealed in some cases of abruption and collects behind the placenta (Figure A+9.4 part B above). This is more likely to occur if the placenta is posterior.

c) The amount of vaginal bleeding is not related to the severity of the abruption.

2.) abdominal pain is a common symptom of abruption. Abruption must be high on the differential diagnosis list whenever abdominal pain occurs in the second half of pregnancy. However, placenta praevia may present with painful contractions, and abruption may occur without typical pain, particularly when the placenta is posterior.

3.) uterine contractions (common)

• High-frequency, low-amplitude uterine contractions occur commonly in abruption.

• Women with abruption are frequently in labour. This is partly due to the action of thrombin, a powerful utero-tonic agent.

4.) uterine tenderness (common)

• The uterus is frequently tender to palpation and may feel hard, with the consistency of wood.

5.) lower back pain (uncommon)

• May be the presenting symptom of a concealed abruption.

6.) fetal death (uncommon)

• Common when more than 50% of the placenta is separated.

Table A+9. 2 Differential diagnosis of abdominal pain and/or vaginal bleeding

Condition	Symptoms and signs	Investigations
Preterm labour	10% of preterm labour is due to abruption May co-exist **Vaginal bleeding** - light in preterm labour moderate to heavy in abruption **FHR abnormality** more likely in abruption rare in preterm labour	Ultrasound may help
Placenta praevia	Usually painless bleeding but painful contractions may occur	Ultrasound. If placenta praevia is not present,

Condition	Symptoms and signs	Investigations
		then assume abruption is likely
Chorioamnionitis	Bleeding uncommon Fever likely History of PPROM or PROM	Raised CRP or raised white blood cells in blood
Acute appendicitis	No vaginal bleeding. Pain is typically located around umbilicus And the right lower quadrant Frequently associated with a loss of appetite, vomiting and fever.	Raised CRP or raised white blood cells in blood Ultrasound may help
Acute pyelonephritis	No vaginal bleeding. Frequently associated with dysuria, **fever, rigors**, flank pain, and costovertebral angle tenderness.	Elevated WBC count and CRP Urine microscopy typically shows evidence of white cells and bacteria on Gram stain. Urine dipstick testing will be positive for leukocyte esterase and nitrites. Positive urine culture of bacteria
Urinary tract infection	No vaginal bleeding. Typically presents with dysuria and supra-pubic pain.	Urine microscopy typically shows evidence of white cells and bacteria on Gram stain. Urine dipstick testing will be positive for leukocyte esterase and nitrites. Positive urine culture of bacteria

Condition	Symptoms and signs	Investigations
Degeneration of fibroids	No vaginal bleeding. Fibroids may occasionally be palpable; however, they may also be **associated with abruption** and preterm labour, so it is important to ensure that women with symptomatic fibroids are not having an abruption. Local tenderness on palpation over the location of the fibroid, particularly when there is no bleeding, will make abruption unlikely.	Ultrasound scan

Treatment of abruption

Treatment depends on the gestational age and on the condition of the mother and fetus. When there is fetal death, the goal is to minimise morbidity to the mother. In cases of a live fetus at term, prompt delivery is indicated. if there are signs of fetal compromise at a viable gestation, this will usually be by Caesarean section.

Remember that there is a high risk of PPH after abruption.

In gestations at 34 weeks or less, conservative management may be attempted if both the mother and the fetus are stable.

Initial management

For all women with placental abruption, initial treatment should consist of stabilisation and monitoring of the fetus and the mother. This includes:

• Intravenous access with wide-bore cannulas.
• FBC for evidence of anaemia. Hct and Hb levels may be low.
• Coagulation profile looking for evidence of impaired coagulation which if present suggests
disseminated intravascular coagulation (DIC).
• Monitoring of the patient's haemodynamic status by monitoring BP, pulse, respiratory rate, volume intake, and urine output.
• Continuous FHR monitoring if possible, otherwise immediately following every contraction for 1 minute if contractions are present
• Anti-D immunoglobulin in Rh-negative women.
• Fluid, Tranexamic acid, blood, or blood-product replacement, as indicated.

• Ultrasound for placental location and for evidence of abruption. Placenta praevia found on sonography makes placental abruption unlikely.

The goals are to prevent and treat hypovolaemia, anaemia, and DIC. Blood and fluid replacement needs can be determined by estimated blood loss, and by vital signs (BP, pulse, and urine output). The goal should be to keep the Hb level above 100 g/L (10 g/dL) and Hct above 30%. Urine output should be at least 30 mL/ hour.
In acute severe haemorrhage tranexamic acid has been shown to have a survival benefit if given early (within 3 hours).

Transfusions, ideally of fresh donor blood containing platelets and clotting factors, should be given as needed (DO NOT WAIT TOO LONG). Only if fresh blood is not available, and If there are signs of DIC, fresh frozen plasma (FFP) or cryoprecipitate should be given early if available, because this will replace clotting factors, including fibrinogen (for cryoprecipitate). Do not give FFP at the same time as fresh blood transfusion as it will dilute clotting factors, especially fibrinogen. It is essential to replace volume, blood, and blood products aggressively if severe bleeding or shock is present (see earlier

Evaluation for abruption after major trauma to the abdomen
Remember that abruption may occur in the absence of **direct** abdominal trauma. In addition, abruption may become clinically apparent only several hours or days after the trauma.
All women involved in trauma should have FHR monitoring for a minimum of 4 hours. If there are uterine contractions, abnormal FHR, vaginal bleeding, uterine tenderness, or rupture of the membranes, further evaluation and/or delivery are indicated depending on gestational age and individual circumstances.

Preterm abruption
There are no clinical trials to guide timing of delivery for women with preterm abruption. Expert opinion suggests that delivery for stable women with a high index of suspicion for a placental
abruption should be in the late preterm or early term period.

Live fetus: >34 weeks' gestation
The aim in these circumstances is rapid delivery. If the mother is stable and the FHR is reassuring, then vaginal delivery can be attempted. Often the mother is having vigorous contractions, but if the mother is not in active labour, amniotomy and oxytocin induction usually results in delivery.
Fresh blood for transfusion and tranexamic acid should be readily available and given as needed.

If maternal condition is worsening with severe haemorrhage, urgent CS may be indicated (although this is rarely needed). Unnecessary delay should be avoided. A study demonstrated that neonates
born to women with placental abruption and bradycardia had better perinatal outcomes if the decision to delivery interval for CS was <20 minutes. It is important that the mother is stabilised both before and during the surgery.

In cases of placental abruption, the uterus may not contract adequately, and therefore haemorrhage may be difficult to control. Utero-tonic agents such as oxytocin or misoprostol may be helpful. In severe cases, where bleeding is unresponsive. Emergency hysterectomy may be needed during which correction of coagulation abnormalities using fresh blood and tranexamic acid is essential.

There is a high risk of PPH.

Live fetus: ≤34 weeks' gestation

In cases where the fetus is alive and mother is stable with no evidence of maternal coagulopathy, shock, or severe ongoing blood loss, conservative management with the aim of delivering a more mature fetus is the main goal of therapy. Uterine muscle relaxants such as terbutaline are **contraindicated** in this situation.

Close monitoring of vital signs, FHR and ultrasound scanning are required.

There is an increased risk of stillbirth, so it is recommended that delivery by 37 to 38 weeks is considered.

Where the fetus or mother are not stable, delivery should take place promptly, with concurrent
stabilisation of the fetus and mother. This is usually by CS unless vaginal delivery is imminent and can be achieved safely. It is important that both blood and blood products are replaced before and during the surgery.

There is a high risk of PPH.

Intrauterine fetal death IUFD

Rapid delivery by the vaginal route should be achieved providing the mother is stable. If the mother is not in active labour, she can be induced by amniotomy and oxytocin.

Women who have had an abruption severe enough to cause IUFD are highly likely to have DIC.

If the maternal condition is worsening with severe haemorrhage, CS may be indicated (although rarely). It is important that both blood and blood products are replaced before and during the
surgery.

PPH is a common and dangerous complication partly because the uterus may not contract adequately in these cases and partly because of coagulation abnormalities. Have an IV infusion of oxytocin and PPH management kit ready to use in such cases.
Ensure a condom catheter is immediately ready to use if required and that emergency surgical assistance such as B-Lynch sutures or emergency hysterectomy can be provided without delay if needed.

Prognosis for placental abruption
This depends on the severity of the abruption and the gestational age at which it occurs

Fetal prognosis
Cases of extremely preterm gestations and those with more than 50% separation of the placenta are associated with a high risk of IUFD and perinatal death. Abruption is also an important cause of preterm birth and is associated with an increased risk of perinatal asphyxia and long-term neurodevelopmental handicap. However, the perinatal outcome may be good in cases where the abruption is recognised promptly, and where the fetus is delivered rapidly.

A neonatal clinician should be present at all deliveries after abruption.

Maternal prognosis
This is linked to the severity of the abruption, particularly to the amount of blood lost and to the presence or absence of associated coagulopathy. There is the increased risk of blood transfusions, surgical and anaesthetic complications, and caesarean hysterectomy.
Maternal outcomes are excellent in cases where there is neither massive blood loss nor coagulopathy.
There is an increased risk of abruption in subsequent pregnancies related to the underlying cause of the abruption.
Finally, women with abruption have an increased risk of ischaemic placental disease (abruption, preeclampsia, and intra-uterine growth restriction in subsequent pregnancies).

Subsequent pregnancies
Subsequent pregnancies should be monitored carefully and all women who smoke or take cocaine should be discouraged from doing so.

Intimate Partner Violence where uterine trauma can be a consequence should be identified and managed if possible before more severe or fatal trauma is inflicted.

Ruptured uterus (see Section A+4)

Vasa praevia
Vasa praevia is a very rare condition affecting between 1 in 1200 and 1 in 5000 pregnancies. In vasa praevia, fetal blood vessels run over or close to the cervix beneath the presenting part. These vessels are vulnerable to laceration and compression and are at risk of rupture when the supporting membranes rupture, as they are unsupported by the umbilical cord or placental tissue. This most commonly occurs at the time of delivery, during labour or when membranes are ruptured. The blood that is lost comes from the fetus who have a small blood volume, so they don't need to lose much blood to become hypovolaemic and anaemic. Up to 6 in 10 affected fetuses can die if this happens.

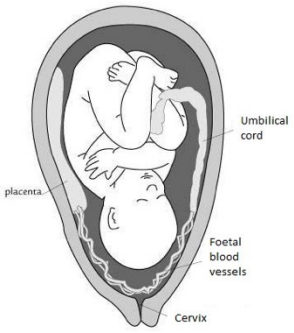
Vasa praevia is more common if the placenta is low-lying, if there is multiple pregnancy or if the placenta or umbilical cord develops in an unusual manner (e.g. multilobed placenta).

Antenatal diagnosis can be suggested by ultrasound when echo lucent linear or tubular structures are found overlying the cervix or in close proximity to it. Transvaginal ultrasound (if available) is the preferred modality. Diagnostic doppler ultrasound examination is unlikely to be available in Liberia.

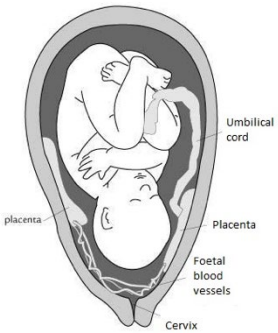
Detection of fetal haemoglobin in vaginal bleeding is diagnostic. If this condition is diagnosed antenatally, then elective CS should be undertaken around 36 weeks' gestation. When bleeding occurs as the patient goes into labor, or if membranes rupture, immediate treatment with an emergency CS may be successful if bleeding is not too heavy at the onset.

During labour and prior to an ARM, the fetal blood vessels my be felt as an extra foldin the membranes, thereby giving a warning to the operator of this possible diagnosis before membranes are ruptured.

Figure A+9.5 Vasa praevia with different types of placenta Thanks to Sigrid de Rooij



Vasa praevia with velamentous umbilical cord insertion



Vasa praevia with multi-lobed placenta

Coagulation defects

These may be due to a pre-existing coagulation problem, or to complications of the pregnancy causing excessive bleeding and disseminated intravascular coagulation (DIC) (consumption of clotting factors).

Obstetric causes include the following:

1. placental abruption
2. pre-eclampsia or eclampsia
3. retained dead fetus
4. septicaemia, including intrauterine sepsis
5. PPROM and PROM with chorio-amnionitis
6. incompatible blood transfusion
7. amniotic fluid embolism.

DIC can cause internal and external bleeding. Internal bleeds can result in blood in the urine or stool and in the brain (producing headache, visual disturbance and seizures). External bleeding can occur under or in the skin producing bruises, petechial haemorrhages and purpura. Bleeding can also occur from the nose, from around the teeth, and from the site of any IV cannulae. Any minor cut can start bleeding heaviy and not stop.

Bleeding from the cervical or vaginal lesions

Bleeding from the cervix is common but is not usually heavy. It may be due to rapid cervical dilatation, cervical ectropion or polyps. Ectropions and polyps may become more vascular and friable in pregnancy, predisposing to bleeding.

Endo-cervical and vaginal infections such as *Chlamydia, Neisseria, Trichomonas* and *Candida* can also cause bleeding.

Cervical carcinoma is a rare but important cause of APH.

Speculum examination should be performed to visualise the cervix and help to diagnose the cause of bleeding, as well as to assess the severity. Bleeding from the vagina or vulva may result from local trauma or infection. Bleeding may also be due to vulval varices and may be heavy.

Section A+10 Abnormally invasive placenta

This condition comprises placenta accreta, placenta percreta and placenta increta. These conditions are distinguished by the depth of adherence of the placenta to the uterine wall and penetration of the uterine wall to invade other organs.

Placenta accreta is used to describe a placenta that invades the myometrium of the uterus because the decidua basalis is thin or absent. The placenta does not invade the full thickness of the myometrium

Placenta increta describes a placenta that deeply invades the myometrium of the uterus

Placenta percreta invades the myometrium and serosa of the uterus with possible involvement of surrounding organs, usually the bladder.

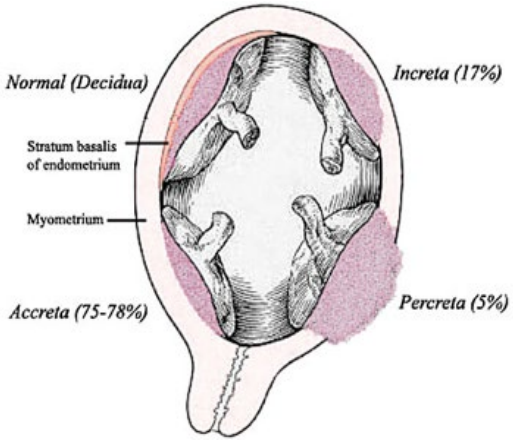


Figure A+10.1 Types of invasive placenta

Abnormally invasive placenta is uncommon, but significantly more likely to occur if there is a placenta praevia in the current pregnancy and previous Caesarean section and/or a history of previous morbidly adherent placenta.
If there is a placenta praevia in the current pregnancy, the incidence of abnormally invasive placenta is 3% if no previous Caesarean sections, 11% if one previous Caesarean section and 40% if 2 previous Caesarean sections.
Other risk factors include previous manual removal of placenta, previous myomectomy and previous curettage of the uterus.

The incidence of peripartum hysterectomy is increasing in some countries, due to higher CS rates. Therefore, there should be a high index of suspicion antenatally where there is noted to be a low-lying anterior placenta on ultrasound scan in a woman with a previous CS.

In well-resourced healthcare systems, MRI scan may be helpful in confirming or excluding morbid placental adherence, as well as in assessing the depth of adherence. In Liberia, ultrasound scan may be the only option for trying to identify the extent of the adherence.

This condition presents clinically as a retained placenta after vaginal delivery or CS. In both instances, attempted manual evacuation of placenta will be unsuccessful. The temptation to remove the placenta in pieces must be resisted, as this will provoke uncontrollable haemorrhage from the placental bed.

When an abnormally invasive placenta is present, the failure of the entire placenta to separate normally from the uterine wall after delivery is typically accompanied by severe postpartum haemorrhage

Women with placenta accreta, increta, or percreta for whom no attempt is made to remove any part of their placenta have reduced levels of hemorrhage and a reduced need for blood transfusion.

In summary, abnormally invasive placenta:

1) Usually occurs in a previous CS scar
2) Placenta invades the scar (becomes “accreta”)
3) Placenta starts low (growing over the cervical os, becoming “previa”)
4) Placenta previa + (multiple) previous CS→ high likelihood of accreta
5) Commonest organ for invasion by the placenta is the bladder

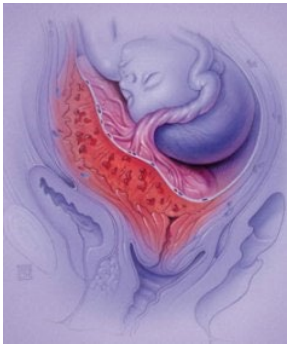


Figure A+10. 2 Anterior placenta praevia with invasion

Placenta accreta– abnormally adherent placenta: does not come out after delivery. Patient bleeds because uterus cannot contract with placenta inside.

Treatment for abnormally invasive placenta
There are two management options where a morbidly adherent placenta is diagnosed:

The **first option** is to clamp the cord close to the placenta and leave it in situ, prescribing broad spectrum antibiotics and keeping the women under surveillance for at least six weeks, while the placenta involutes. Despite these precautions, bleeding and/or sepsis may supervene, necessitating hysterectomy. In Liberia this management is risky and probably should be avoided.

The **second option** is to undertake obstetric hysterectomy at the time that the condition is recognised. This may seem to be a drastic step, but it ensures that the procedure is carried out with the woman in optimal condition for undergoing a major operation, without sepsis or massive haemorrhage.

Where morbidly adherent placenta is diagnosed antenatally, plans may be put in place for elective CS followed directly by obstetric hysterectomy.

In addition, on rare occasions, concealed abruptio placentae may be associated with extravasation of blood into and through the full thickness of the myometrium (Couvelaire uterus) making it unresponsive to oxytocic drugs, thus necessitating hysterectomy.

It must be emphasized, however, that in the majority of cases of abruptio placentae with Couvelaire uterus, the response to oxytocic drugs is appropriate and the haemorrhage is due to DIC rather than failure of the uterus to contract.

References

Fitzpatrick K, Sellers S, Spark P, Kurinczuk J, Brocklehurst P, Knight M. The management and outcomes of placenta accreta, increta, and percreta in the UK: a population-based descriptive study. *BJOG*. 2014;121(1): 62-71.

Sentilhes L, Goffinet F, Kayem G. Management of placenta accreta. *Acta Obstet Gynecol Scand*. 2013;92(10):1125-1134.

Section A+11 Post partum haemorrhage

1. Emergency management of Primary PPH: <24 hours after delivery

If there are antenatal or intrapartum risk factors for PPH, have a reliable IV cannula in place before delivery and have uterotonic drugs (oxytocin and misoprostol) and PPH box ready next to patient. Also draw up IV oxytocin for IV /IM injection and have 40 IU of oxytocin ready in the fridge to be immediately added to IV fluid bag and started if PPH begins. Ensure doctor, obstetric clinician, theatre staff and transfusion team are aware.

Introduction

The definition of a postpartum haemorrhage (PPH) is blood loss of more than 500 mL from a vaginal birth and more than 1 litre after a Caesarean section. It is common, occurring in 1–3% of all pregnancies. Globally it causes 25–50% of maternal deaths and is the leading cause of death in low-resource settings. Estimates of blood loss are inaccurate and tend to be underestimated, often around half the actual loss. Blood is mixed with amniotic fluid and sometimes with urine. It also soaks swabs, towels and linen, and is found in buckets and on the floor.

TABLE A+11.1 Blood loss in pregnancy

	Percentage circulating blood loss		
Vital Sign	< 25%	25–40%	> 40%
Heart rate	slight increase	moderate increase	marked increase or bradycardia
Systolic BP	normal	normal	beginning to fall
Pulse volume	normal or decreased	seriously decreased	very seriously decreased
Skin	cool, pale, sweaty, CRT prolonged	cool, mottled, sweaty CRT prolonged	cool and sweaty CRT prolonged
Respiratory rate	slight increase	moderate increase	sighing respirations
Mental status	slight agitation	lethargic or uncooperative	only reacts to pain

* CRT Prolonged Capillary refill time > 3 seconds.

Note that blood pressure may be normal until up to 50% of the patient's circulatory volume has been lost. The blood pressure is initially well maintained despite continuing bleeding in pregnancy. As an indicator of haemorrhage, it can be falsely reassuring. A progressively worsening tachycardia is more relevant. A monitoring device which displays measurements of pulse rate, ECG trace and blood pressure is useful if available.

The significance of any given volume of blood loss varies depending on the mother's initial haemoglobin level. A mother with a normal haemoglobin level will tolerate blood loss that would be fatal for an anaemic woman. This is why it is essential to ensure that every woman who reaches labour has an adequate haemoglobin level and iron stores.
Even healthy non-anaemic women can have catastrophic blood loss.
Bleeding may occur at a slow rate over several hours, in which case the condition may not be recognised until the mother is shocked. Previously healthy women can compensate for substantial blood loss.

Risk assessment in the antenatal period may not predict women who will have PPH. However, identification and treatment of anaemia antenatally usually allows women to better tolerate PPH.

Table A+11.2 Factors which place a woman at increased risk of PPH: *however, remember that any patient can have a massive PPH, not just those at increased risk.*

Pre-dating present pregnancy	**Arising during present pregnancy**	**Arising during labour**
High parity	Placenta praevia	Induced labour
Fibroids	Placental abruption	Prolonged/obstructed labour
Previous retained placenta	Polyhydramnios	Precipitate labour
Previous PPH	Multiple pregnancy	Instrumental delivery: forceps or vacuum
Previous surgery to the uterus including previous CS	Intrauterine fetal death	CS
Previous prolonged or obstructed labour	Eclampsia and severe pre-eclampsia	General anaesthesia

Medical disorders such as blood clotting disorder	Use of tocolytic drugs for preterm labour	Chorioamnionitis
Anaemia	Any conditions associated with anaemia such as malaria, hookworm infection	Inversion of the uterus
		Blood clotting problem for example DIC

Prevention of PPH

Active management of the third stage of labour

This is essential for prevention of PPH, and it consists of three possible interventions:

1. a prophylactic uterotonic drug after delivery, after checking first that there is not a second twin present.
2. controlled cord traction
3. uterine massage after delivery of the placenta.

Prophylactic uterotonic drug after delivery This is the most important intervention. Oxytocin 10 IU IM or, especially if the mother is shocked, 5 IU by slow (over 1–2 minutes) IV injection is the first choice because it causes uterine contractions rapidly to prevent atony rapidly and with minimal adverse effects. Atony is the most common cause of PPH (around 80% of cases). Where oxytocin is unavailable or does not work, other uterotonic drugs should be used, including:

1. ergometrine 200 or 500 micrograms IM (**must never be given to a mother with pre-eclampsia**)
2. or misoprostol 600 micrograms sublingually or orally if the mother is fully conscious
3. or misoprostol 800 micrograms (rectally if the mother is drowsy or unconscious).

All uterotonic drugs should be given within 1 minute of the complete birth of the fetus, to aid separation of the placenta by enhancing uterine contractions and reducing the risk of bleeding from an atonic (relaxed) uterus. **It is essential that, before giving such drugs, you must be sure that there is not another fetus in the uterus.**

Remember that ergometrine is contraindicated in heart disease, hypertension, pre-eclampsia and eclampsia, as it raises the blood pressure by vasoconstriction, which increases the risk of cerebrovascular accidents (strokes).

Ensure that both oxytocin and ergometrine are protected from heat damage by paying close attention to the cold chain and their storage, otherwise they may not be effective. Ideally oxytocin should be stored in a fridge, but it can be kept at 15–30°C for 3 months. Oxytocin must never be frozen. **Ergometrine must always be stored in a fridge** at 2–8°C. Misoprostol can be stored at ambient temperature.

Early cord clamping and cutting
This is not an essential part of the active management of the third stage of labour, and it is no longer recommended unless the infant needs resuscitation.

Controlled cord traction
This is optional where delivery is undertaken by a skilled birth attendant but contraindicated if a skilled attendant is not available. Details are given in Section A3.

Strong uterine massage
This should always be undertaken immediately after delivery of the placenta until the uterus is contracted and remains so. Check the state of contraction of the uterus every 15 minutes for 2 hours and repeat the massage if at any time the uterus becomes soft and relaxed.

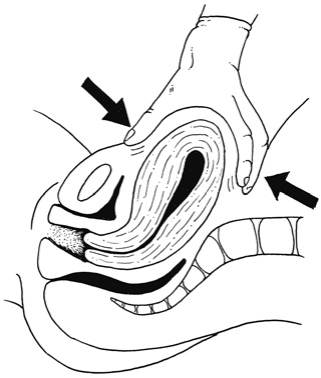


Figure A+11.1 Strong massage applied to cause uterus to contract.

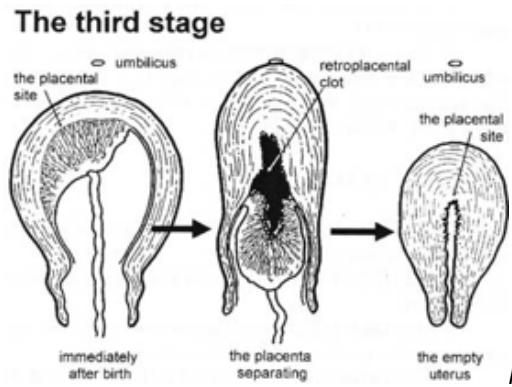


Figure A+11.2 The third stage.

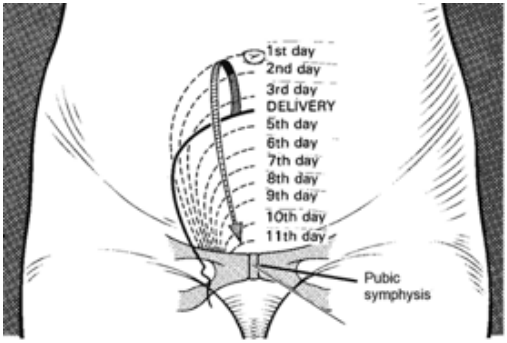


Figure A+11.3 The uterus during the puerperium.

In order to prevent PPH **during or after Caesarean section**, the use of oxytocin plus cord traction is recommended in preference to manual removal of the placenta.

How to manage the third stage of labour if uterotonic drugs are not available
Unfortunately, it is not uncommon for hospitals to run out of uterotonic drugs. In this **avoidable and dangerous situation**, expectant and/or physiological management should be undertaken.

1. Place the baby on the mother's breast.
2. Leave the cord alone.
3. Observe for the following signs of placental separation:
    - a small gush of blood
    - a lengthening of the cord at the introitus

- the mother feeling uncomfortable, feeling a contraction and wanting to 'bear down'.

Most placentas separate within 1 hour of birth. If this does not happen, seek help.

4. Deliver the placenta.
   - Sit the mother upright.
   - Encourage her to bear down with a contraction (only after placental separation).
   - Catch the placenta. If membranes are dragging behind it, gently twist a few turns and with slight traction and an up-and-down movement deliver the placenta plus membranes.

Controlled cord traction must not be undertaken prior to the separation of the placenta in the absence of uterotonic drugs.

Monitoring after the placenta has been delivered by active or expectant management

1 Monitor the blood pressure, pulse and state of the uterus (i.e. whether it is contracted) every 15 minutes for 2 hours after delivery of the placenta.

2 Examine the placenta for completeness.

Resuscitation measures aimed at stopping further bleeding ***CABC Control bleeding ABC***

1. **Palpate the uterus and massage it strongly and immediately, as it is most likely that an atonic uterus is the cause.** (*see* Figure NN1 and below). 90% PPH is due to atonic uterus and so massage the uterus while telling mother what you are doing. Expel clots and rub up a contraction
2. Call for help include surgeon, nurse anaesthetist, blood bank and potential blood donors
3. Ensure that the airway is open and remains so.
4. Provide high-flow oxygen through a face mask with reservoir bag if there is adequate spontaneous respiration.
5. If not in place already, place a wide-bore IV cannula (14 or 16 gauge). Take blood for Hb or hematocrit, cross match 4-6 units, ideally fresh blood, assess whole blood clotting time.
6. **Give uterotonic drugs:**

   Oxytocin 5 or 10 IU IV over 1 minute (IM if no IV cannula). Repeat IV bolus of 5 or 10 IU if uterus not contracted after 5 minutes.

   Oxytocin starts to work 2–3 minutes after IV injection, but has a relatively short duration of action, and an infusion will be needed to maintain a contracted uterus. Following an oxytocin bolus, give an IV infusion of oxytocin 40 IU in 500 mL of Ringer-lactate or Hartmann's solution over 4 hours (40

drops/minute = 2ml/minute = 120 ml/hour with a standard IV giving set where 20 drops = 1 mL).

Side effects include hypotension (due to vasodilatation when given as a rapid IV bolus) and fluid
retention. Warn mother she may feel flushing during IV bolus injection but this is because of the drug you are giving and not a feeling for her to worry about.

Ergometrine If the mother does not have eclampsia, pre-eclampsia or hypertension, **ergometrine** 200 to 500 micrograms IM in addition to oxytocin may help uterine contraction (Ergometrine has a hypertensive action which increases the risk of convulsions and cerebrovascular accidents).

Misoprostol If oxytocin does not stop bleeding within a few minutes, give 4 x 200 micrograms of **Misoprostol** (which, unlike oxytocin and ergometrine, does not need to be kept in a refrigerator).

800 micrograms can be given orally, as tablets (buccal or sublingual) or oral solution. The latest evidence suggest that **oral** misoprostol solution is the most reliable and appropriate.

To make up an oral misoprostol solution for treating PPH: 4 x 200 mcg misoprostol tablets are dissolved in 200 ml of drinking water and given as soon as dissolved.

Buccal- tablets are placed between the cheek and gums and if treating PPH swallowed after 5 minutes. Sublingual tablets are placed under the tongue and swallowed after 5 minutes if treating PPH.

The rectal route in PPH is particularly helpful if the mother has reduced conscious level (for example after CS or if under general anaesthesia).

7. **insert urinary catheter** and leave it in place as a bladder containing urine could be preventing the uterus from contracting. The presence of a catheter allows accurate measurement of urine output which is helpful in assessing response to resuscitation (aim for > 30 ml per hour).
8. Give **Tranexamic acid (**1 gram (100 mg/mL) at rate of 1 mL per minute. If bleeding continues, give a 2nd dose after 30minutes.
9. If placenta is retained and bleeding is continuing, **manual removal of placenta** is needed as an emergency
10. **KEEP EXTERNAL UTERINE MASSAGE GOING THROUGHOUT.**

If the uterus is atonic, a contraction must be rubbed up by abdominal and suprapubic massage. Must be strong massage not just pinching of the skin.

- Massage the fundus in a circular motion with the cupped palm of your hand until it is contracted.
- When it is well contracted, place your fingers behind the fundus and push down in one swift action to expel any clots.

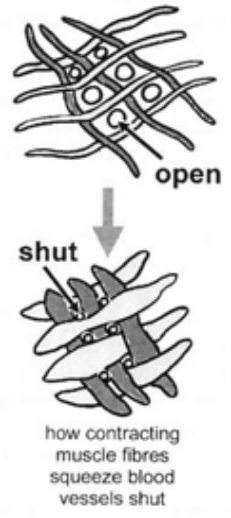


Figure A+11.4 Contraction of uterine muscle fibres squeezes blood vessels shut

11. In emergency give **O negative blood** if possible
12. **Elevate the legs to increase venous return to the heart and lungs.**
13. MCAI advises that, only if there are sufficient helpers, putting in place **only the leg segments (1,2, and 3)** of an anti-shock garment can be helpful in gaining time whilst awaiting blood transfusion.
    MCAI does not consider that applying the pelvic or abdominal segments (4 and 5) of the garment are safe as it can distract from more important treatments such as external uterine massage, uterotonic drugs etc. **Do not stop other vital activities such as external uterine massage or uterotonic drugs whilst placing the leg segments of the garment in place.**
14. Once the leg segments are in place, it is not necessary to elevate the legs.
15. Give **500ml to 1 litre bolus IV of Ringer-Lactate or 0.9% saline** as rapidly as possible, repeat x 1 if needed
16. Obtain and **transfuse blood** as soon as possible. (ideally **fresh blood** if available from donors)
17. Place a **second IV cannula** as soon as possible: do not wait until bleeding gets worse; it may then be more difficult to access collapsed veins. However, if alone do not stop uterine massage to place a second cannula.

Vital signs assessment revealing shock

1. Rapid breathing (> 30 breaths/minute). Normal respiratory rates at rest are 15–20 breaths/minute; tachypnoea can be due to acidosis.
2. Fast, weak pulse (≥ 100–110 beats/minute). Normal heart rates in a pregnant mother at rest are 60–90 beats/ minute. Tachycardia is an early sign of shock.
3. Low-volume (weak) pulse.
4. Anxiety, confusion or unconsciousness.
5. Nausea with or without vomiting.
6. Pallor (especially of the inner eyelid, palms or around the mouth).
7. Sweatiness or cold clammy skin.

8. Prolonged capillary refill time (> 3 seconds).
9. Low blood pressure (systolic pressure < 90 mmHg) is a late sign. Healthy women and girls can maintain a normal or even high blood pressure while losing large volumes of blood.
10. Reduced urine output (< 30 mL/hour). Urinary catheterisation is needed for measurement of hourly urine output if the patient is shocked (normal output is > 30 mL/hour).

If bleeding is continuing Re-assess causes – 1. Atony, 2. Trauma, 3. Retained placental tissue, 4. Coagulation disorder. This reassessment may change order of management depending on clinical picture. **Also, if enough staff, different steps of management can be carried out at the same time.**

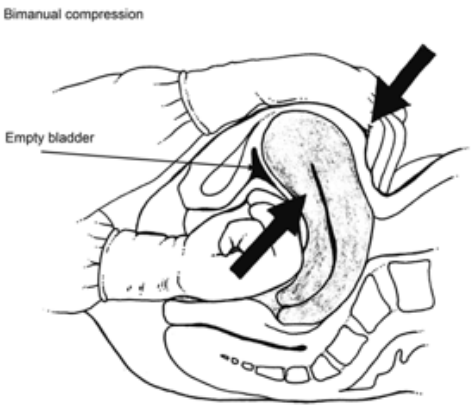
18. If still bleeding and uterus feels well-contracted, **examine vagina and cervix for lacerations** using sterile speculum and repair using emergency kit.

19. Bimanual uterine compression

If atonic uterus still bleeding, bimanual compression whilst preparing condom catheter

If heavy PPH continues despite uterine massage, and with the placenta already delivered, this procedure can be very effective. If the placenta is still in place priority should be given to removing it as soon as possible.

● You must wear sterile or disinfected gloves (ideally long versions up to the elbow).



● Introduce your right hand into the vagina, clench your fist with the back of your hand positioned posteriorly and your knuckles in the anterior fornix.

● Place your other hand on the abdomen behind the uterus and squeeze the uterus firmly between both hands.

● Continue compression until the bleeding stops (i.e. there is no bleeding when compression is released), and the uterus is contracted.

Figure A+11 .5 Bimanual compression.

Although this procedure is painful, it is highly effective and can significantly reduce or even successfully treat uterine haemorrhage. Therefore, if the bleeding is profuse, and the number of staff attending the patient allows, it is a good idea for one member of the team to commence bimanual compression while others are continuing resuscitation such as placing a second IV cannula and opening a condom catheter pack.

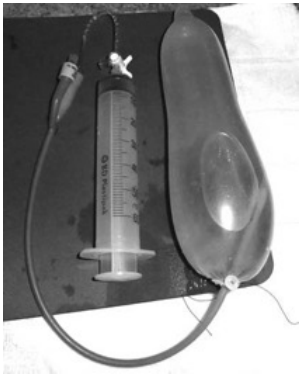


Figure A+11.6 .Condom catheter inflated with 0.9 % saline

Figure A+11.7 Spigot for use in inflating condom catheter

18. Uterine tamponade using condom catheter.

Uterine packing with a hydrostatic balloon such as a Rusch balloon or condom over a urinary catheter can help to control haemorrhage from an atonic uterus that does not respond to the above measures.

Rusch balloon tamponade is expensive and in Liberia a condom catheter is the treatment of choice. Sterile packs container the condom catheter immediately ready to use are important and save time when initiating this treatment.

A condom catheter is inserted into the uterus as a sterile procedure and filled with 250–500 mL of sterile Ringer-lactate/Hartmann's solution or 0.9% saline to create a uterine wall tamponade. This is an effective way of stopping continuing uterine bleeding that is continuing despite the use of uterotonic drugs and procedures (*see* Figure A+11.6). It is important to check that the inflated condom is fully inside the uterus as it is inflated, and to take measures to ensure that it does not become displaced into the vagina. This can be done by packing the vagina with a sterile gauze pack. The procedure is shown in the linked video https://youtu.be/iozNedxg0Ik and uses a special spigot placed between a 500 ml bag of sterile IV fluid Figure A+11.7 (Diamedica)

Figure A+11.8 Condom catheter packs prepared in advance to save time in an emergency

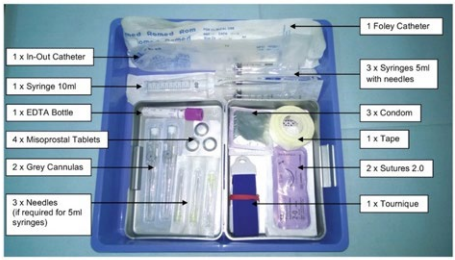
Leave the balloon in position for up to 24 hours or until the bleeding has stopped (the exact time needed is unclear). Before removing it, ensure that at least 1 unit of cross-matched blood for possible transfusion is available, with the possibility of making more available if required. Theatre staff and an anaesthetist should be warned in case bleeding occurs when the catheter is removed. One approach is to remove 50 mL from the condom every 30 minutes until it is fully emptied. Observe the patient closely for 4 hours after removal of the catheter, looking at vaginal blood loss and vital signs.

IV prophylactic antibiotics should be given when the catheter is first put in place and should be continued for 48 hours.

It is helpful to have already made up sterile packs (see Figure A+11.8) containing the condom catheter in the PPH emergency pack (see below).

PPH Box: Box Layout - Large Items

PPH Box: Tray Layout - Small Items in Blue Tray



PLUS Tranexamic acid 1 gram
1 Anti-shock garment

18. If none of the above actions work, and especially if DIC developing, do not wait too long to undertake B-Lynch sutures or emergency hysterectomy. (Sections E11 and E12)

19. PPH occurring soon after a Caesarean Section
It is essential to identify where the bleeding is coming:

1. From uterine atony
2. From a tear in the lower segment of the uterus
3. From failed stitching of the uterine incision when bleeding can occur vaginally or directly into the abdominal cavity or both.
4. If previous labour from a tear in the cervix or vagina

Ultrasound scan may be helpful but there should be no delay in laparotomy to examine the uterus if a tear or failed stitching is likely to be the cause.

Additional information on measures used to undertake treatment of PPH

A. Fluid resuscitation

1. The aim of fluid resuscitation is to maintain perfusion of vital organs (the brain, heart and kidneys) during the manoeuvres described above.
2. Insert a wide-bore IV cannula (ideally two) (14- to 16G) and send blood for a full blood count, cross-matching (4–6 units) and clotting. Try to obtain two vascular access sites in order to give large volumes quickly, and in case one cannula is lost. However, if only one skilled person is present do not take essential time away from other components of resuscitation in order to place the second cannula. If peripheral veins are difficult to access, the external jugular vein or long saphenous vein cut down are alternatives.
3. If venous access is not possible, consider inserting an intra-osseous line using the newly available drill system (*see* Section E13).
4. Give 500 mL of O-negative blood if it is immediately available. If not, standard practice is to give an initial rapid IV bolus of 500 ml to 1 litre of Ringer-lactate/Hartmann's solution (or of 0.9% saline if the former are not available) while waiting for blood for transfusion. It is essential that the IV bolus is given as rapidly as possible, with the aid of pressure bags or manual pressure. A blood pressure cuff that is wrapped around the fluid bag and inflated can be used to speed up infusions (s*ee* Figure A+11.9). An alternative is to push the boluses in using a 20- to 50-mL syringe (with a three-way tap linked to the IV giving set).
5. As soon as it is available give 1 unit of blood (450 to 500 mL) as soon as it is available and as rapidly as possible and repeat as required. Fresh blood is particularly useful for correcting the coagulopathy that occurs in major blood loss if specific coagulation components such as platelets are unavailable. Remember that blood loss is usually underestimated.
6. Further 500- to 1000-mL boluses of IV crystalloid or better fresh donor blood, if available, will usually be required in the first hour. Once more than 2 litres have been given IV, complications such as pulmonary oedema may sometimes occur, so watch for symptoms and signs of circulatory overload.
7. The concept of *targeted crystalloid fluid resuscitation* may be relevant here and requires urgent research. If this approach is adopted the initial boluses of IV crystalloids required to treat shock would only be given to keep the vital organs (especially the brain, heart and kidneys) perfused before blood becomes available and, most important of all, before specific treatments to stop the bleeding have started to take effect. Giving too much IV crystalloid fluid may theoretically increase bleeding by disrupting early clot formation and damaging the coagulation system. There is no clear evidence to indicate the precise blood pressure or clinical signs that should be achieved in a woman

in shock due to PPH. Adequate perfusion of vital organs may be indicated by a radial pulse that can be palpated and an alert patient.

8. Until bleeding has been stopped and blood is available for transfusion, our personal recommendation, especially in low resource settings, is therefore to start with IV boluses of 500 mL of crystalloid and reassess after each bolus.
9. Further IV fluid administration should be guided by the response of the pulse rate, blood pressure and capillary refill time, and later by the hourly urine output. Aim for a pulse rate of < 100–110 beats/minute and a systolic blood pressure that is maintained > 90–100 mmHg and stable.
10. *Blood transfusion (see Section C5).* Fresh donor blood is the ideal choice if it is available as it contains platelets and other clotting factors.
11. Full cross-matching of blood may take up to an hour and is often unavailable in resource poor settings. In an emergency, group-specific blood should be used. The patient's blood group should have been established during pregnancy, as this facilitates the provision of blood when it is needed. O-Rhesus-negative blood can be transfused in acute emergencies.
12. All large-volume infusions of blood should be warmed. A good way of warming blood is to place each bag of blood or fluid under a relative's clothes next to their skin. Do not infuse cold fluid directly through a central venous line.

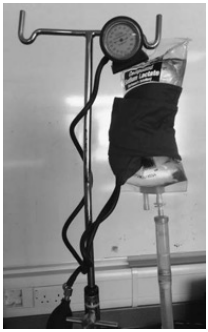


Figure A+11. 9 *Pressure over bag containing Ringer- lactate or Hartmann's solution*

B. Treating blood clotting problems including DIC

Measure the Whole Blood Clotting Time (WBCT) as follows:

- If laboratory clotting tests are not available, transfer 2 mL of venous blood into a small dry clean plain glass test tube (approximately 10 mm x 75 mm).
- Hold the tube in your closed fist to keep it warm (+ 37°C).
- After 4 minutes, tip the tube slowly to see if a clot is forming. Then tip it again every minute until the blood clots and the tube can be turned upside down.
- Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down indicates a blood clotting disorder (coagulopathy)

The best treatment for prolonged clotting in Liberia is fresh blood from a donor relative or friend. If available, fresh frozen plasma and/or other clotting factors such as platelets can also be lifesaving.

C. Preventing hypothermia Keep the patient warm but do not overheat them, as this will cause peripheral vasodilatation and reduce the blood supply to vital organs. Hypothermia is especially likely if a lot of blood has been transfused after being kept in a refrigerator. Hypothermia will exacerbate poor peripheral perfusion, acidosis and coagulation abnormalities.

D. Tranexamic acid

If there is continuing bleeding, this inexpensive and safe drug can be helpful. Recent evidence has shown that tranexamic acid can reduce mortality from major haemorrhage in major trauma in adults. The drug should be started as soon as possible, and within the first 3 hours after the onset of major haemorrhage, in order to be effective.

The loading dose is 1 gram over 10 minutes followed by an IV infusion of a further 1 gram over 8 hours. This slow IV bolus dose is given by injecting 1 gram of tranexamic acid into a 100-mL bag of 0.9% saline and letting it run through over a period of about 10–20 minutes (the exact timing is not crucial).

The 8-hour infusion is given by injecting 1 gram of tranexamic acid into a 500-mL bag of 0.9% saline and giving it over a period of 8 hours (i.e. approximately 60 mL/hour). If there is a gap between the initial bolus and the subsequent infusion this probably does not matter too much, but ideally one should follow the other.

E. The non-pneumatic anti-shock garment (NASG)

This compression garment is made from neoprene, a stretchable material that recoils and applies pressure through the skin. It feels like a tight diving wet-suit to wear and consists of five segments that compress the legs (segments 1, 2 and 3), the pelvis (segment 4) and the abdomen (segment 5) (*see* Figures A+11.10 and A+11.11). The abdominal segment includes a foam compression ball that presses on the area of the uterus. The segments are held in place by Velcro.

Preliminary pre- and post-intervention trials have shown that the NASG significantly reduces shock, blood loss, the need for emergency hysterectomy, and maternal mortality and severe morbidity associated with PPH and other causes of obstetric haemorrhage.

Figure A+11.10 *NASG garment before it is placed on the patient.* Reproduced with permission from Miller S, Martin HB, Morris JL. Anti-shock garment in postpartum haemorrhage. *Best Pract Res Clin Obstet Gynaecol.* 2008; **22**(6): 1057–74. © Elsevier

However, MCAI advises that elevation of the legs should first be undertaken. Then MCAI advises that, only if there are sufficient helpers available, consider placing

the leg segments (1,2, and 3) only of an anti-shock garment to gain time whilst awaiting blood transfusion. **Do not apply the pelvic or abdominal segments (4 and 5) of the garment and do not stop other vital activities to arrest the bleeding whilst placing the leg segments of the garment in place.**

The NASG reduces shock by compressing blood vessels in the lower parts of the body, thereby diverting up to 30% of total blood volume to the heart, lungs, brain and possibly the kidneys. There is evidence that, through the applied pressures of 25–50 mmHg, it decreases blood flow in the pelvis and, in PPH, blood loss from the atonic uterus.

It is particularly promising in settings where there can be delays in transfer to facilities where comprehensive emergency obstetric care is available and blood transfusion and surgery can be undertaken. In such settings, even in hospitals, blood transfusion is frequently delayed for between 1 and 3 hours, with O-negative blood rarely available and supplies of stored blood precarious. The NASG, by stabilising the patient, gives time for blood transfusion to become available and other treatments to be given, as well as very probably reducing the amount of blood that subsequently needs to be transfused.

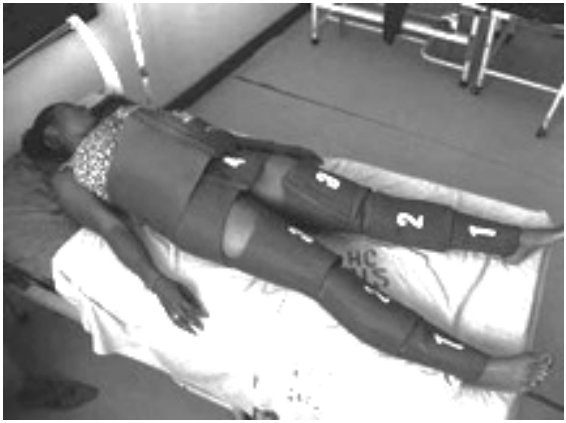


Figure A+11.11 *NASG garment on a patient.* Reproduced with permission from Miller S, Martin HB, Morris JL. Anti-shock garment in postpartum haemorrhage. *Best Pract Res Clin Obstet Gynaecol.* 2008; **22**(6): 1057–74. © Elsevier

As reported by the International Federation of Gynecology and Obstetrics (FIGO), *'The NASG is not a definitive treatment – the woman will still need to have the source of bleeding found and definitive therapy performed.'*

The following paragraphs describe the standard approach to applying and using the anti-shock garment. However, as indicated above, and in other parts of this handbook, MCAI remains uncertain about the appropriateness of placing the pelvic and abdominal segments (4 and 5).

Standard international approach to its use in PPH

The NASG is applied in sequence from the lower legs up to the abdominal compression segment (segment 5). With experience it can be applied by one person in 2 minutes, although it takes from 5 to 10 minutes if the healthcare worker is alone and unused to applying it. Help from others present, such as porters or relatives, can be valuable. **In PPH due to uterine atony, it is particularly important that someone is massaging the uterus and giving the other treatments outlined above whilst the NASG is being applied.** After the garment is in place the legs do not need to be elevated and the uterus can still be externally massaged by placing one hand underneath the pelvic segment of the NASG. Vaginal examinations and repair of cervical or vaginal tears can be performed while the NASG is in place. The pelvic and abdominal segments can be opened for surgery such as emergency hysterectomy or B-Lynch sutures.

The NASG can be applied in addition to all the other measures for PPH described above when signs of shock first appear. The only contraindication to its use is known heart disease. The aim with all treatments is for a pulse rate of < 100–110 beat/minute and a systolic blood pressure that is > 90–100 mmHg and stable in a woman who is fully alert and has a urine output of > 30 mL/hour.

The NASG is removed segment by segment when bleeding has been reduced to safe levels and the patient's cardiovascular stability has been maintained for at least 2 hours (systolic blood pressure > 90–100 mmHg, heart rate < 100–110 beats/minute and haemoglobin concentration of > 7 g/dL). Removal begins at the ankles with 15-minute gaps between each segment that is opened, and clinical measurements being made before each segment is removed. If the systolic blood pressure drops by > 20 mmHg and/or the heart rate increases by > 20 beats/ minute, reapply that segment of the NASG and consider additional treatments such as further blood transfusion.

Between patients, the NASG can be laundered in the same way as for bloodstained sheets. First soak the garment in 0.5% chloride solution for 15 minutes. Then wash and scrub it with a soft brush in soapy water. Finally rinse it in

clean water and leave it to air-dry. Fold and store the garment when it is completely dry.

Each NASG can be used 50–100 times, and at present costs US$150–200 plus extremely high freight costs.

F. Stopping bleeding due to retained placenta or retained products of conception

Always examine the placenta and ensure that it is complete.

Management of retained placenta

https://www.youtube.com/watch?time_continue=96&v=4iHSXADzc98&feature=emb_title

A retained placenta is defined as occurring:

1. after active management of the third stage of labour (*see* Section A3), if the placenta is not delivered within 30 minutes of the birth
2. after expectant management of the third stage of labour, if the placenta is not delivered within 60 minutes of the birth.

Risk factors include a full bladder, a previous retained placenta, high parity, uterine fibroids, a history of previous uterine surgery and placenta praevia. The placenta may become trapped in the cervix or lower uterus. There may be no bleeding with a retained placenta, especially if there is abnormal adherence (placenta accreta).

A retained placenta occurs in around 2% of deliveries.

Management

If there is a clinically significant PPH, the placenta must be removed urgently. Call for help (including an anaesthetist and an obstetrician), insert a venous cannula, take blood for haemoglobin and cross-matching as for PPH, and ensure that the operating theatre is ready.

Massage the uterus, and if there is atony it should be managed as described for PPH above. However, although oxytocin should be used as necessary, **do not give ergometrine because it causes tonic uterine contraction which may delay expulsion**.

Cause 1: The placenta is separated but trapped in the lower part of the uterus or cervix

If the placenta is undelivered after 30 minutes of oxytocin stimulation, and the uterus is contracted and the placenta separated (usually indicated by the gushing of blood and rising of the uterus into the abdomen as a firm, more movable structure as

with a normal placental separation and delivery), attempt controlled cord traction. During this procedure, and at all times, keep one hand on the abdomen to support the uterus and prevent its inversion.
Avoid forceful cord traction and fundal pressure, as they may cause uterine inversion.
This situation usually responds to firm and persistent traction on the cord with the other hand countering this on the uterus to prevent inversion. Ensure that the bladder is empty. Ask the mother to empty her bladder, otherwise catheterise the bladder if necessary. If you can see the placenta, ask the mother to push it out; an upright position may help. Undertake a sterile vaginal examination and if you can feel the placenta in the vagina or cervix, remove it.
If the cord has broken from the placenta, it is still possible for the placenta to be pushed out by the mother.

Cause 2: The placenta has failed to separate from the uterus
If controlled cord traction plus uterotonic drugs are unsuccessful, manual removal of the placenta is likely to be required (see below).

Cause 3: The placenta is morbidly attached to the uterus (see Section A+10)
Very adherent tissue may be placenta accreta, a situation that is more likely to occur after a previous Caesarean section. Efforts to extract a placenta that does not separate easily may result in heavy bleeding or uterine perforation, which usually requires hysterectomy.
Therefore, if there is any suspicion of a morbidly adherent placenta the patient should ideally be referred to a hospital with operating facilities and a surgical team (if available).
Where there is significant haemorrhage, balloon tamponade/condom catheter can halt the bleeding and eventually allow residual placenta to disintegrate and resorb/expel on its own. Hysterectomy will be needed if bleeding cannot be stopped by the measures described above.

If bleeding continues, assess clotting status using a bedside clotting test. Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down easily, suggests coagulopathy.

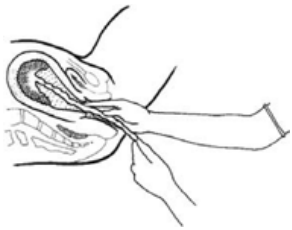
If there are signs of infection (fever with foul-smelling vaginal discharge), give antibiotics as for endometritis.

Manual removal of the placenta

This is a painful procedure associated with a high risk of infection unless it is undertaken using full sterile procedures. In many low-resource settings, manual removal of the placenta is undertaken without analgesia or anaesthesia, and often not even in the operating theatre.

Unless it is performed as an emergency for major PPH, we consider that manual removal of the placenta should be undertaken in an operating theatre with preceding morphine or ketamine in the presence of an anaesthetist. Elbow-length sterile gloves should be used. Provided that active PPH is not occurring, the mother should first be adequately resuscitated with IV fluids/blood and oxygen. The pulse rate, blood pressure, oxygen saturation and urine output should be closely monitored. Ideally, facilities for blood transfusion and, if necessary, emergency hysterectomy should be available.

After the placenta has been removed, massage the uterus to encourage tonic uterine contraction. An IV infusion of oxytocin 40 units in 500 mL of Ringer-lactate/ Hartmann's solution or 0.9% saline should be administered over 4 hours to ensure continued uterine contraction.



Details of management

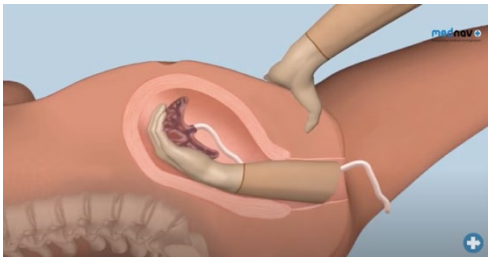
If the placenta does not separate within 1 hour of delivery, or immediately if there is heavy bleeding:

1) Ensure an IV infusion is in place
2) Ensure that the bladder is emptied either by the mother or by catheterisation
3) Only if an anaesthetist is present give a slow IV injection of ketamine (1–2 mg/kg or 50–100 mg) or morphine (10 mg)
4) Give a single dose of prophylactic antibiotics just before manual removal:
    a. ampicillin 2 grams IV *plus* metronidazole 500 mg IV
    b. *or* ceftriaxone 1 gram IV *plus* metronidazole 500 mg IV.
5) Ensure full aseptic drapes.
6) Hold the umbilical cord with a clamp. Pull the cord gently until it is taut.
7) **Step 1** Wearing long above-elbow sterile gynaecological gloves insert a hand into the vagina and follow the cord up into the uterus until you reach the edge of the placenta (*see* Figure A+11 12). If the cervix is closed, gentle pressure with one or two fingers will usually relax it and make it open.

Figure A+11.12 *Introducing one hand into the vagina along the cord.*

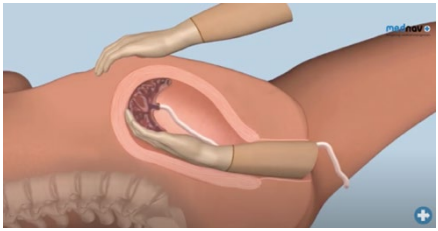
8) **Step 2** Move the fingers of the hand laterally until the edge of the placenta is located. Reach the implantation site by keeping the fingers tightly together and using the edge of the hand to gradually make a space between the placenta and the uterine wall (Figure A+13. 13). Proceed slowly all around the placental bed until the whole placenta is detached from the uterine wall. If the placenta does not separate from the uterine surface by gentle lateral movement of the fingertips at the line of cleavage, suspect placenta accreta. Consider laparotomy and possible subtotal hysterectomy (see Section E11).

FIGURE A+.13 *Supporting the fundus while detaching the placenta. Reach the placenta from the implantation site by keeping the fingers tightly together and using the edge of the hand to gradually make a space between the placenta and the uterine wall*



9) **Step 3** Let go of the cord with the other hand and move the hand up over the abdomen in order to support the uterus (*see* Figure A+11 14). Withdraw the hand plus the placenta from the uterus with the other hand providing counter-traction on the uterus to prevent uterine inversion. Hold the placenta and slowly withdraw the hand from the uterus, bringing the placenta with it. If uterine inversion occurs, reposition the uterus immediately.

Figure A+11 14 Supporting the fundus while removing the placenta.



10) Palpate the inside of the uterine cavity to ensure that all placental tissue has been removed.

11) After the placenta has been removed, massage the uterus to encourage tonic uterine contraction. An IV infusion of oxytocin 40 units in 500 mL of Ringer-lactate/ Hartmann's solution or 0.9% saline should be administered over 4 hours to ensure a contracted uterus.

Problems

If the placenta is retained due to a constriction ring or if hours or days have passed since delivery, it may not be possible to get the entire hand into the uterus. Consider using a general anaesthetic to help to relax the cervix and extract the placenta in fragments using two fingers or ovum forceps but be very careful not to penetrate the soft uterine wall.

If hours or days have passed and/or signs of sepsis are present, treat for puerperal sepsis with a full course of IV antibiotics (see Section A+14) and ensure patient is stable before removing the placenta.

Post-procedure care

1) Observe the mother closely until the effect of IV analgesia has worn off.
2) Monitor the vital signs (pulse, blood pressure, respiration and temperature) every 15 minutes for the first hour and then every 30 minutes for the next 6 hours or until the patient is stable.
3) Palpate the uterine fundus to ensure that the uterus remains contracted.
4) Check for excessive lochia.
5) Continue infusion of IV fluids.
6) Transfuse as necessary, especially if the mother is severely anaemic before the procedure.
7) Warn the mother of the increased risk of retained placenta occurring at the time of the next pregnancy, and therefore advise her to deliver in a well-equipped comprehensive EmOC facility.

Treatment of PPH that continues despite all of the above interventions

Reassess the patient and determine whether bleeding is continuing and whether there is a clotting disorder. Assess the clotting status using a bedside clotting test. Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down easily, suggests coagulopathy.

Re-examine the patient and ensure that the oxytocin IV infusion is running correctly (40 units of oxytocin in 500 mL of Ringer-lactate or Hartmann's solution over 4 hours).

Exclude the following:

- inverted uterus
- retained products of conception
- damage to the genital tract: check for bleeding from the cervix, vaginal walls and perineum.

If the above measures fail to control PPH, do not wait too long.

The following operative interventions are available:

- B-Lynch sutures (Section E12)
- Emergency hysterectomy (Section E11), which may be lifesaving, and should be considered early in order to reduce the risk of life- threatening coagulopathy.

Check the haemoglobin levels or haematocrit after resuscitation and when the patient is stable. Consider administering oral iron if the patient is anaemic.

Health service risk factors which place mothers at high risk of death from PPH

1. Delays in manual removal of placenta in cases of retained placenta
2. Delays in starting appropriate resuscitative measures due to a variety of factors, including lack of resources
3. Poor technique at CS or during operative vaginal deliveries
4. Underestimation of blood loss and delay in calling for help or in referring the woman
5. Unavailability of oxytocic drugs
6. Insufficient well-trained staff
7. Lack of effective protocols
8. Restrictive barriers to midwives, and other non-medical staff, carrying out emergency life-saving procedures.

Community risk factors for maternal death from PPH

1. Traditional beliefs about the third stage of labour
2. Lack of awareness about the seriousness of excessive bleeding
3. Great distance from a woman's home to a health facility
4. Transport problems
5. Low socioeconomic status
6. Lack of education
7. Lack of trust in formal health services (potentially avoidable).
8. Lack of awareness that all previous C/S and scars on uterus should be delivered in a facility that can provide emergency surgery

2. Emergency management of secondary PPH: >24 hours of delivery

This is particularly dangerous in low-resource settings. Severe and life-threatening anaemia can develop rapidly, and frequently the woman is admitted in shock and urgently requiring blood transfusion. Severe life-threatening septic shock can also develop.

Assess vital signs and temperature, and if the patient is shocked call for help and proceed as described above for massive PPH. If there is shock present, undertake CABC (Control bleeding ABC) and consider tranexamic acid and fresh blood transfusion (identify donors urgently).

Assess the uterine size and whether or not it is correct for the number of days postpartum. Perform a speculum and vaginal examination and note the degree of bleeding, whether the blood is offensive, whether the cervix is still open, and whether there is cervical and uterine tenderness.

Ultrasound scan (USS) is very important early on and and can identify if there are retained products.

Insert an IV line and take blood for haemoglobin, blood cultures, cross-matching and whole blood clotting time (as DIC may occur). Try and identify donors for fresh blood.

If placental tissue is seen on USS or if the uterus feels soft give an IV bolus of oxytocin 5 IU followed by an infusion of 40 IU in 500mls of 0.9% saline or RL over 4 hrs. Sometimes this will expel the placental tissue. If the patient passes tissue , rescan to make sure nothing is left in the uterus. Remember that both retained tissue and endometritis can both be present.

Urgently start 7 days of treatment with IV antibiotics, as the bleeding is often secondary to infection. This is especially likely if there is foul-smelling lochia, a fever, or prolonged rupture of membranes prior to delivery.
Give IV ampicillin 2 grams IV every 6 hours

- plus gentamicin 80 mg IV or IM every 8 hours or 5 mg/ kg body weight IV/IM once every 24 hours
- plus metronidazole 500 mg IV every 8 hours.

Alternatively, give ceftriaxone 2 grams IV or IM once daily plus metronidazole 500 mg IV every 8 hours.

Provide blood transfusion (ideally fresh live donor blood) if the haemoglobin level is < 5 g/dL, or if it is < 7.5 g/dL with symptoms suggesting early cardiac failure or shock or if there is brisk ongoing blood loss.

Only when the patient is stable, and if retained placental tissue is present in the uterus on USS, and provided the cervix is open, examine carefully digitally inside the uterus with sterile elbow length gloves and remove placenta fragments if present.

If cervix is closed so that digital exploration is not possible and ultrasound shows retained products, in the operating theatre with anaesthetist support, and after 10 units oxytocin IM to make uterus contract and reduce risk of perforation, carefully dilate the cervix and use an MVA catheter or blunt curette to remove products but be aware of risk of uterine perforation. Ask an assistant to put the ultrasound scanner on the lower abdomen so that you can visualise exactly where the MVA cannula is in relation to the fundus and walls of the uterus.

Placental tissue that sticks to the uterus may be placenta accreta, which may result in heavy bleeding (see Section A+10 for management).

Laparotomy is occasionally needed to deal with continued bleeding from an infected or ruptured uterine incision or infected placental bed or placenta accreta.

Further reading

1. A Textbook of Postpartum Hemorrhage: a comprehensive guide to evaluation, management and surgical intervention. www.sapienspublishing.com/pph_pdf/PPH.pdf
2. Videos on techniques used to treat PPH: www.glowm.com FIGO Safe Motherhood and Newborn Health (SMNH)
3. Committee (2012) FIGO Guidelines: prevention and treatment of postpartum hemorrhage in low-resource settings. www.figo.org/files/figo-corp/IJGO_2012%20PPH%20 Guidelines.pdf
4. World Health Organization (2012) WHO recommendations for the prevention and treatment of postpartum haemorrhage. http://apps.who.int/iris/bitstream/10665/75411/ 1/9789241548502_eng.pdf

Section A+12 Management of PPH due to trauma to the cervix

If the bleeding continues despite all of the measures described above, examine the perineum, vagina and cervix with a sterile speculum. Postpartum bleeding with a contracted uterus is usually due to a cervical or vaginal tear. Trauma to the lower genital tract is the second most frequent cause of PPH and may coexist with an atonic uterus.

Bleeding from trauma can be substantial and may be fatal, especially if there is pre-existing severe anaemia. Suture packs, a torch, a Sims' speculum and sutures must always be immediately available on the PPH emergency trolley.

Initially stop the bleeding with sterile packing until a surgeon is able to repair the wounds.

It is essential to ensure that the uterus is contracted even when a traumatic cause is present.

Always use a good light and the MCAI kit for cervical tear repair.

Ensure good quality local anaesthesia with 1% Lidocaine.

Prevention and management of cervical tear(s)

Causes of cervical tears

The main cause is vaginal delivery through a cervix that is not fully dilated when a mother begins pushing or is asked to push.

Other causes include:

1. Wrong application of forceps or a vacuum cup by an inexperienced operator
2. Use of the vacuum cup or forceps when the cervix is not fully dilated
3. Dangerous application of fundal pressure during labour (mostly undertaken at home or in clinics by untrained staff)
4. Lack of pain control during labour and an urge to push by some mothers to push out her baby as quickly as possible, even when the cervix is not fully dilated.

Background

- Bleeding from cervical tears can be life threatening.
- Arterial bleeding may occur.
- A special sterile set containing vaginal retractors and long instruments should be available in every maternity ward for exploration and treatment of deep cervical and vaginal tears.

- **Do not forget to ensure that an atonic uterus is managed if present as this may occur in addition to a cervical tear. Constantly review the state of uterine contraction.**

Diagnosis
Suspect a tear in cases of postpartum haemorrhage where there is good uterine contraction and uterine rupture has been ruled out.

The source of the bleeding is discovered during inspection of the birth canal, with careful examination of the vagina and cervix using two vaginal retractors.

A bucket-handle tear is a laceration of either the anterior lip or the posterior lip of the cervix so that it hangs like the handle of a bucket. These cervical injuries are more common in term deliveries and are associated with cervical cerclage, induction of labour, young maternal age, assisted vaginal delivery, prostaglandin use and precipitate labour.

Management
If the mother is bleeding heavily from a cervical tear, call for help, including nurse anaesthetist and it may be best initially to manually pack the tear with sterile gauze whilst resuscitating with blood transfusion. Then repair when the mother is stable and most of the bleeding has stopped, **unless there is heavy ongoing blood loss despite compression, in which case repair needs to be undertaken urgently while resuscitation continues.**

Apply antiseptic solution (10% polyvidone iodine or chlorhexidine) to the vagina and cervix.

Local anaesthesia with 1% Lidocaine may be required. For tears that are high and extensive, obtain urgent nurse anaesthetist support to consider Ketamine or opiate analgesia.

Insert an IV line (16-18G catheter), group and cross match blood for transfusion (ideally fresh blood) and administer 500ml to 1 litre Ringer lactate or 0.9% sodium chloride.

An assistant is usually needed to identify the tissues by holding retractors. Good lighting is essential.

Repair

1. Gently grasp the cervix with ring or sponge forceps. Apply the forceps on both sides of the tear and gently pull in various directions to see the entire cervix. There may be several tears.

2. Close the cervical tears with continuous 0 or 2-0 absorbable chromic catgut (or polyglycolic) suture starting at the apex (upper edge of tear), which is often the source of bleeding. Sometimes, the cervical tear bleeds heavily and requires a 2-0 absorbable Figure-of-eight suture in a single layer. Place the initial suture above the apex of laceration to control bleeding from retracted arteries.
3. If a **long section of the rim of the cervix is tattered**, under-run it with continuous 0 or 2/0 chromic catgut (or polyglycolic) suture.
4. If the **apex is difficult to reach and ligate**, WHO advises that it may be possible to grasp it with artery or ring forceps. Leave the forceps in place for 4 hours. Do not persist in attempts to ligate the bleeding points as such attempts may increase the bleeding. Then:
    - After 4 hours, open the forceps partially but do not remove; -
    - After another 4 hours, remove the forceps completely.
5. A laparotomy may be required to repair a cervical tear that has extended above the vaginal vault.
6. Small cervical tears with minimal bleeding should heal spontaneously with no suturing and without complications.
7. Tears in the vaginal walls should also be sutured if bleeding. For multiple vaginal lacerations with friable tissue that tears on suturing, insert a vaginal pack and remove after 24 hours. Insert a Foley catheter while the pack is in place

Section A+13 Management of severe pre-eclampsia and eclampsia

Introduction

- Have an eclampsia box containing essential drugs and equipment available at all times.
- Any patient with a headache or episode of visual disturbance in the second half of pregnancy should immediately have their BP measured and urine tested for protein.
- Eclampsia can occur even when the BP is normal.
- Around 40% of eclampsia occurs after delivery, especially within the first 24 hours after birth.
- Magnesium sulphate is essential for preventing eclampsia and if it occurs for preventing further fits
- A period of coma is unusual after an eclamptic fit, look for other causes such as cerebral haemorrhage.

Hypertension in pregnancy occurs when the systolic blood pressure is ≥ 140 mmHg and/or the diastolic blood pressure is ≥90 mmHg. If the blood pressure is elevated, confirm this by making repeated measurements (see below).

Severe hypertension (systolic pressure ≥160 mmHg and/or diastolic blood pressure ≥110 mmHg) must be treated, because a systolic or diastolic blood pressure at or above these levels is associated with a risk of cerebral haemorrhage, hypertensive encephalopathy and placental abruption.

Measuring blood pressure and looking for hypertension

When you measure the blood pressure of a woman, she should be rested and seated at a 45-degree angle with the machine on the bed beside her. Do not prop it up on her abdomen. Also do not lie her down, as this causes compression of the central veins. Open the cuff out flat, and make sure that you place the centre of the inner bladder on the artery. A falsely high reading will be obtained if the cuff's bladder does not encircle at least 80% of the circumference of the arm.

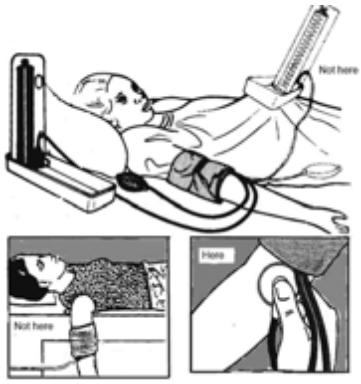


Figure A+13.1 *Measuring blood pressure*

If the blood pressure is consistently higher in one arm, this arm should be used for all subsequent measurements. Some automated blood pressure machines under-measure systolic blood pressure.

The systolic pressure is the onset of the first sound (Korotkov 1). The diastolic pressure is the complete disappearance of sounds (Korotkov 5). The normal systolic blood pressure in pregnancy is in the range 95–135 mmHg. The normal diastolic blood pressure is in the range 60– 85 mmHg. Diastolic blood pressure measures peripheral resistance and does not vary with the woman's emotional state to the same degree that systolic pressure does. The blood pressure normally falls during the second trimester of pregnancy, reaching its lowest value by the end of the second trimester, and returning to pre-pregnancy levels at term.

If the systolic pressure is ≥ 140 mmHg and/or the diastolic blood pressure is ≥ 90 mmHg on two consecutive readings taken > 4 hours apart, hypertension should be diagnosed.

In addition to a blood pressure of ≥ 140/90 mmHg, any increase in systolic pressure of >30 mmHg or in diastolic pressure of > 15 mmHg over recent previous measurements requires close monitoring, even if the pressures do not reach 140 mmHg systolic or 90 mmHg diastolic.

The categories of hypertension in pregnancy
These can be classified as follows.

Pre-eclampsia
This is hypertension (blood pressure of ≥ 140/90 mmHg) that develops after 20 weeks' gestation, always in association with proteinuria ≥ 0.3 grams in a 24-hour specimen). This level correlates with ≥1+ on dipstick testing.
Pre-eclampsia is a multi-system disorder.
Other conditions cause proteinuria, and false-positive results are possible (e.g. due to contamination with normal vaginal discharge or amniotic fluid). Urinary infection may also produce proteinuria, but rarely ≥ 2+ on dipstick testing. Blood in the urine due to catheter trauma, schistosomiasis or contamination with vaginal blood may also give false-positive results.

Random urine sampling, such as the dipstick test for protein, is a useful screening tool. A change from negative to positive during pregnancy is a warning sign. If dipsticks are not available, a sample of urine can be heated to boiling point in a clean test tube. Add a drop of 2% acetic acid to check for persistent precipitates that can be quantified as a percentage of protein in the sample. Only clean-catch midstream specimens should be used. Catheterisation for this purpose is not justified, due to the risk of urinary tract infection.

Eclampsia is fitting associated with the syndrome of pre-eclampsia. Seizures can occur without any previous signs or symptoms. The diagnosis of pre-eclampsia is made when there is hypertension after 20 weeks' gestation associated with significant proteinuria ≥0.3 grams/24 hours) (see above).
It is associated with a risk of developing one or more of the following:

- significant proteinuria (≥0.3 grams/24 hours) (see above)
- renal involvement (serum/plasma creatinine > 90 micromol/litre with or without oliguria-a low urinary output)
- haematological involvement (low platelet count, haemolysis, DIC)
- liver involvement (raised transaminases, epigastric or right upper quadrant abdominal pain)
- neurological involvement (headache, persistent visual disturbances including photophobia, scotomata, blindness and retinal vasospasm, hyperreflexia with sustained clonus, stroke)
- pulmonary oedema
- intrauterine growth retardation
- placental abruption.

HELLP is a syndrome that consists of Haemolysis, Elevated Liver enzymes and Low Platelets. It may complicate pre-eclampsia, sometimes with only mild or borderline hypertension and marginally abnormal proteinuria.

Pre-eclampsia and eclampsia are still one of the main causes of maternal mortality and morbidity in low-resource countries. In one study it was reported that 38% of eclamptic fits occur antenatally, 18% occur in the intrapartum period, and the remaining 44% occur postpartum, usually in the first 48 hours after delivery. Sometimes the first fit occurs postnatally.

Oedema occurs with the same frequency in women with and without pre-eclampsia. However, if oedema develops suddenly and is widespread, always screen for pre-eclampsia. Test for oedema by pressing with your finger for 1 minute over the bony part of the mother's tibia. If there is a dent when you take your finger away, oedema is present. If the mother has been lying down, look for oedema over the sacrum. Oedema can also make a finger ring tight. Oedema of the face is more likely to represent a sign accompanying pre-eclampsia.

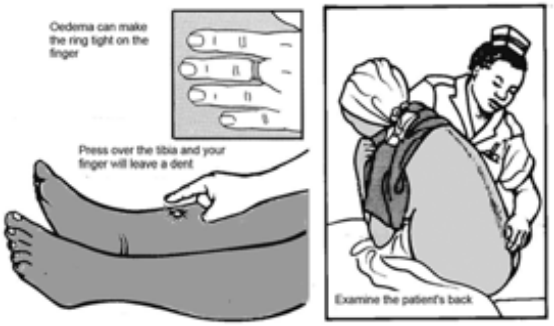


Figure A+13.2 *Testing for oedema of the ankles and lower back.*

Gestational hypertension

This is hypertension that develops only after 20 weeks' gestation but with no other features of pre-eclampsia, and which resolves within 3 months after birth. Patients who present early in pregnancy (after 20 weeks) and with severe hypertension are more likely to develop pre-eclampsia.

Chronic hypertension

1 Essential hypertension (also called primary hypertension) occurs before 20 weeks' gestation, without cause (see below).
2 Hypertension may also be secondary to other medical conditions such as chronic renal disease, endocrine disorders or diabetes mellitus.

It is important to control the hypertension in these cases, keeping the blood pressure below 150/100 mmHg, but not permitting the diastolic pressure to go below 80 mmHg.

Pre-eclampsia in a woman with chronic hypertension and gestational hypertension

Women with hypertension in pregnancy are at increased risk of developing superimposed pre-eclampsia and should be monitored more frequently for the presence of proteinuria and systemic features of pre-eclampsia from 20 weeks' gestation onwards but especially in the third trimester.

Pre-eclampsia

Risk factors

These include the following:

- first pregnancy
- multiple pregnancy
- family history of pre-eclampsia
- chronic hypertension (see above)
- renal disease

- hypertension/pre-eclampsia during a previous pregnancy
- diabetes mellitus
- molar pregnancy.

For those at high risk of recurrence, a systematic review of 59 trials involving 37,560 women found that low doses of aspirin reduced the risk of pre-eclampsia by about a sixth (17%), with a similar lowering of the risk of the baby dying (14%), and a small lowering of the risk of the baby being born too early (8%). Doses up to 75 mg appear to be safe and high-risk women are advised to start taking it from 12 weeks' gestation and to continue until 36 weeks' gestation. There is no evidence that starting aspirin in the third trimester in a patient who has pre-eclampsia has any benefit and close to delivery may increase the risk of bleeding.

Investigations

These include the following:

- urine dipstick test for protein and microscopy or stick tests for bacteria and white blood cells to exclude infection
- haemoglobin levels and platelet count
- urea and electrolytes, and creatinine
- liver function tests
- lactate dehydrogenase (LDH) and uric acid (id available)
- fetal growth assessment by ultrasound scan.

If there are signs of DIC, clotting studies should be undertaken (whole blood clotting time in low-resource settings; see below.

If there is severe hypertension in early pregnancy, investigations (if available) for the rarer causes such as molar pregnancy, autoimmune disorders, pheochromocytoma, etc. may be indicated.

Management of pre-eclampsia and gestational hypertension

Pre-eclampsia progresses during pregnancy, and the only definitive treatment is delivery. If the patient is at term (i.e. after 36 weeks' gestation) then, after stabilisation of the mother, the baby should be delivered as soon as possible. There is no evidence that bed rest improves the outcome for the mother or the fetus. Heavy physical labour is clearly inappropriate. However, women in low-income settings are commonly seen working in this way despite being in advanced pregnancy.

Women with mild pre-eclampsia can be cared for without hospital admission, but there needs to be regular (at least weekly) checks on blood pressure and urine, and

the family must be made aware of the warning signs of severe pre-eclampsia or eclampsia (see below).

If there is severe pre-eclampsia or eclampsia, if the blood pressure cannot be adequately controlled, or if there is pulmonary oedema, deteriorating renal or liver function, placental abruption or evidence of falling platelet counts or DIC, delivery is urgent but must always take place after stabilisation.

Stabilisation involves correction of severe hypertension, control of fluid intake, monitoring of urine output, correction of blood-clotting disorders (in low-resource settings with fresh blood transfusion), and prevention or control of eclampsia (see below).

Antihypertensive drugs for pre-eclampsia
Mild pre-eclampsia does not require antihypertensive drugs.

If the systolic blood pressure is 150–160 mmHg and/ or the diastolic blood pressure is 95–105 mmHg, treatment with oral antihypertensive drugs should be started.

Systolic pressure of ≥ 160 mmHg and/or diastolic pressure of ≥110 mmHg must be urgently treated with antihypertensive drugs. **However, it is essential that the blood pressure is not lowered too rapidly, as this can seriously affect the woman's brain circulation and the circulation to the placenta and fetus.** Aim for a systolic blood pressure of 150 mmHg.

Oral antihypertensive drug treatment

Methyldopa
This drug acts directly on the central nervous system and takes 24 hours to work. The dose is 250 mg three times a day initially, increasing every 2 days up to 750 mg three times a day. Side effects include dry mouth, postural hypotension, sedation and **depression**. Methyldopa is contraindicated in patients with depression or liver disease. The simultaneous administration of oral iron and oral methyldopa can lead to a drug interaction that can result in clinically significant increases in blood pressure (> 15 mmHg increase in systolic pressure and > 10 mmHg increase in diastolic pressure). **Depression is a very serious potential complication and every woman taking methyl dopa needs close monitoring for this complication.**

Labetalol
This is a beta-blocker with mild alpha-blocking effects. The dose is 100–400 mg three times a day. Side effects include bradycardia, bronchospasm, weakness, scalp tingling (only for 24–48 hours), nausea and headache. Labetalol is contraindicated in patients with asthma.

Hydralazine
This is a vasodilator; that is it relaxes the muscle in the walls of blood vessels. The dose is initially 25 mg twice a day, increasing gradually to 50 mg three times a day. Side effects include uncontrolled hypotension, flushing, tachycardia, palpitations, headache and (uncommonly) a lupus syndrome.

Treatment of severe hypertension
It is vital that severe hypertension is controlled at any gestation, both before and after delivery.

Antihypertensive drugs should be given urgently to all patients with a systolic blood pressure of ≥ 160 mmHg and/ or a diastolic blood pressure of ≥ 110 mmHg. Without urgent treatment, there is a risk of cerebral haemorrhage, eclampsia and pulmonary oedema.

The aim should be a gradual and sustained reduction in blood pressure with one or more of the drugs described below.

Blood pressure should not be allowed to fall below 140/80 mmHg before delivery.

Hydralazine
This is the most widely available antihypertensive drug in low-resource settings. Give 5 mg IV slowly over a period of 5 minutes. (It acts within 5 minutes). Repeat the BP after every 15 minutes and treat with further doses of 5 mg until the diastolic blood pressure is 90–100 mmHg and the systolic BP is 140–160. Repeat the hydralazine hourly as needed or give hydralazine 12.5 mg IM every 2 hours as needed.

Alternatively, give hydralazine IV infusion, 20 mg in 200 mL of 5% dextrose at 0.5 mL (10 drops) per minute (20 drops = 1 mL for a standard giving set), and stop the drip when the diastolic blood pressure is 90 mmHg or below. Hydralazine may cause an increase in the maternal heart rate.

Side effects include uncontrolled hypotension, flushing, tachycardia, palpitations, headache and (uncommonly) a lupus syndrome.

Labetalol
Intravenous labetalol is preferable to hydralazine if the maternal pulse rate exceeds 120 beats/minute.

The labetalol dosage is 10 mg IV. If the response is inadequate (i.e. if diastolic blood pressure remains above 110 mmHg) after 10 minutes, give a further dose of labetalol 20 mg IV. Increase the dose to 40 mg and then 80 mg if a satisfactory response is not obtained after 10 minutes of each dose.

Alternatively, use an IV infusion of 200 mg in 200 mL of Ringer-lactate solution at 40 mg/hour, increasing the dose at 30-minute intervals as required to a maximum of 160 mg/hour.

Side effects include bradycardia, bronchospasm, weakness, scalp tingling (only for 24–48 hours), nausea and headache. **Labetalol is contraindicated in patients with asthma, as it may cause severe bronchospasm.**

Nifedipine
The slow release/modified action version of the tablets must always when available be used in this situation.

Nifedipine is a calcium antagonist that can be administered as an initial 10 mg oral dose (onset of action within 10–20 minutes), with a repeat dose of 10 mg if there is an inadequate response after 30 minutes. Subsequent oral doses are 20 mg twice a day. Side effects include severe headaches associated with flushing and tachycardia. Oedema, weakness and constipation may also occur. Nifedipine is contraindicated in patients with aortic valve stenosis. It may inhibit labour.

Give prophylactic magnesium sulphate if hypertension is accompanied by proteinuria and/or if protein testing is not available and there are symptoms which suggest that eclampsia may occur (see below).

Eclampsia and severe pre-eclampsia
Although pre-eclampsia and eclampsia are most common in the primigravida, they can occur in multiparous patients.

Symptoms and signs of impending eclampsia and diagnostic of severe pre-eclampsia
These include the following:

- headache, visual disturbances, epigastric pain and vomiting
- rapidly developing generalised (especially facial) oedema
- pulmonary oedema
- right upper quadrant tenderness
- recently developed hypertension ≥ 160/110 mmHg with proteinuria > 1 gram/24 hours, or a rapid rise in blood pressure

- ankle clonus and increased tendon reflexes
- HELLP syndrome.

Any woman with headache or epigastric pain occurring in the second half of pregnancy should be investigated for pre-eclampsia. (Measure the blood pressure and test the urine for protein).

Differential diagnosis

In pregnancy a fit/seizure is due to eclampsia unless one of the following is present

- in a patient with known epilepsy (*see* Section B5)
- in severe malaria (*see* Section B8)
- in head injury (*see* Section D1)
- in meningitis/encephalitis (*see* Section B5).
- Intoxication (alcohol overdose)
- Amniotic fluid embolus (*see* Section A+16).

Maintain a high index of suspicion of pre-eclampsia or eclampsia even in those with malaria, migraine or epilepsy, as these conditions may coexist.
A small proportion of mothers with eclampsia have a normal blood pressure. Treat all convulsions as eclampsia until another diagnosis is confirmed.

Convulsions with signs of pre-eclampsia indicate eclampsia.

Convulsions due to eclampsia:

- can occur regardless of the severity of hypertension
- are difficult to predict, but rarely occur without increased tendon reflexes, headache or visual changes
- are tonic–clonic and resemble grand mal convulsions of epilepsy
- may recur frequently, as in status epilepticus, and may be fatal
- will not be observed if the woman is alone
- may be followed by coma that lasts for minutes or hours depending on the frequency of convulsions
- occur after childbirth in about 44% of cases, usually but not always within the first 24 hours after birth. The longer the gap between delivery and a fit, the more likely the diagnosis is to be a condition other than eclampsia (e.g. cerebral venous thrombosis).

The first eclamptic fit is usually self-limiting.

Control of blood pressure is essential in the management of severe pre-eclampsia or eclampsia where high blood pressure may cause a cerebrovascular accident

(stroke). Magnesium sulphate is essential for preventing eclampsia and, if eclampsia occurs, for preventing further fits.

TABLE A+13.1 Differential diagnosis of hypertension and convulsions in pregnancy

Diagnosis	Symptoms	Signs	Results of investigations	Treatment
Essential hypertension	None unless very severe	Blood pressure ≥ 140/90 mmHg before 20 weeks' gestation	Urine for protein negative Renal function tests normal	Consider antihypertensive drugs
Hypertension secondary to other disease such as renal impairment, or autoimmune disease	None unless very severe	Blood pressure ≥ 140/90 mmHg before 20 weeks' gestation	Proteinuria ≥ 2+	Treat hypertension with drugs if severe, and treat the underlying condition
Pregnancy-induced hypertension	None unless very severe	Blood pressure≥140/90 mmHg after 20 weeks' gestation	No proteinuria	Treat hypertension with drugs if severe
Mild to moderate pre-eclampsia	None unless very severe	Blood pressure ≥ 140/90 mmHg AFTER 20 weeks' gestation	Proteinuria ≥ 2+	Avoid work involving heavy labour
Severe pre-eclampsia	Headaches increasing in frequency and unrelieved by paracetamol Visual disturbance Upper abdominal pain Shortness of breath Passing small amounts of urine Oedema	Blood pressure ≥ 140/90 mmHg after 20 weeks' gestation Hyperreflexia Passing less than 400 mL of urine in 24 hours. Pulmonary oedema Facial and rapidly developing oedema	Proteinuria ≥ 2+	Urgent admission to hospital Magnesium sulphate

Diagnosis	Symptoms	Signs	Results of investigations	Treatment
Eclampsia	May be a history of severe pre-eclampsia Generalised convulsions Unconscious	Generalised fitting Coma Blood pressure ≥ 140/90 mmHg after 20 weeks' gestation Facial and rapidly developing oedema	Proteinuria ≥ 2+	ABC Magnesium sulphate
Tetanus	Difficulty opening mouth and swallowing	Spasms of the face, neck and trunk Arched back Board-like abdomen		ABC, Penicillin, anti-tetanus immunoglobulin Muscle relaxants (magnesium and/or diazepam) Nasogastric feeding
Epilepsy	Past history of convulsions	Convulsions Coma Normal blood pressure	EEG abnormal	ABC blood glucose glucose Anticonvulsant drug Blood glucose Phenobarbital
Severe malaria	Chills/rigors Headache Muscle/joint pain	Fever Convulsions Coma Severe anaemia Jaundice	Blood smear for malarial parasites	ABC, blood glucose Antimalarial drugs

Diagnosis	Symptoms	Signs	Results of investigations	Treatment
Meningitis or encephalitis	Headache Stiff neck Photophobia Vomiting	Fever Stiff neck Reduced conscious level or coma Convulsions	Full blood count Blood culture Lumbar puncture (unless there is evidence of raised intracranial pressure)	ABC Antibacterial or antiviral drugs
Migraine	Headache Blurred vision Photophobia History of migraine	Normal blood pressure	No proteinuria	Paracetamol Bed rest in dark room
Cerebral venous thrombosis	Reduced conscious level	Neurological signs indicating a stroke	CT scan if available	Medical opinion

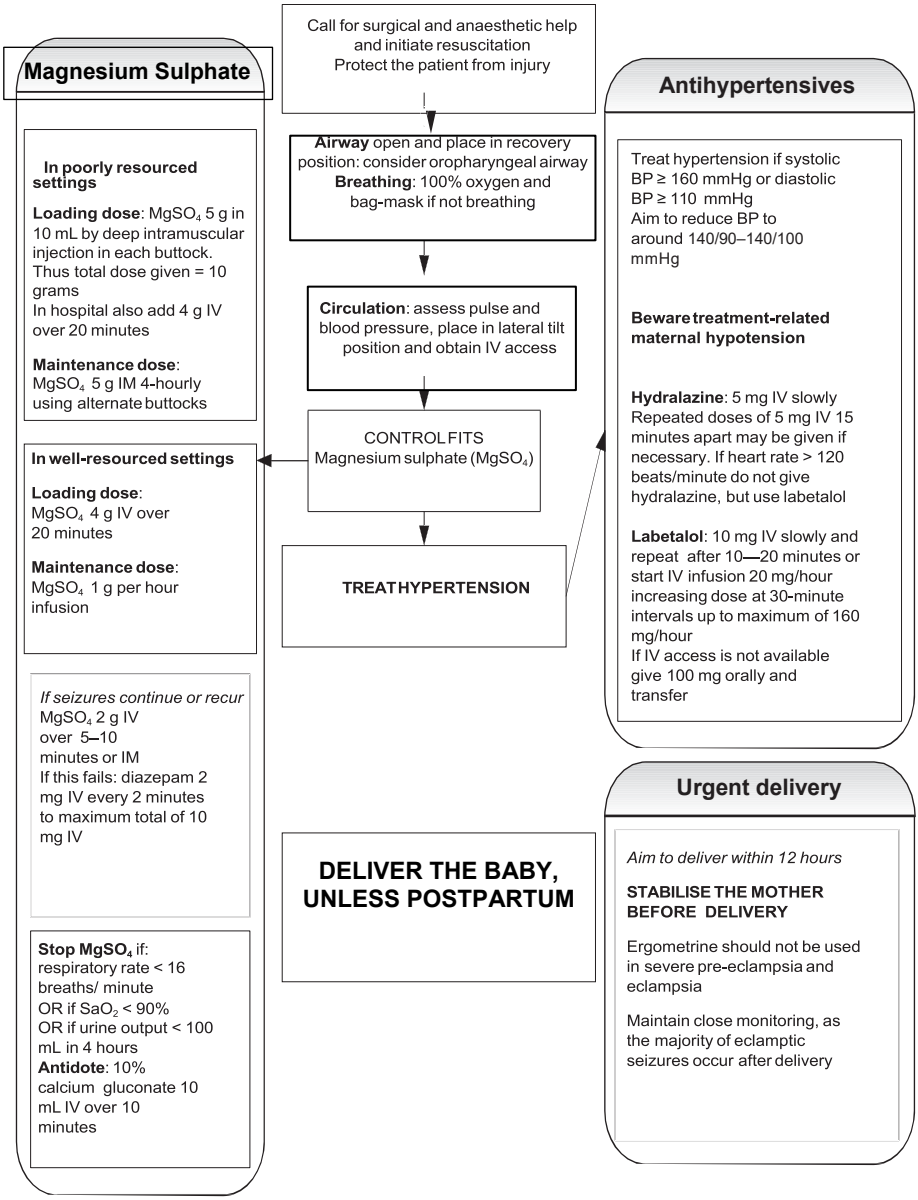


Figure A+13.4 *Pathway of care for eclampsia when the mother is having convulsions.*

Severe pre-pre-eclampsia

This is defined as severe hypertension BP 160/110 mmHg or more **plus** 1 or more plus of proteinuria. Some of the following symptoms and clinical signs occur when severe preeclampsia is present and indicate that eclampsia is about to occur:

1. Headache, visual disturbance
2. Epigastric pain and/or right upper abdominal tenderness over the liver
3. Vomiting
4. Pulmonary oedema (basal lung crepitations)
5. Recently developed severe hypertension, two or more+ of proteinuria, a rapid sudden rise in BP
6. Ankle clonus and increased tendon reflexes
7. Widespread rapidly developing oedema; especially of the face
8. Reduced (<100 ml over 4 hours) or no urine output

Complications of severe pre-eclampsia

These include the following:

- eclampsia
- cerebrovascular accident (stroke)
- renal failure
- HELLP syndrome, possibly leading to rupture of the liver capsule
- pulmonary oedema
- placental abruption, possibly leading to DIC
- intrauterine growth restriction, fetal death.

Management of severe pre-eclampsia

1. Urgently admit the woman to hospital with frequent regular vital signs monitoring
2. Urgently start magnesium sulphate to prevent eclampsia. Give 4-gram (8ml of 50%) magnesium sulphate IV over 15-20 minutes. Then give magnesium sulphate by deep IM injection (dose = 5gram (10ml of 50% solution) into each buttock; that is total dose IM of 10grams). Ensure IM injection is not in a vein. Add 1ml of 1% lidocaine to the total of 20 ml for IM injection never for IV injection.
3. Urgently give anti-hypertensive drugs aiming to gradually reduce and maintain a safe BP (not less than 140/90 mmHg) by using one of the following drugs: Hydralazine IV, Labetalol IV (not if known asthmatic) or Nifedipine tablets. Careful fetal monitoring during the commencement of treatment is vital, as a rapid fall in maternal blood pressure may cause fetal heart rate abnormalities, especially in a growth-restricted or compromised fetus. If hypotension occurs, give a 50 to 100 ml bolus IV of Ringer Lactate/0.9% saline.

4. Give Hydralazine 5 mg IV slowly over a period of 2 to 5 minutes (it acts within 5 minutes). Repeat the BP after every 15 minutes and treat with further doses of 5 mg until the diastolic blood pressure is 90–100 mmHg and the systolic BP is 140–160. Repeat the hydralazine every 30 to 60 minutes as needed. Try not to exceed a total cumulative dose of 20 mg. Side effects include hypotension, flushing, tachycardia, palpitations, headache.
5. When BP is controlled and reduction in dose of an IV antihypertensive drug is started, always reduce dose slowly.
6. A good alternative to hydralazine is IV labetalol. Give 20 mg over 1 minute. Check BP after 10 minutes and if still too high give another 20 mg IV. Administer additional doses of 40 mg then 80mg with 10 minutes between each dose as long as BP is uncontrolled and unsafe. Do not exceed a total cumulative dose of 300mg. **DO NOT USE if patient is known to suffer asthma. If Labetalol is used, monitor newborn for 72 hours after birth as risk of hypoglycaemia, bradycardia and respiratory distress.**
7. **Maintenance doses of magnesium sulphate** are then 5 grams IM 4 hourly (plus 0.5 to 1ml of 1% lidocaine in the same syringe) changing sides of the buttock with each 4-hourly injection.
8. If eclampsia recurs despite magnesium loading or maintenance doses, give further 2 grams (if woman's weight less then70 kg) or 4 grams (if woman's weight more than 70kg) IV slowly over 5 minutes.
9. Once patient is stable, induce labour and deliver the baby as soon as possible (*within 24 hours of diagnosis*). If induction fails and vaginal delivery cannot occur within this time scale, CS may be necessary. The need for delivery is dependent on the maternal and fetal conditions. Either CS or induction of labour may be appropriate depending on the clinical findings. Although delivery will start the process of resolution of the disease, it is inappropriate to deliver an unstable mother, even if there is fetal distress.
10. Insert urinary catheter and monitor urine output
11. Monitor fetal heart rate regularly: ideally immediately following every contraction when in labour.
12. **Never give ergometrine.**
13. If anaesthesia is necessary, inform anaesthetist of pre-eclampsia/eclampsia. Ketamine should be avoided if possible; ideally use spinal anaesthesia.

Management of Eclampsia

If there are no signs of life at any time perform chest compressions 30:2 breaths with bag-valve-mask and oxygen.

Remember to displace the uterus (see APH section A+9).

1. Call for help, including nurse anaesthetist. The majority of fits are self-limiting.
2. If the airway is not open, open it and keep it open. Do not attempt to insert an oropharyngeal airway whilst the patient is convulsing. Instead place **in recovery position** to reduce risk of aspiration if vomiting occurs. As soon as convulsion stops place a suitable sized oropharyngeal airway until consciousness returns. Only place an oropharyngeal airway if you know how to do it and **never if the patient is conscious** because a choking response may cause vomiting. Suction under direct vision if needed.

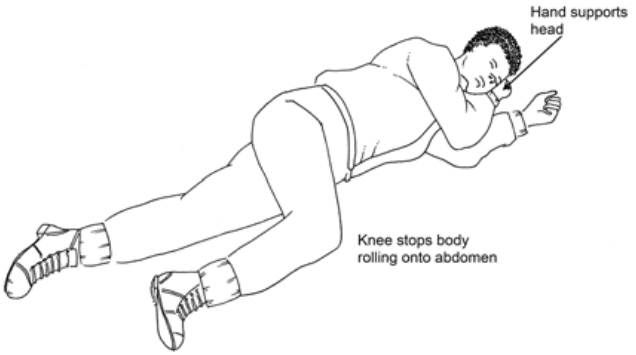


Figure A+13.5 *The recovery position*

3. If spontaneous breathing occurs give high flow oxygen using face mask and reservoir
4. If apnoea is present, provide ventilation with bag-valve-mask-reservoir and 100% oxygen. Apnoea after an eclamptic fit is usually brief.
5. Place in the left lateral tilt or recovery position to optimise cardiac output
6. Insert 14G or 16G IV cannula and take blood for Hb, haematocrit, group and cross match 2-4 units of blood. If possible, also do a whole blood clotting test because of possible clotting abnormality due to low platelets or DIC. Attach a pulse oximeter if one is available.
7. Commence magnesium sulphate or give additional dose if already receiving this drug

   Give 4 g (8ml of 50%) magnesium sulphate IV over 15-20 minutes. *(If the mother is conscious, warn her that there will be a feeling of warmth passing through her body when magnesium sulphate is infused, and that this is not harmful. Failure to do so may result in the mother pulling out her IV cannula, and other potentially dangerous reactions).*

   Then immediately after the IV dose, give magnesium sulphate by deep IM injection (dose = 5g (10ml of 50% solution) into each buttock; that is total dose IM of 10grams). Ensure IM injection is not in a vein. Add 1ml of 1% lidocaine to the total of 20 ml for IM injection.

8. Maintenance doses of magnesium sulphate are then 5 grams IM 4 hourly (plus 0.5 to 1ml of 1% lidocaine in the same syringe) using alternate buttocks.
9. If eclampsia recurs despite magnesium loading or maintenance doses, give 2 grams IV slowly over 5 minutes.
10. Closely monitor BP. If diastolic remains at 110 mmHg or higher or systolic pressure at 160 mmHg or higher there is a risk of cerebral haemorrhage and therefore reduce BP slowly using IV hydralazine or labetalol (as above). Aim for blood pressure of 140/90.
11. Prepare to deliver the baby as soon as mother is stable *within 12 hours of the first fit*. The need for delivery is dependent on the maternal and fetal conditions. Either CS or induction of labour may be appropriate depending on the clinical findings. Although delivery will start the process of resolution of the disease, it is inappropriate to deliver an unstable mother, even if there is fetal distress.
12. Do not give too much IV fluid (see below)
13. Place urinary catheter and monitor output. A fluid balance chart must be carefully kept.
14. Do not leave the mother alone and place cot sides up to prevent her falling out of the bed
15. Vital signs must be regularly undertaken after eclampsia at least every 15 minutes during the first 2 hours after a fit and then every 30 minutes thereafter. Include pulse rate, respiratory rate, BP, urine output (ideally by catheter), SaO_2, ankle reflexes, fetal heart rate.
16. Monitor the FHR regularly, immediately following every uterine contraction when in labour.

Continued treatment with magnesium sulphate

Continue MgSO4 for 24 hours after delivery or after the last convulsion if that occurs after birth, provided that:

- respiratory rate is > 12–16 breaths/minute
- urine output is > 30 mL/hour (WHO Figure is > 100 mL over 4 hours)
- tendon reflexes are present.
- blood pressure is stable and consistently below 150/100 mmHg
- diuresis has started
- there are no neurological symptoms.

Important concerns regarding treatment with magnesium sulphate

1. Magnesium should be given for 24 hours after delivery of the baby or until 24 hours after the last convulsion, if a postpartum fit occurs.
2. If the mother is conscious, it is important that she is warned that there will be a feeling of warmth passing through her body during the IV loading dose.

3. It is essential that you give an additional dose of 2 grams if body weight < 70Kg (4 gram if body weight >70Kg.) of magnesium sulphate if a convulsion occurs despite the fact that a loading dose and maintenance doses have been given.
4. If the respiratory rate of the mother falls below 10 breaths per minute in a woman on maintenance doses of magnesium, withhold the next dose of magnesium until the respiratory rate is above 16 breaths per minute and tendon reflexes are present.
5. When giving magnesium IM, adding 1ml of 1% lignocaine to the syringe reduces pain from the injection but **never add lignocaine to IV injections**.
6. If magnesium sulphate does not control fits, other causes of fitting should be considered. These include a cerebrovascular accident (stroke), malaria and meningitis
7. If magnesium sulphate is not available (a serious mistake) then IV diazepam can be given if an eclamptic fit occurs. However, diazepam is associated with a high risk of apnoea; a bag and mask and oxygen must be immediately available and an anaesthetist present when diazepam is given.
   Loading dose: diazepam 2 mg increments IV every 2 minutes up to 10 mg.If convulsions recur, repeat the loading dose.
   Maintenance dose: diazepam 40 mg in 500 mL of Ringer-lactate or Hartmann's solution, titrated to keep the mother sedated but able to be woken and without hypoventilation.
   Maternal respiratory depression may occur when the dose exceeds 30 mg in 1 hour. Assist ventilation (e.g. bag-valve-mask, anaesthesia apparatus, intubation) if necessary, and do not give more than 100 mg in 24 hours.
   Rectal administration: give diazepam rectally when IV access is not possible. The loading dose is 20 mg in a 10-mL syringe. Remove the needle, lubricate the barrel and insert the syringe into the rectum to half its length. Discharge the contents and leave the syringe in place, holding the buttocks together for 10 minutes to prevent expulsion of the drug. Alternatively, the drug may be instilled in the rectum through a catheter.
   If convulsions are not controlled within 10 minutes, administer an additional rectal dose of 10 mg.
   Be prepared for neonatal resuscitation when diazepam has been administered, especially if it was used in large doses.
8. If eclamptic fits are recurrent and not controlled by magnesium sulphate, consider IV phenobarbital but ensure nurse anaesthetist is present. Give one dose of 10 mg/kg (max. 1 g) administered IV over 20 minutes minimum. If necessary, a second dose of 5 to 10 mg/kg may be administered 15 to 30 minutes after the first dose. Do not administer more than 1 mg/kg/minute.
9. *Notes for anaesthetists*:
   There is an increased sensitivity to muscle relaxants (particularly non-depolarising agents) in patients receiving magnesium sulphate.

In patients with known renal disease or myasthenia gravis, magnesium sulphate is contraindicated and, if available, phenytoin should be used. The loading dose is 15 mg/kg (maximum dose 2 grams) over 20 minutes by slow IV injection. Subsequently a dose of 100 mg orally twice a day can be given. IV injection if given too rapidly can cause severe hypotension, cardiac arrhythmias or respiratory arrest.

Magnesium toxicity

Magnesium given in the doses recommended is generally safe, but the most common causes of toxicity are kidney failure (indicated by low urine output) or giving too much by mistake.

Clinical symptoms and signs associated with magnesium toxicity

1. Neurological such as double vision, confusion, slurred speech, buzzing in the ears, nausea and weakness
2. Loss of tendon reflexes
3. Respiratory depression with respiratory rates < 12-15 breaths/minute
4. SpO_2 reduced < 94%
5. Low urinary output (indicates magnesium not being excreted)
6. Respiratory arrest as the toxicity worsens
7. Cardiac arrest as the toxicity worsens

Management of magnesium toxicity

1. Stop the infusion of magnesium if reflexes absent, respiratory depression <12-15 breaths/minute, SpO_2 < 94% or urine output less than 30 ml/hour over last 4 hours
2. If low respiratory rate or low SpO_2 is present give 100% oxygen and calcium gluconate 1 gram (10ml of 10% solution) IV slowly over 1-2 minutes.
3. If respiratory arrest occurs, provide chest inflations with bag valve mask and reservoir and give calcium gluconate
4. Monitor urine output regularly

The magnesium sulphate infusion may be recommenced at a reduced dose, if this is considered necessary, once normal respiration and reflexes have returned.

Complications of severe pre-eclampsia or eclampsia

1. Fluid in the wrong body compartment

1) There is usually total body fluid overload but within the intravascular compartment there is hypovolaemia due to low blood albumin and leakage of fluid through vessel walls and therefore **fluids** must be restricted to less than 100ml/hour (or 1.5ml/KG body weight per hour).

2) Complications of excessive fluid in the wrong body compartment include cerebral oedema, pulmonary oedema (see below for management), laryngeal oedema with stridor and shortage of urinary output and renal failure.
3) Oral fluids can usually be continued, but close monitoring of urine output is essential. Total **oral** plus IV fluid should not exceed 2400 ml in 24 hours. If woman can drink, then IV fluids should be decreased or stopped.
4) One good way of providing fluid safely is to add 30 ml per hour to the measured urinary output in the previous hour (then give the total of oral plus IV over the next hour). Insert an indwelling urinary catheter and keep a strict intake–output chart with hourly running totals. The total maintenance fluid intake should not exceed 1.5–2 litres over 24 hours. If the average urine output is less than 30 mL/hour over a period of 4 hours, this is usually due to the decreased intravascular volume. The risks of acute renal injury versus pulmonary oedema must be carefully weighed up before considering fluid challenge
5) Where there is over-hydration with pulmonary oedema, furosemide 20 to 40 mg IV may be helpful (see pulmonary oedema guideline below for doses). Mannitol is not advisable because of the fluid load that results from its administration, and because of its rebound effects.
6) Magnesium is excreted by the kidneys and therefore a low urinary output will result in an increased blood level of magnesium and risk of toxicity (see above). If the average urinary output over a 4-hour period is of less than 25ml per hour, then give an IV bolus of 100ml of Ringer Lactate to try and keep urine output at a safe level of 30 ml/hour or more.
7) Renal failure may develop secondary to the hypertension particularly if there are maternal complications that are likely to require a Caesarean section or high-dependency care.

2. Management of Acute Pulmonary Oedema in Hypertension in Pregnancy.

Acute pulmonary oedema in pregnancy or in the puerperium is life-threatening. It can occur in any hypertensive disorder of pregnancy, but it occurs most frequently in post -partum eclampsia. It is associated with disease severity and excessive fluid administration.

Diagnosis of pulmonary oedema.

- Sudden onset of breathlessness: an increased respiratory rate is an early sign of pulmonary oedema.
- Breathlessness on lying flat
- Agitation
- ↑ BP >140/90 ↑ Respiratory rate ↑ Heart rate
- ↓ O_2 saturation < 95%
- Crackles, crepitations and wheeze on auscultation of lung bases

- Chest X ray (if available) shows upper lobe redistribution, Kerley B lines and pulmonary infiltrates.

Management of pulmonary oedema
Stabilise patient;

- Sit patient upright.
- Give O_2 by mask or nasal cannulae at 4-6 l/min.
- 15-minute observations of B.P. Resp. rate, Heart rate, SpO_2, level of consciousness. Fetal heart rate monitoring if not post -natal.
- Strict fluid balance. Restrict fluids; stop I.V. fluids, monitor input and output. Consider bladder catheterisation. Minimise dilution of magnesium sulphate or other drugs if given I.V.
- Avoid NSAIDs.

Treatment of pulmonary oedema; aim for BP 140/90, and diuresis.

1. Glyceryl Tri Nitrate (GTN.) by sublingual spray (400micrograms/puff) Dose 2 puffs every 5 minutes. Aim to reduce systolic BP by 30mmHg over 5 minutes, then a slower reduction to a target of 140/90.
2. I.V. furosemide 40mg over 2 minutes. Repeat dose of 40mg IV after 30 minutes if there is an inadequate diuretic response and repeat again after a further 30 minutes if needed. (Maximum dose 120mg in one hour)
3. If hypertension persists after GTN and furosemide, calcium channel blockers such as nifedipine can be used. Nifedipine 10mg orally, repeated after 30 minutes until optimal B.P. achieved. Maximum dose is 30 mg in the acute setting.
4. I.V. morphine 2 mg can be given as a dilator of veins and reduces anxiety and stress in the mother.

If still pregnant, ensure delivery as soon as patient is stabilised.

3. Neurological complications

These include cerebrovascular accidents (strokes) and cerebral oedema.

Undertake regular (2-4 hourly) neurological examination (including pupillary and tendon reflexes) and record the AVPU. All patients should be able to open their eyes to stimulus, obey commands and respond to questions about their name and age. If not, they may be developing cerebral complications.

Cerebral oedema is usually localised to the occipital and parietal cortical areas of the brain. Magnesium sulphate can help to prevent this. Mannitol is not indicated.

Recurrent convulsions despite magnesium sulphate with or without other anticonvulsants may require intubation and controlled ventilation (if available).

4. Hematological complications

These include disseminated intravascular coagulation (DIC) and a low platelet count.

Group and save and cross-match fresh blood. Check the full blood count, including a platelet count if possible.

Do a whole blood clotting test. Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down easily, suggests coagulopathy.
An APTT (if available) is valuable.

If the platelet count is >100,000 × 10^9, a major coagulation problem is unlikely. Spontaneous haemorrhage may occur with counts below 10,000 × 10^9.

If DIC is present, give whole fresh blood transfusion if there is bleeding.

5. Hepatic complications

These include jaundice, bleeding tendency, hepatic failure, hepatic sub-capsular oedema or hepatic rupture. (The last two cause right upper quadrant or epigastric pain and tenderness).
Delivery of the baby is urgent.

6. Fetal problems

These include intrauterine growth restriction, fetal distress in labour, preterm delivery as a result of obstetric intervention, fetal death due to placental abruption or fetal hypoxic ischaemic injury (birth asphyxia) in labour.

7. HELLP syndrome (Haemolysis, Elevated Liver enzymes, Low Platelet counts)

This syndrome is a dangerous complication of severe pre-eclampsia.
If the platelet count is < 50,000 × 10^9 there is a high risk of bleeding, and if bleeding occurs in the absence of platelet transfusions, fresh blood may be helpful.

Liver dysfunction may cause upper abdominal pain and lowering of the blood pressure may be helpful.

Delivery is urgent.

General nursing care
Airway and breathing management should be undertaken as appropriate. This includes ensuring that SaO_2 remains normal at > 94%.

If before delivery, maintain the patient in the lateral tilt or recovery position at all times depending on conscious state.

Manage the indwelling aseptically placed urinary catheter, undertake an hourly urine output measurement and keep a fluid balance chart.

Delivery of the baby
The need for *in-utero* transfer should be considered, particularly if there are maternal complications that are likely to require a CS or high- dependency care which cannot be provided in the health facility.

The need for delivery is dependent on the maternal and fetal conditions. Either Caesarean section or induction of labour may be appropriate, depending on the clinical findings. Although delivery will resolve the disease, it is inappropriate to deliver an unstable mother, even if there is fetal distress. Once eclamptic seizures have been controlled and severe hypertension has been treated and any hypoxaemia corrected, delivery can be expedited.

In severe pre-eclampsia, aim to deliver within 24 hours of the onset of symptoms. In eclampsia, aim to deliver within 12 hours of the onset of convulsions. It is always essential to stabilise the mother's condition first. Then decide about the mode of delivery.
In selected patients, labour may be induced for vaginal delivery if the following conditions apply:

- the cervix is favourable
- the maternal condition is stable (i.e. eclampsia and blood pressure are controlled), there is no fetal distress and there is a cephalic presentation.

Assessment of the cervix

- If the cervix is favourable (i.e. soft, thin and partly dilated), rupture the membranes and induce labour using an oxytocin infusion (*see* Section A4) or oral misoprostol (*see* Section A4 and below).
- If vaginal delivery is not anticipated within 12 hours (for eclampsia) or within 24 hours (for severe pre- eclampsia), deliver by Caesarean section.
- If there are fetal heart rate abnormalities, ideally measured immediately following every uterine contraction, consider Caesarean section if this is safe for the mother.

- If the cervix is unfavourable (i.e. firm, thick and closed) and the fetus is alive, deliver by Caesarean section if the mother is adequately resuscitated.
- If there are no facilities for Caesarean section transfer when safe to a Comprehensive Emergency Obstetric Facility. If this is not possible attempt vaginal delivery.
- If the fetus is dead or too premature for survival, deliver vaginally.

Aiming for vaginal delivery

Patients with pre-eclampsia often labour well even if cervix is unfavourable at the beginning of induction. It is important to monitor the fetal heart closely however as these fetuses are often small for gestational age.

If the cervix is unfavourable (i.e. firm, thick and closed) and the fetus is alive, a trial of induction of labour should be attempted but if the cervix is not dilating to the safe timetable needed for delivery a Caesarean section should be performed.

If the fetus is dead, induction of labour should be undertaken. If there has been a previous CS, careful use of oxytocin should be adopted but misoprostol is contraindicated. A Foley catheter is the safest option and is also useful even if no previous C/S.

There are many possible misoprostol regimens for induction of labour (vaginal misoprostol tablet, oral misoprostol solution or oral misoprostol tablet). Each has been widely used. The latest evidence is that oral misoprostol solution is the most appropriate treatment. (Cochrane reviews).

When giving oral misoprostol solution: A single misoprostol tablet is dissolved in drinking water (a 200-microgram tablet in 200 mL of water or a 100-microgram tablet in 100 mL of water), and 20–25 mL of misoprostol solution (20–25 micro- grams) are then given every 2 hours. The solution is stable for up to 24 hours at room temperature but should then be discarded.

Oral misoprostol tablets: 100-microgram misoprostol tablets can be cut to 25 micrograms size and administered orally every 2 hours up to a maximum of six doses. However, this may not be very accurate, so there is a danger of giving an incorrect dosage. The solution described above is much safer.

Caesarean section

If Caesarean section is performed, ensure that coagulopathy has been treated.

Ensure that fresh blood for transfusion is available.

Spinal anaesthesia is usually safer than general anaesthesia for Caesarean section, unless there is a contraindication (e.g. maternal refusal, coagulopathy, thrombocytopenia, decreased conscious level, ongoing seizures). There does not appear to be an exaggerated decrease in blood pressure after spinal anaesthesia, and vasopressors (e.g. ephedrine) should be used cautiously in order to avoid a hypertensive response. An IV bolus of 500 mL of Ringer- lactate or Hartmann's solution may occasionally be required if the blood pressure does fall.

The use of general anaesthesia in severe pre-eclampsia or eclampsia is hazardous. There may be laryngeal oedema, which makes airway management difficult.

There may also be increases in blood pressure during intubation and extubation, with an increased risk of intracranial haemorrhage. Drugs to weaken the vasopressor response to intubation should be used.

Local anaesthesia or ketamine in women with pre- eclampsia or eclampsia are contraindicated unless facilities and/or expertise dictate that these are the safest options in a given situation.

Management after delivery

- If the patient is post-eclampsia or at high risk of convulsions, continue to administer parenteral anticonvulsants (i.e. magnesium sulphate, or diazepam if magnesium sulphate is not available) for 24 hours after the birth, or 24 hours after the last fit, whichever is the later.
- If undelivered, carefully consider the duration of continuing anticonvulsants.
- Do not give ergometrine to women with pre-eclampsia, eclampsia or high blood pressure, because it increases the risk of convulsions and cerebrovascular accidents (strokes).
- Monitor the mother closely.
- Use antihypertensive agents, even if not taken before birth, if the diastolic blood pressure is ≥ to 100 mmHg or the systolic blood pressure is ≥ to 150 mmHg.
- consider reducing antihypertensive treatment that had been started before birth if the blood pressure falls below 140/90 mmHg
- stop antihypertensive treatment if the blood pressure falls below 130/80 mmHg.

- Continue oxytocin infusion after delivery for at least 4 hours to keep the uterus contracted as the risk of PPH is high and very dangerous.
- To prevent PPH, Syntometrine (which contains ergometrine, and can cause or worsen hypertension) is contraindicated. Give oxytocin alone or with misoprostol and avoid the possible hypertensive effects of ergometrine. If PPH occurs, this should be managed as described in Section A+11.
- Keep the mother in the delivery unit or in a close observation area for at least 24 hours after the last fit and until blood pressure is 130/80 or below ideally off treatment.
- Review the need for further anticonvulsants and anti-hypertensive drugs.
- It is not uncommon for the blood pressure to drop transiently following delivery only to rise again after 24 to 48 hours. Patients with severe pre-eclampsia and eclampsia should be monitored as in-patients for at least 72 hours after delivery so that dangerous post-partum rises in BP can be detected and treated.
- Plans for care should be communicated to the patient

Emergency box for eclampsia and severe pre-eclampsia management

Equipment	*Quantity*
Drugs	Magnesium sulphate 50%, 5 g in 10-mL ampoule × 10 ampoules Calcium gluconate 10%, 10-mL ampoule × 2 ampoules Hydralazine, 20 mg in 1-mL ampoule × 2 ampoules Labetalol, 200 mg in 20-mL ampoule × 1 ampoule 0.9% Sodium chloride, 10-mL ampoule × 10 ampoules Diazepam, 5 mg/mL ampoules × 20
Intravenous fluids	500-mL bag of Ringer-lactate or Hartmann's solution or 0.9% saline × 1 Giving set × 1 IV blood giving set × 1
Venous access	20-gauge cannula (pink) × 2 18-gauge cannula (green) × 2 16-gauge cannula (grey) × 2 Tourniquet × 1 Fixation tape × 1 roll
Airway equipment	Guedel airways: sizes 4, 3 and 2 Self-inflating bag-mask-valve Green oxygen tubing (2 metres) and high and medium concentration (MC) facemasks for oxygen delivery Yankauer sucker
Other equipment	50-mL syringe × 2 20-ml syringe × 2 10-mL syringe × 2 Green needles × 2 Patella hammer × 1 Urinary catheter Charts for vital signs and fluid balance

Section A+14 Severe infection after birth: puerperal sepsis.

TABLE A+14.1 Symptoms and signs of infection, with diagnosis and treatment

Diagnosis	Symptoms	Signs	Investigatio	Treatment
Endometritis	Rigors/chills Lower abdominal and/or pelvic pain Foul-smelling vaginal secretions Persistent light vaginal bleeding History of incomplete placenta delivered History of prolonged rupture of membranes, frequent unsterile vaginal examinations in labour	Fever (usually > 37.5°C) Tender uterus Shock Delayed rate of involution of uterus	Full blood count, including white blood cell count, CRP and ESR Blood culture Lochia for microscopy, culture and sensitivity	Treat shock urgently if present IV antibiotics ampicillin 2 grams IV/IM every 6 hours plus gentamicin 80 mg IV/ IM every 8 hours or 5 mg/ kg body weight IV/IM once every 24 hours plus metronidazole 500 mg IV every 8 hours
Mastitis	Breast pain Rigors	Tender over breast Red wedge-shaped area of induration of one breast Fever ≥ 37.5°C		If bacterial infection is suspected, give anti-staphylococcal antibiotics: flucloxacillin or cephalexin orally for 7 days
Breast abscess	Breast pain Rigors, chills and/or malaise	Swinging fever Fluctuant swelling in the breast, possibly with pointing and draining of pus		Surgical drainage If the patient is systemically very unwell, give anti-staphylococcal antibiotics IV: flucloxacillin or cefotaxime or ceftriaxone

Diagnosis	Symptoms	Signs	Investigatio	Treatment
Wound abscess	History of Caesarean section Rigors, chills and/or malaise	High, swinging fever Swelling and redness around incision		Surgical drainage
Peritonitis	History of Caesarean section Rigors, chills and/or malaise Severe abdominal pain Vomiting	High fever Abdominal distension Rigid abdomen Absent bowel sounds Shock		Treat shock Give IV antibiotics Nasogastric tube Immediate laparotomy in operating theatre
Pelvic abscess	Lower abdominal pain Diarrhoea History of Caesarean section	Swinging fever Swelling in adnexae or pouch of Douglas Tender uterus	Full blood count, including white blood cell count Blood culture Pus for microscopy, culture and sensitivity Ultrasound	Give IV antibiotics: Ampicillin 2 grams IV/IM every 6 hours plus gentamicin 80 mg IV/ IM every 8 hours or 5 mg/ kg body weight IV/IM once every 24 hours plus metronidazole 500 mg IV every 8 hours Surgical drainage
Pyelonephritis	Pain in the lower abdomen or loin Nausea and/or vomiting Increased frequency of passing urine	High fever Tenderness of one of the loins over the kidney Normal bowel sounds	Microscopic examination of urine Stick tests for infection (if available) Urine culture and sensitivity if possible	IV antibiotics (see Section B11) If the patient is in shock, initiate immediate treatment

Diagnosis	Symptoms	Signs	Investigatio	Treatment
Pneumonia	Difficulty in breathing Cough, sometimes with expectoration Pleuritic chest pain	Fever Respiratory distress Signs of consolidation or effusion	Chest X-ray Ultrasound if there is effusion	IV antibiotics (see Section B6)
Malaria	Rigors Headache Muscle and/or joint pains	Fever Enlarged spleen Reduced consciousnes s Jaundice Anaemia Fitting	Full blood count Thick film for parasites RDT Blood glucose	Antimalarial drugs (see Section B8)

Endometritis

This is the most serious and common cause of puerperal sepsis. It accounts for up to 15% of maternal deaths in resource-limited countries. Infection of retained products of conception is the most common cause. (Suspect this if there is excessive vaginal bleeding or poor involution of the uterus). This can lead to long-term health problems, including infertility, chronic pelvic inflammatory disease and ectopic pregnancies.

Endometritis is defined as infection of the genital tract at any time between the onset of rupture of the membranes or labour and the 42nd day following delivery or abortion, in which two or more of the following are present:

- abdominal and/or pelvic pain
- fever of ≥ 37.5°C (can be masked by paracetamol or other antipyretic drugs)
- abnormal quantity of vaginal discharge
- foul-smelling discharge
- delay in the rate of involution of the uterus.

Puerperal sepsis can present with few symptoms, although the woman feels unwell and usually has a fever. It can also progress rapidly to become life-threatening within hours.

Section A+14 Severe infection after birth: puerperal sepsis diagnosis of infection after childbirth

Pathogens that cause sepsis

The pathogens most commonly responsible are group A beta-haemolytic streptococcus (often of community origin) and endotoxin-producing enterobacteria (e.g. *E. coli*). Less commonly involved are *Clostridium*, *Bacteroides*, *Chlamydia* and *Mycoplasma*. Bacterial infections are often mixed.

Risk factors

These include the following:

- prolonged rupture of membranes before delivery PROM or PPROM
- contact with others, especially children, with a bacterial throat infection (*Streptococcus*)
- frequent (particularly unsterile) vaginal examinations
- prolonged and obstructed labour
- instrumentation (e.g. forceps delivery)
- Caesarean section (especially in an emergency)
- retained products of conception
- lack of sanitary towels and hygienic materials to manage lochia during the postnatal period
- sickle-cell disease.

Pathogenesis

- Endotoxins are released from the cell walls of Gram-negative bacteria.
- Endotoxins can cause shock.
- Extensive tissue necrosis, even gangrene, may occur, especially in the uterus.

Prevention

- Antibiotic prophylaxis for prolonged rupture of membranes
- Careful postnatal examination of the placenta
- Caesarean section only when essential
- Antiseptic cream for vaginal examinations (e.g. Chlorhexidine obstetric cream).
- Provision of sanitary towels and other hygienic items to all women and girls who have given birth, and where family poverty means that these items are not available.

Complications

Section A+14 Severe infection after birth: puerperal sepsis diagnosis of infection after childbirth

- wound infection and wound dehiscence (burst abdomen)
- pyometra (unusual as cervix rarely completely closed)
- peritonitis
- ileus
- septicaemia, possibly accompanied by shock
- abscess formation in cul-de-sac and sub-diaphragmatic space
- adnexal infections
- ovarian abscess
- pelvic abscess
- breast infection or abscess
- deep vein thrombosis
- pulmonary embolus.

Investigations (if available):

- Full blood count, CRP, ESR, blood cultures

culture of vaginal fluid if bacteriology facilities are available
midstream samples of urine (MSSU) and microscopy of urine.

Treatment

Treat as an emergency, including IV fluid boluses if shock is present (*see* Section C6) if there is persistent tachycardia (> 100 beats/minute), hypotension (systolic blood pressure < 90 mmHg), increased respiratory rate (> 25 breaths/minute), confusion or disorientation, oliguria (< 30 mL/hour), rash or bradycardia (< 50 beats/minute).

Give antibiotics until the patient has been fever-free for 48 hours or 7–10 days:

ampicillin 2 grams IV every 6 hours

– *plus* gentamicin 80 mg IV/IM every 8 hours or 5 mg/ kg body weight IV/IM once every 24 hours
– *plus* metronidazole 500 mg IV every 8 hours.

If fever is still present 72 hours after initiating antibiotics, re-evaluate the patient and consider revising the diagnosis and/or change to ceftriaxone 1gram IV once daily IV or IM plus metronidazole.

The 1 to 2-week antibiotic course is completed orally once the patient has been free of fever for 48 hours.

Only when the patient is stable and if retained placental fragments are suspected, and ideally confirmed by ultrasound scan, perform a digital exploration of the uterus to remove clots and large pieces. Cervical dilatation may be needed and use MVA or a blunt curette if necessary but be very careful not to penetrate the uterine wall,

which is very soft at this stage. If possible, wait for 12 to 24 hours after starting antibiotics.

Where general anaesthesia is not available or safe, agents such as ketamine may be considered for this procedure.

If there is no improvement with conservative measures, and there are symptoms and signs of general peritonitis (abdominal pain, fever, and abdominal tenderness with rebound tenderness), perform a laparotomy to drain the pus, and if the uterus is the source do not leave it too late to perform a hysterectomy.

Wound infections

Wound infections may be superficial or deep. Superficial infections involve the skin and subcutaneous tissues, but not the rectus sheath (fascia). They may present with cellulitis or abscess formation. Cellulitis should be treated with antibiotics; which may prevent the development of a wound abscess.

Clear or purulent fluid exuding from the wound should raise concern that the infection is deep to the sheath. Where there is abscess formation, the wound should be opened by removing sutures to the skin and subcutaneous tissues, to allow drainage of pus. Antibiotics are not always required if an abscess is drained and the surrounding tissues appear healthy.

The wound may require debridement if tissue necrosis is suspected. If the sheath looks healthy and intact, the fascial sutures should be left *in situ*. The wound should be packed with a damp dressing, which must be changed every 24 hours.

If the sheath appears necrotic or infected, it should be opened, and the peritoneal cavity inspected for collections of pus. If pus is present, it should be evacuated, and a broad corrugated drain left *in situ* in the peritoneal cavity to facilitate drainage post-operatively.

Necrotising fasciitis is a relatively uncommon but potentially life-threatening variant of wound infection, which presents with rapidly spreading cellulitis, with severe pain and tenderness. Urgent wide debridement of necrotic tissue is required, with antibiotics as for deep wound infection (see below). Secondary closure should be undertaken 2–4 weeks later, provided that the infection has resolved.

Antibiotic regimes for wound infections

Where possible, swabs should be taken for culture and sensitivity.

Superficial infections

Give ampicillin 500 mg by mouth, four times a day for 5 days *plus* metronidazole 500 mg by mouth three times a day for 5 days.

Deep infections

Give benzyl penicillin, 2 million units (1200 mg) IV every 6 hours, *plus* gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours, *plus* metronidazole 500 mg IV every 8 hours.

If this combination does not work, consider ceftriaxone 1 gram daily IV or IM plus metronidazole.

IV antibiotics should be continued until at least 48 hours after the pyrexia has settled.

The patient may then be switched to oral antibiotics, as described above.

Peritonitis

Treat shock, if present. Then:

insert a nasogastric tube with regular 4 hourly gentle aspiration as long as ileus is present.

- infuse IV fluids for maintenance and replacement
- give antibiotics IV until the patient has been fever-free for 48 hours:
  ampicillin/amoxicillin 2 grams IV/IM every 6 hours
  – *plus* gentamicin 80 mg IV/IM every 8 hours or 5 mg/ kg body weight IV/IM once every 24 hours
  – *plus* metronidazole 500 mg IV every 8 hours.
- consider ceftriaxone 1 gram daily IV or IM plus metronidazole if poor response to the above triple antibiotics
- if necessary, perform a laparotomy to repair diseased or injured bowel.
- Once perforated bowel is excluded/repaired and ileus has ended, give small frequent feeds via a nasogastric tube or orally as soon as is possible and safe.

Pelvic abscess

Pelvic abscesses usually involve multiple bacteria both aerobic and anaerobic.

Pelvic cellulitis typically presents 5 to 10 days after surgery with fever, vague abdominal pain, or the sensation of pelvic fullness. Pelvic abscess symptoms mirror

that of pelvic cellulitis with the addition of a palpable mass corresponding to the collection of infected fluid or ultrasonic evidence of abscess.

Approach to management depends on the clinical status of the patient and characteristics of the pelvic abscess. Treatment with antibiotics alone is appropriate for women who meet the following criteria: being hemodynamically stable, having pelvic abscess <8 cm in diameter, and having adequate response to antibiotic therapy. Recommended antibiotic regimens for pelvic abscesses is metronidazole (500 mg every 12 hours) plus ceftriaxone (2 g every 24 hours).

Minimally invasive drainage, laparoscopy, or exploratory laparotomy may be required in women with abscesses >8 cm or who show no signs of improvement but are not worsening clinically.

Clinically worsening patients, suspected bowel rupture, and extremely septic patients require immediate laparotomy which may be life-saving.

Duration of antibiotic therapy is for at least 14 days or more depending on resolution of the pelvic abscess.

Start antibiotics before draining the abscess, and continue until the patient has been fever-free for 48 hours:

- ampicillin/amoxicillin 2 grams IV every 6 hours
- *plus* gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours
- *plus* metronidazole 500 mg IV every 8 hours.

Consider ceftriaxone 1 gram daily IV or IM plus metronidazole if poor response to the above triple antibiotics

Drainage should be performed if an adequate response to antibiotic therapy is not registered within 2-3 days or if the pelvic abscess is >8 cm in size (if this can be assessed).

Criteria for failure may include the following:

1. Patients with no ultrasound reduction in abscess size. Greater than a 50% reduction should be seen.
2. Patients whose abscess progressively increases in size.
3. New onset of fever or persistent fevers
4. Clinical deterioration with persistent or worsening abdominal/pelvic tenderness despite appropriate antibiotic therapy.

5. Patients meeting criteria for sepsis. Septic patients should be continued on antibiotics and taken to the operating room for emergency operative treatment.
6. Ruptured or suspected intra-abdominal rupture of abscess. Abscess rupture is life-threatening emergency that can result in sepsis and septic shock. Ruptured abscess should be treated immediately.

Surgical intervention is advocated in these patients to improve their outcome. These patients should also be continued on antibiotics and taken to the operating room for emergency operative treatment.

If the abscess is fluctuant in the cul-de-sac, drain the pus through a culdocentesis (see below). If the spiking fever continues, perform a laparotomy.

Bowel may be secondarily involved in the inflammatory process, and care must be taken to avoid bowel perforation. Peritonitis may develop in association with a pelvic abscess. Prompt nasogastric suction and administration of intravenous fluids are important, as well as IV antibiotic therapy as described above.

Culdocentesis

Culdocentesis for the detection of and withdrawal of pus

- Administer pain relief, preferably IV paracetamol (see Section C7).
- Apply antiseptic solution to the vagina, especially the posterior fornix.
- Infiltrate with 1% lignocaine.
- Gently grasp the posterior lip of the cervix with sponge forceps and gently pull to elevate the cervix and expose the posterior vagina.
- Place a long needle (e.g. spinal needle) on a syringe and insert it through the posterior vagina, just below the posterior lip of the cervix (*see* Figure A+14.1).
- Pull back on the syringe to aspirate the cul-de-sac (the space behind the uterus).
- If pus is obtained, try to remove as much as possible

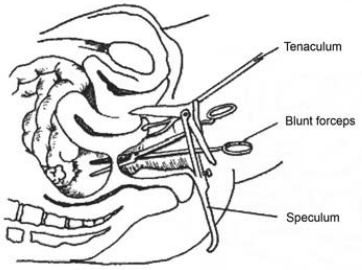


Figure* A+14.*1 *Culdocentesis: diagnostic needle aspiration of the cul-de-sac.*

Colpotomy for draining a pelvic abscess.
Latest evidence now suggests that recurrent drainage by culdocentesis is preferable to colpotomy.

Based on a number of studies, recommendations regarding drainage are the following: pelvic abscess >8 cm should be drained by culdocentesis in addition to the administration of empiric parenteral antibiotics; cultures and sensitivities should be obtained; early drainage of a pelvic abscess is safe, improves outcomes, reduces hospitalization, and is appropriate for the clinician to consider as primary therapy; and the preferred method for drainage trans-vaginally and only if the patient is hemodynamically stable.

Mastitis

Mastitis may be infective or non-infective, ranging in severity from mild local erythema and tenderness through to abscess and septicaemia.

Non-infective mastitis may be due to a blocked lactiferous duct, or to difficulties with breastfeeding technique. It may lead to infective mastitis.

Infective mastitis is common in lactating women. It is usually caused by the bacterium *Staphylococcus*, which generally responds to a 7 to 10-day oral course of flucloxacillin or a cephalosporin, both of which are safe to take while breastfeeding.

Mastitis usually presents with a hot red swollen section of one breast. It may be associated with flu-like symptoms, namely pyrexia of 37.5°C or above, chills and myalgia.

Treatment

Continue breastfeeding. Although the symptoms of mastitis may discourage breastfeeding, it is important to try to continue. Regular breastfeeding will help to:

- remove any blocked breast milk from the breast
- resolve the symptoms of mastitis more quickly
- prevent mastitis from becoming more serious.

The milk from the affected breast may be a little saltier than normal but is safe for the baby to drink. Any bacteria that are present in the milk will be harmlessly absorbed by the baby's digestive system and cause no problems. Feeding from the breast is more efficient than a breast pump. However, if the baby is not feeding well, a breast pump or hand expression will be needed to get the milk out. It may be less painful if the affected breast is given to the baby after initial feeding from the unaffected breast when the let-down reflex has occurred.

Mastitis can usually be successfully treated by resting, drinking plenty of fluids and varying the baby's position at the breast. It is important to ensure that the baby is properly attached to the nipple, and that the breast is empty after the feed. It may be necessary to feed more frequently, and to express the remaining milk after a feed. Paracetamol is useful for pain control. Massaging the areas of tenderness may be beneficial.

Prevention of mastitis

The following advice should be given to any mother who has experienced mastitis:

- Relieve engorgement promptly. Milk that does not flow gets thicker and clogs the ducts.
- Breastfeed frequently. Do not restrict the length of feedings.
- If the mother feels her breasts getting full, she should encourage the baby to feed without waiting for the baby to initiate this.

Repeated mastitis

This is usually the result of irregular breastfeeding patterns, such as missing feeds and giving bottles in place of breastfeeding. Recurrent mastitis may also result from tiredness and stress.

With regard to antibiotic treatment, the bacterium involved in mastitis is usually *Staphylococcus*, and the two most effective antibiotics are cloxacillins and cephalosporins, which are safe to take while breastfeeding. A 10-day oral course is recommended.

Lachiewicz MP, Moulton LJ, Jaiyeoba O. Pelvic surgical site infections in gynecologic surgery. *Infect Dis Obstet Gynecol*. 2015;2015:614950.

Section A+15 Managing Deep Vein Thrombosis (DVT) and Pulmonary Embolus (PE) in Pregnancy

Introduction

Deep vein thrombosis (DVT) is a serious condition where a blood clot develops, often in deep veins of the legs but in pregnancy most common and dangerously in the pelvis. It can be fatal if the clot dislodges and travels to the lungs. This is known as a pulmonary embolus (PE).

Having a DVT or PE is not common in pregnancy, but pregnant women, and women who have delivered in the previous six weeks, are more likely to develop them than are non-pregnant women of the same age. The majority of DVTs associated with pregnancy are in the iliac or femoral veins, and these are more likely to travel through central veins to the pulmonary circulation in the lungs, causing a PE. The puerperium is the time of highest risk

Risk factors for DVT and PE (Venous Thrombo-embolism)

In addition to pregnancy, other factors that put a patient at risk of deep vein thrombosis include:

- Operative delivery: Caesarean section increases the risk of pulmonary embolism by two-to eight-fold; the risk is greater after an emergency procedure than after an elective one.
- Having had a previous DVT or PE
- Other surgical procedures during pregnancy or the puerperium
- Pre-eclampsia, dehydration, excessive blood loss, homocystinuria, and sickle cell disease
- Age: the mortality from DVT and pulmonary embolism is 100 times higher in pregnant women over 35 years of age.
- Obesity, with a BMI of 30 or more
- Multiple pregnancy
- Having a parent, brother or sister who has had a DVT or PE
- Not moving (being immobile) for long periods of time
- Smoking cigarettes
- Having severe varicose veins – if they are painful or above the knee with redness or swelling
- Sickle cell disease
- Congenital and acquired thrombophilia: Patients with antithrombin III deficiency, protein C or S deficiency, activated protein C resistance, lupus anticoagulant and antiphospholipid antibody are all at increased risk of DVT and/or pulmonary embolism.

Deep vein thrombosis

The signs of a DVT usually, but not always, occur on one side only. If the DVT is within the pelvis, the only sign may be unilateral swelling of the leg.
If the DVT is within the leg, the following may occur:

- Swelling, pain, warmth and tenderness
- Redness, particularly at the back of the leg below the knee

Managing DVT associated with pregnancy

If left untreated, as many as one quarter of patients with DVT will have a pulmonary embolism. However, when DVT is treated with anticoagulants (if that is possible), pulmonary embolism occurs in only around 5% of cases, and the mortality rate is less than 1%. Once a DVT is diagnosed and treatment is started, the risk of developing a PE is very small.

However, the lack of safe monitoring of blood clotting in low-resource settings makes the treatment of DVT or suspected PE with unfractionated heparin a major problem with considerable danger.

Injections with low molecular weight heparin (LMWH) can be used to treat pregnant women with DVT. LMWH is an anticoagulant, which means it prevents the blood clot getting bigger. It does not affect the developing fetus. The injections reduce both the risk of a PE and the risk of developing another DVT.

LMWH does not require coagulation monitoring. Dose is based on early pregnancy weight.

A LMWH, such as Enoxaparin, is given **subcutaneously**. The drug is available in syringes of 40, 60, 80 and 100 mg. A dose of 0.75 mg/kg (pre-pregnancy or booking weight) is given 12 hourly, or 1.5mg /Kg. once daily. The advantage of LMWH over unfractionated heparin is that obstetric haemorrhage is much less likely to occur, and thrombocytopenia which is a side - effect of unfractionated heparin) is also less likely to occur.

The mother can then be discharged home when she has been taught how to administer the injections, and to dispose safely of the needles.

Anticoagulation following DVT should be continued throughout pregnancy and for at least 6 weeks postpartum. If necessary, it may continue for longer, to complete a minimum of three months' total treatment time.

On entering labour, the mother should not be given any further doses of LMWH. If she has a vaginal delivery, and there are no concerns about bleeding, it may be restarted 4 hours after delivery.
If an elective Caesarean section is planned, the mother should have the usual dose of LMWH the day before surgery. After the Caesarean, as long as there are no concerns about bleeding, the LMWH may be restarted after 8 hours.

A once-daily regimen may be used; this is especially suitable after 3 days, when concerns about haemorrhage are much reduced.

Although medical treatment for DVT and PE is essential, the following can also help to prevent DVT and PE:

- Staying as active as possible during pregnancy, and especially after a Caesarean section or other procedure
- Wearing compression stockings, to help the circulation in the legs after a CS

Pulmonary embolus (PE)

Here, blood clot from the veins in the leg or pelvis travel to the pulmonary vasculature in the lungs. It can be fatal.

Symptoms and clinical signs of PE

- difficulty breathing (dyspnoea) and/or rapid breathing (tachypnoea)
- pleuritic chest pain (that is, pain which is worst on breathing in), or tightness of the chest
- coughing, especially if accompanied by haemoptysis (coughing up of blood)
- collapse and shock
- low grade fever and a raised white blood cell count can occur
- Evidence of DVT may not always be found in patients with pulmonary embolism.
- Symptoms and physical findings must be interpreted with caution during
- pregnancy, because dyspnoea on exertion and leg discomfort (cramps) are
- common findings as pregnancy progresses.

A **massive pulmonary embolism** may be associated with:

- cyanosis and circulatory collapse, with shock and loss of consciousness
- chest pain

On examination, there may be signs of right-sided heart failure, with jugular venous distension and an enlarged liver.
However, tachycardia and a few localised lung crepitations may be the only findings on physical examination.
Unfortunately, in low-resource settings, there are no investigations which will prove or disprove a diagnosis of PE.

Section A+16. Amniotic fluid embolism (AFE)

Introduction

Amniotic fluid embolism occurs when a bolus of amniotic fluid is released into the maternal circulation during uterine contractions. It becomes trapped in the maternal pulmonary circulation and causes cardiorespiratory collapse and clotting problems with disseminated intravascular coagulation (DIC). It is very rare, and extremely difficult, if not impossible, to treat without critical care resources. It is therefore important to exclude and treat other reversible causes of cardiovascular collapse.

Clinical presentation

Amniotic fluid embolism usually presents late in the first stage of labour (70%). It can also occur during Caesarean section (19%) or immediately postpartum (11%). It has been reported during first-trimester surgical termination of pregnancy, second-trimester termination, after abdominal trauma and after amniocentesis.

The diagnosis is essentially clinical, and by exclusion and treatment of other possible causes.

The major clinical signs include the following:

- acute hypotension or cardiac arrest
- acute hypoxaemia (sudden onset of severe shortness of breath (dyspnoea), cyanosis or respiratory arrest)
- coagulopathy (Disseminated Intravascular Coagulation (DIC) or fibrinolysis, with severe clinical haemorrhage, including spontaneous bleeding from venepuncture sites, if the patient survives long enough for DIC to become established (more than 30 minutes)
- the absence of other causes or symptoms (see below).

Diagnosis

- This is based on the clinical presentation.
- Chest X-ray may show pulmonary oedema, adult respiratory distress syndrome (ARDS), or right atrial enlargement and prominent pulmonary arteries.
- The ECG may show a tachycardia and right ventricular strain pattern.
- Clotting studies, if available, may show low platelets (thrombocytopenia) and elevated fibrin degradation products. The whole blood clotting time is very prolonged (see Section C6).

Differential diagnosis including some more treatable or preventable causes

Cardio/Respiratory

1. Pulmonary embolus: infrequent during labour, often accompanied by chest pain, without development of coagulopathy.
2. Air embolism: may follow ruptured uterus, IV infusion using a pressurized infusion pump, with air in the bag of IV fluids and Caesarean section. A characteristic reported finding in air embolism is pre-cordial water-wheel murmur, which is rarely heard. There is no coagulopathy.
3. Aspiration of gastric contents: especially if conscious level has been decreased before collapse. There will be no coagulopathy.
4. Anaphylactic shock: there is no coagulopathy.
5. Acute left heart failure: usually more insidious onset. There is no coagulopathy.

Sepsis

1. Septic shock: unlikely if well prior to collapse.
2. Endometritis or pneumonia for example

Obstetric causes

1. Eclampsia – may be preceded by hypertension and proteinuria. Cerebral haemorrhage may occur as a complication of very high blood pressure. Coagulopathy may accompany HELLP syndrome (hemolysis, elevated liver enzymes, low platelets) associated with hypertensive disease of pregnancy). It is usually a more gradual onset than collapse due to Amniotic Fluid Embolus.

2. Obstetric haemorrhage - Placental abruption, uterine atony, uterine rupture

   a. Abruption can occur without visible blood loss and with coagulopathy. If treated and coagulopathy reversed, woman can survive.
   b. Uterine rupture can occur without visible blood loss. Coagulopathy is usually delayed

Consequences of treatment (iatrogenic)

1. Toxic reaction to anaesthetic or local anaesthetic agents: there is no coagulopathy.
2. High or total spinal anaesthesia
3. Anaphylaxis – should be considered after giving any drug or IV fluid
4. Blood transfusion reactions

The above possible diagnoses should be considered and treated, because survival from collapse due amniotic fluid embolus is very rare.

Management

Management is supportive, and aims to correct hypoxaemia, shock and coagulopathy and its consequences.

1. Give 100% inspired oxygen by face mask and reservoir.
2. If the patient is unconscious (P or U on the AVPU scale), intubation and assisted ventilation (if available) will usually be needed.
3. High positive end-expiratory pressure (PEEP) should be avoided.
4. Two large-bore cannulae (16G) IV should be sited.
5. Check whole blood clotting time to make diagnosis of DIC. Urgently cross-match and transfuse fresh donor blood (if available).
6. Cardiac arrest is managed according to protocols (*see* Section C9).
7. If the woman is in labour, immediate delivery is required, by Caesarean section (under general anaesthetic) if vaginal delivery is not imminent and will assist resuscitation of the mother.
8. In cardiac arrest, if a cardiac output cannot be restored immediately, cardiac massage and ventilation should continue, and perimortem Caesarean section should be considered (see Section C9).
9. Circulatory support depends on the causes of decreased cardiac output. A failing left ventricle is a feature of the condition. In patients who survive the initial haemodynamic collapse, there is a high risk of pulmonary oedema. Inotropic support, using IV infusions of adrenaline or dopamine, may be lifesaving.
10. Massive haemorrhage may not only be due to coagulopathy, but also to coexisting uterine atony. Oxytocic drugs will be needed. Uterine tamponade may reduce blood loss while the coagulopathy is corrected.
11. If the patient survives a cardiac arrest, there is a high risk of neurological injury.

Outcome

The outcome is poor, even when optimum treatment and monitoring is available, so it is important to exclude other possible and treatable causes of collapse, including anaphylaxis, pulmonary embolism, haemorrhage, sepsis, eclampsia, hypoglycaemia and drug toxicity (e.g. magnesium, local anaesthetic drugs).

The outcome depends on the facilities for cardiorespiratory support and the ability to manage the DIC with blood and blood products.

Section A+17 Ovarian cysts in pregnancy

Ovarian cysts in pregnancy may cause abdominal pain due to torsion or rupture. Laparotomy is required if torsion of an ovarian cyst is suspected. If the findings at laparotomy are suggestive of malignancy (i.e. solid areas in the tumour, growth extending outside the cyst wall), the specimen should be sent for immediate histological examination if available and the woman should be referred to a tertiary care centre for evaluation and management.

Corpus luteum cysts are common and normal in the first trimester. They should not be removed surgically, as the pregnancy depends on the hormones secreted by the corpus luteum; these cysts will disappear as pregnancy progresses.

Asymptomatic ovarian cysts

If, on ultrasound, the cyst is found to be more than 10 cm in diameter, observe by regular ultrasound examinations for growth or complications.

Torsion

If there is torsion, this will produce pain, and the cyst (and possibly the whole ovary) will need to be surgically removed.

Torsion is especially likely to occur postpartum.

Surgery will pose a significant risk of miscarriage and premature delivery. In the case of a cyst that has become twisted (torsion) the resulting necrosis and infection will themselves place the woman and fetus at risk of acute complications, and therefore prompt intervention is unavoidable.

Malignancy is difficult to diagnose even where access to advanced imaging such as MRI is available, and therefore a decision to operate on the basis of suspected malignancy is not advised in low resource settings, unless the index of suspicion is very high. If this is considered, then it should take in to account the gestation of the pregnancy, the risk of pregnancy loss/prematurity, and the treatment available to the mother following delivery.

If the cyst is less than 10 cm in diameter and remains so on ultrasound examination, it will usually regress on its own and does not require treatment.

Section A+18. Reduced fetal movements, intrauterine death and stillbirth

Diagnosis

TABLE A+18.1 Diagnosis of reduced fetal movements

Diagnosis	Symptoms	Signs	Investigation	Treatment
Placental abruption	Decreased or absent fetal movements Bleeding (but may not be external) Collapse Severe constant abdominal pain or severe backache if placenta is posterior	APH Shock in the mother Tense and/or tender uterus Fetal distress or absent fetal heart sounds	Pinard's stethoscope, Fetal doppler device: listen to FHR for 1 minute after every uterine contraction Ultrasound scan	Deliver the baby as soon as possible (see below)
Ruptured uterus Major risk factors are prolonged labour, previous Caesarean section and use of uterotonic drugs	Decreased or absent fetal movements Bleeding (but may not be external) Collapse Severe constant abdominal pain	Shock Diffuse uterine tenderness with easily felt fetal parts (unless posterior rupture) Fetal distress or absent fetal heart sounds	Pinard's stethoscope, Fetal doppler device: listen to FHR for 1 minute after every uterine contraction Ultrasound scan	Treat shock When the mother is stable perform laparotomy

Diagnosis	Symptoms	Signs	Investigation	Treatment
Fetal asphyxia due to placental failure	Decreased or absent fetal movements If membranes are ruptured, meconium staining of liquor	Abnormal fetal heart rate (< 110 beats/ minute or > 160 beats/ minute)	Pinard's stethoscope, Fetal doppler device: listen to FHR for 1 minute after every uterine contraction Ultrasound scan Partogram should show alerts	Deliver the baby as soon as possible if there are signs of fetal life
Fetal death	Absent fetal movements	Symphysis-fundal height decreases Absent fetal heart rate If membranes are ruptured, meconium staining may be present	Pinard's stethoscope or Doppler device ultrasound scan Full blood count in mother Clotting screen, including measurement of platelet count if possible Syphilis testing	Deliver baby as soon as possible (see below)

Fetal death in the absence of an abruption

Intrauterine fetal death (IUFD) may be the result of fetal asphyxia from placental failure, fetal infection, cord accident or congenital anomalies. Where syphilis is prevalent, a large proportion of fetal deaths are due to this disease.

Fetal death can be confirmed by abdominal ultrasound with confidence if there is a lack of fetal heart activity.

If IUFD is diagnosed, inform the woman or girl and her family and discuss the options for management with them.

Common causes are infection (especially malaria and chorio-amnionitis), abruption, and placental insufficiency. In the case of intrapartum IUFD, fetal hypoxaemic ischaemic injury may be to blame, often, but not always, associated with a prolonged obstructed labour or malposition. In the labouring patient, uterine rupture must also be considered.

The following investigations should be performed as a minimum: blood group and cross match, Hb, malaria RDT +malaria smear and urine analysis to assess for urinary infection and pre-eclampsia.

Testing for syphilis should also take place.

If a clotting test shows failure of a clot to form after 7 minutes, or a soft clot that breaks down easily, suspect coagulopathy. Obtain fresh blood for transfusion and give broad-spectrum IV antibiotics, including metronidazole.

Expectant management

Explain to the mother that in 90% of cases the fetus is spontaneously expelled within 1 month of diagnosis. However, most mothers and their families will request delivery as soon as possible and in Liberia **there is a danger of major infection if delivery is delayed.**

In addition, expectant management carries with it the risk of infection and DIC;both of which complicate management and risk the mother's life. If this approach is used, it must be possible to monitor the patient for complications, and there should be access to prompt and comprehensive treatment if they occur.

If IUFD is diagnosed in a labouring women, then once she has been assessed and treated for potential causes as above, the labour can be allowed to continue with the usual maternal monitoring. It is important to actively assess for life-threatening causes such as placental abruption and uterine rupture.

Active management

If there is no evidence of active labour and no indication for urgent delivery by Caesarean section, induction of labour with misoprostol is an effective way of inducing labour. As is the case for mid-trimester miscarriage, mifepristone, where available, can be helpful in shortening the length of time it takes for misoprostol to work. This is especially the case where there is no evidence of labour, the cervix is unfavourable and the patient is primigravid.

The following drug regime is recommended for women with an IUFD of 26 weeks' gestation or more. (See below for women with a previous Caesarean section, and Section A+7. for management of miscarriage before 26 weeks' gestation):

1. Mifepristone 200 mg orally stat (only if available: unlikely in Liberia at present). Wait for 36 to 48 hours after giving this drug – shorten if any clinical concerns arise during this interval
2. Misoprostol 50 micrograms orally or vaginally every 4 hours to a total of 5 doses
3. if delivery has not occurred by the fifth dose of misoprostol, the patient should be reviewed by a doctor or obstetric clinician.
4. Subsequent options for management include continued use of misoprostol (usually after a period of 'rest' for 12 to 24 hours) or use of oxytocin.

For women with an IUFD at term (37 weeks and over), an alternative is to use the same induction of labour protocol as described previously (Section A3 'Managing labour and delivery), for women with a live fetus, i.e. 25 micrograms of misoprostol every 2 hours.

Note: The evidence base for the optimum dose of misoprostol to be used in this scenario is poor, and it is recognised that higher doses of 50 micrograms or more every 4 to 6 hours, have historically been used. Recent evidence *suggests* that lower doses *may* be as efficacious, and it is with this in mind, as well as concerns about optimising safety, that the above dose has been recommended. Further research is needed into the optimal regimen, especially in resource-poor settings.

If the cervix is favourable (Bishop's score 6 or more) misoprostol or oxytocin induction to achieve delivery as rapidly as possible but, without artificial rupture of membranes because of the high risk of infection related to the presence of the IUFD, is therefore appropriate.

If the cervix is unfavourable, the cervix can be 'ripened' with a Foley balloon catheter as previously described (Section A4).

Oxytocin

Although misoprostol is recommended as the first-line induction agent in the case of IUFD where there are no risk factors for uterine rupture, oxytocin may be used if misoprostol is not available or proves ineffective. It may also be used where the risk of rupture is high (as discussed below after previous CS), and a titratable

and short-acting agent is therefore preferred. In practice, oxytocin is more effective following rupture of the membranes, although of course it is preferable to keep these intact as long as possible to avoid infection (see above). Rupturing the membranes before the cervix becomes favourable (Bishop's score > 6) should therefore be avoided and ripening of the cervix with a Foley balloon catheter may be safer.

Do not use oxytocin within 8 hours of using misoprostol.

Avoid Caesarean section if possible, except for unavoidable obstetric reasons such as transverse lie, suspected uterine rupture, major abruption, or two or more previous Caesarean sections.

The membranes should be kept intact for as long as possible to prevent infection. However, they may be ruptured if it is necessary to achieve rapid delivery. Vaginal assessments should be performed in a sterile manner and as infrequently as possible. Ideally, use chlorhexidine obstetric cream when doing vaginal examinations in this situation.

If the membranes have been ruptured for more than 18 hours prior to delivery, treat the patient with prophylactic antibiotics (ampicillin 2 grams IV stat followed by 1 gram every 6 hours). If there are signs of infection (fever and/or foul-smelling vaginal discharge), treat with triple IV antibiotics as described for endometritis (*see* Section A+14).

Women who have undergone a previous Caesarean section

In women with a previous Caesarean section, previous uterine surgery, or in grand multipara, there is a risk of uterine rupture in labour that is likely to be increased with the use of uterotonic drugs (oxytocin or misoprostol), and therefore their use should be extremely carefully considered. Misoprostol in particular should not be used as it is long-lasting, and its effects will not end until the dose wares off. Vaginal delivery is still the preferred mode of delivery if the fetus is dead, but care must be taken to minimise the risk as much as possible.

Oxytocin use is associated with a lower risk of uterine rupture than induction with misoprostol, but still increases the risk as compared with spontaneous labour. Close monitoring of the infusion, to prevent hyperstimulation, and of the patient for signs of any complication, is therefore essential. If the cervix is unfavourable, the cervix can be 'ripened' with a Foley balloon catheter as previously described (Section A4). ARM in addition to careful use of oxytocin may also help achieve safe vaginal delivery in this situation.

If a woman has had two or more previous Caesarean sections, she will need to be delivered by Caesarean section, even though the fetus is not alive.

Fetal death in the presence of an abruption (Section A+9)
Adopt the active management approach described above.

Stillbirth

Introduction

Between 2.08 and 3.79 million stillbirths occur each year worldwide. Of these, 98% occur in low- and middle-income countries. 55% occur in rural families in sub-Saharan Africa or South Asia, where facilities for giving birth are much poorer than in urban areas, with fewer skilled birth attendants, and less access to comprehensive emergency obstetric care.

Around 45% of stillbirths occur during birth (intra-partum). The global average rate is 19 in 1000 births, the rate in low-resource settings is >25 in 1000 births, and the rate in well-resourced settings is < 5 in 1000 births.

Most stillbirths are not registered especially in low resource settings, and the body is disposed of without any recognition or rituals such as naming, funeral services, or even the mother holding or dressing her baby. In some cultural settings, there is a belief that sinning by the mother or evil spirits are responsible for the stillbirth, and the dead baby may be seen as a taboo object. Families affected may be subjected to stigma and marginalisation. Some healthcare workers believe that few stillbirths are preventable, and that these babies were just '*not meant to live'*. There is considerable suffering involved for the family, and mothers frequently become depressed or anxious after a stillbirth, with similar emotions to those experienced after the death of a child.

Definitions of stillbirth

An early stillbirth is defined by the International Classification of Diseases as a birth weight of ≥ 500 grams or, if this measurement is missing, ≥ 22 completed weeks of gestation or, if this is missing, a body length of ≥ 25 cm.

WHO defines stillbirth as a birth weight of ≥ 1000 grams or, if this measurement is missing, ≥ 28 completed weeks of gestation or, if this is missing, a body length of ≥ 35 cm.

Causes of stillbirth

The major causes, which overlap with the causes of maternal and neonatal mortality, are as follows:

- complications of childbirth
- maternal infections in pregnancy (e.g. syphilis)
- medical disorders of pregnancy (especially pre-eclampsia, eclampsia or hypertension)
- maternal under-nutrition and fetal intrauterine growth restriction
- congenital abnormalities.

Prevention

The most important issues in low-resource situations are to increase the number of skilled birth attendants who can manage antenatal and intra-partum care, to increase the number of healthcare facility-based births, and to prevent or treat syphilis and malaria during pregnancy.

Specifically, the following ten interventions have been subjected to systematic review and are reported to reduce stillbirth rates:

1 taking folic acid before and soon after conception
2 skilled care at birth
3 basic emergency obstetric care
4 comprehensive emergency obstetric care.
5 insecticide-treated bed nets or intermittent drug treatment to prevent malaria
6 detection and treatment of syphilis
7 detection and management of hypertensive disorders in pregnancy
8 detection and management of diabetes
9 detection and management of fetal growth restriction
10 routine induction to prevent post-term pregnancy

The main aim is to strengthen the healthcare systems involved in antepartum and intra-partum care, which include, in addition to the ten items listed above:

1. improved antenatal care
2. prevention of malaria (*see* Section B8) and syphilis (*see* Section B13) in endemic areas

3. the availability of emergency obstetric surgery, in particular Caesarean section, without delay and with attention to "task Sharing" to improve access, especially in rural areas
4. advocacy to address poverty and its consequences. (Stillbirth rates are inversely correlated with wealth and development)
5. systems to manage and prevent domestic violence
6. efforts to achieve sexual equality, improve reproductive health, and improve the secondary education of boys and girls.

Ideally, bereaved families should form groups that advocate for change at all of the levels identified above.

Further reading

The Lancet Stillbirths series, launched in London, New York, Hobart, Geneva, New Delhi, Florence, and Cape Town on 14 April 2011.

Section A+19. Fetal distress during labour

Introduction

In all clinical circumstances, the well-being of the pregnant woman takes precedence over that of the unborn baby, and there are often situations where resuscitation of the mother will automatically bring about benefits for the fetus. Careful thought has to be given to the assessment and management of the fetal condition in labour. This is especially so in resource-limited countries, where severe shortages of both equipment and suitably trained personnel often mean that women do not receive the life-saving care which they require in labour. In such situations, strict priority of needs is required, and fetal well-being has to take second place to maternal survival.

When considering taking steps to monitor fetal well-being, the following factors must be taken into account:
The availability of trained staff to monitor the fetus during labour and to ensure the partograph is completed as per latest WHO guidelines
the cost of monitoring equipment, including maintenance, and replacement of disposable items
the cost of training staff in the use of such equipment
the proportion of caregivers' time required to be allocated to assessment of fetal well-being
the availability of suitable interventions, should fetal distress be diagnosed
the potential risks to the mother of an intervention for the sake of fetal well-being
the availability of neonatal care facilities and expertise, following on from an intervention to deliver a distressed and possibly premature baby.

Methods of monitoring fetal well-being in labour range from the low-cost low-technology Pinard's stethoscope to the relatively expensive high-technology cardiotocograph.

Pinard's stethoscope

This is an inexpensive, portable and resilient, and requires no electricity or battery. It is used to listen to the fetal heart through the maternal abdomen. in February 2018, WHO updated its guidelines on intermittent FHR auscultation in labour, now recommending auscultation every 15-30 minutes during the first stage, and every 5 minutes during the second stage of labour stating that auscultation should begin during a contraction and continue for at least 30 seconds after the contraction has ended. These latest guidelines also recommend that if the FHR is not always within the normal range (110-160 bpm), auscultation should be prolonged to cover at least 3 contractions and also recommend recording the baseline FHR, and the presence or absence of accelerations and decelerations

A healthy fetus will withstand the relative hypoxia and ischaemia brought about by the compression of the blood vessels in the placenta during a uterine contraction.

A doppler ultrasound fetal monitor

A simple ultrasound Doppler monitor (e.g. a Sonicaid) can be used instead of a Pinard's stethoscope, but it does require batteries. A recent development by Laerdal of the MOYO fetal monitor is also based on using doppler ultrasound. It is superior to the Sonicaid which costs only around 30 USD in that it has a re-chargeable internal Lithium battery and with this device it is much easier to find and monitor the FHR. However, it is much more expensive (around 300 USD each including freight to low resource countries).

Fetal heart rate monitoring by Pinard/ Sonicaid: normal ranges and abnormalities

Where continuous electronic fetal monitoring (CEFM) is available, any abnormality detected by intermittent monitoring results in the mother being transferred on to CEFM. Where this is not possible, it is even more difficult to determine whether fetal distress is present. In addition, without the ability to perform fetal blood sampling (below), it is not possible to confirm whether the fetus is distressed before delivery, or to determine the degree of distress likely. It should be noted that approximately 50% of babies with pathological electronic fetal heart rate tracings may not in fact be distressed.

The impact of intermittent fetal monitoring on Caesarean section rates and neonatal morbidity and mortality, in this context, is therefore unknown. Decisions on whether to pursue Caesarean section with its inherent risks for the current and future pregnancies, is extremely difficult in this context, where information on the fetal condition is so incomplete.

Recently, and at present only in Liberia, a feasibility study has found that mothers can be trained to effectively use a doppler ultrasound probe to monitor their own fetal heart rates during labour. In a change to the original and new 2018 WHO partograph guidelines mothers are asked to monitor immediately after the end of every contraction for approximately 60 seconds, listening for a change in FHR (bradycardia or tachycardia). If this situation is identified, the mother alerts her midwife who undertakes a longer assessment using the sonicaid. If this reveals a pattern suggestive of fetal distress, the actions below to prevent birth asphyxia are undertaken.

The normal fetal heart rate

Baseline:

The baseline is the rate that is returned to after any episodes of variation such as an acceleration or a deceleration. In simple terms it is the most common heart rate for that baby.

When listening with a Pinard or sonicaid this may be the rate over the first minute of listening. However, if part of the minute includes a period of more rapid heartbeat (an acceleration), or slower heart beat (deceleration) then it may be higher or lower than the baseline.

Therefore, if when listening, the FHR can be heard to be very slow or very fast for part or all of the period, auscultating this may not be the baseline and it will be necessary to continue listening over a longer period to gain more information.

The normal range for the baseline is between 120 and 160 bpm. A rate of 110 to 160 bpm is often also a normal finding, especially in babies at term or post term. A rate of 160 to 170 can also be a normal finding in a premature baby. A rate below 110 and above 160 is usually be considered to be abnormal.

Variability:
It is normal for the FHR to vary with every beat. This variation occurs continually above and below the baseline and is usually by approximately 5 to 15 bpm from the lowest to the highest reading (although normal variation is up to 25 bpm). Variation is not easily detected by the Pinard or sonicaid as monitoring involves counting for 1 minute and it is therefore the average heart rate over that time that is obtained. With a Sonicaid, however, the fetal heart rate may be displayed and then it can be seen to vary around a certain level (the baseline).

Variability is a positive sign, and generally suggests that the fetus is coping well with labour.

Accelerations:
These are short episodes (usually less than 1 to 2 minutes in duration) in association with fetal movements where the FHR increases by 15 beats or more above the baseline and for more than 15 seconds. They can be heard on a Pinard's with practice, although they are easier to hear the higher and longer they are. They are easier to hear on a Sonicaid, where the number displayed can be seen to increase over a period before falling back to its more usual level.

Accelerations are usually a positive sign as they represent fetal movement. If the fetus is distressed it will not move and the accelerations will stop. Although it is reassuring when they are present, accelerations are often not present during labour.

Abnormalities of the fetal heart rate

Tachycardia:
This is a FHR above 160–170 bpm. A tachycardia can be a result of a maternal pyrexia or tachycardia or of an obstetric complication such as prolapsed cord or obstructed labour.

Decelerations:
A deceleration is a reduction in the FHR of 15 bpm or more below the base line for 15 seconds or more.

An early deceleration occurs at the onset of the contraction and recovers by the end of the contraction. It is a common feature during labour (especially during the second stage) and is not usually associated with fetal distress, and therefore it is not routine to listen to the fetal heart rate during a contraction.

A late deceleration starts during or at the end of a contraction and persists beyond the end of the contraction. This is more commonly associated with fetal distress and if it occurs the fetal heart should be monitored following the next 2 contractions to see if it recurs. If it does, there is a significant chance that the fetus is distressed.

Bradycardia:
A bradycardia is a deceleration that continues for over 3 minutes. It may occur during pregnancy or labour and may be associated with inferior vena-caval compression if the patient is lying supine, sudden drops in maternal blood pressure from any cause or cord compression.

Bradycardia may also represent the end stage of a prolonged period of fetal distress. If the cause of the bradycardia is self-limiting, then the FHR should recover, whereas if it has occurred due to period of prolonged distress or the insult is ongoing, it will not recover and will end in fetal death. Even if it resolves, a bradycardia of over 10 minutes may cause brain damage to the fetus and have implications for the neonate.

Cardiotocograph (CTG)
The cardiotocograph is a relatively expensive, sophisticated but non-invasive item of equipment that requires expertise in its use and in its interpretation, as well as regular maintenance, and ongoing provision of disposables, such as print-out paper. It also requires a power supply (either mains electricity or batteries). It also requires a high skilled birth attendant work force.

It has a high sensitivity for detecting possible evidence of fetal distress, but a relatively low specificity, such that an additional method of assessment of fetal well-being, usually fetal scalp pH assessment (if available), is required in order to avoid excessive intervention.

If a cardiotocograph is used in the absence of fetal blood sampling, there are certain FHR patterns which are very likely to be associated with serious fetal distress and that warrant urgent actions to protect the fetus, usually immediate delivery.

Fetal scalp pH assessment (only available in well-resourced settings)

This is achieved by fetal scalp blood sampling, which is carried out with the woman in the lithotomy position with a wedge or pillow to prevent aorto-caval compression or in the left lateral position. A speculum is inserted in the vagina, the fetal scalp is visualised with the aid of a light source, and a blood sample is obtained using a lancet and a capillary tube.

A blood gas analyser (an extremely expensive item of equipment) is required for assessment of the sample.

Fetal blood gas analysis (only available in well-resourced settings)

This is used to detect fetal acidosis, which is a consequence of hypoxia. A capillary sample is assessed for pH and base excess. Generally, a pH of >7.25 is considered to be normal, but it has to be borne in mind that acidosis may develop rapidly, and the sample therefore needs to be repeated if the CTG abnormality persists. A full guide to the interpretation and use of fetal blood gas analysis is not included here as it is not a technique available in the majority of resource poor settings.

Fetal blood sampling is contraindicated if the mother is infected with HIV or in high prevalence areas in the untested patient. Other contra-indications include maternal pyrexia in labour, and pre-term labour.

Clinical assessment of fetal well-being
A large amount of information may be gained by clinical assessment as follows.

History
Gestational age is important, as an immature fetus withstands the stresses of labour less well than if he/she had reached term. Similarly, those with intrauterine growth restriction are at risk.

A reduction in fetal movements should always give rise to concern, as it may reflect fetal distress (see Section A+18).

Pre-eclampsia, antepartum haemorrhage (APH), preterm pre-labour rupture of membranes (PPROM) or other obstetric or medical problems, prolonged pregnancy, multiple pregnancy, diabetes and previous Caesarean section all increase the risk of fetal distress.

The use of oxytocin, a maternal fever, meconium- or bloodstained liquor, and prolonged first and second stage of labour also increase the risk.

The duration of labour at the time of admission is crucial, as obstructed labour is a potent cause of severe maternal and fetal morbidity and mortality.

Examination of the maternal abdomen
Fetal size: small or large for dates.

Amniotic fluid volume: oligohydramnios (too little) or polyhydramnios (too much).

Oligohydramnios is often associated with poor fetal growth. Growth-restricted fetuses are more likely to become distressed in labour than are well-grown fetuses.

Polyhydramnios may be associated with fetal abnormalities or fetal infection in utero.

Abdominal tenderness with or without hardness feeling like wood: consider placental abruption.

Colour of amniotic fluid after rupture of membranes:

Frank blood loss vaginally: consider placental abruption, uterine rupture, placenta praevia and vasa praevia.

Meconium-stained liquor: consider the possibility of a hypoxic/ischaemic episode causing fetal distress. Passage of meconium is often a physiological (normal) phenomenon in a mature fetus. In the presence of plentiful amniotic fluid, the meconium will be dilute. Where there is little fluid, it will be thick.
Meconium may signal fetal distress. It may also trigger neonatal respiratory problems through meconium aspiration, which occurs when a distressed fetus gasps in utero or during delivery.
During a breech delivery, meconium may be passed as a normal phenomenon. And is not necessarily a sign of fetal distress.

Haematuria in labour may result from uterine rupture, usually in association with severe abdominal pain and tenderness, commonly in a woman with a previous Caesarean section scar or in a woman of high parity, particularly where labour is induced or augmented. Immediate delivery is urgent.

Management of fetal distress
If fetal distress is suspected, attention should first be paid to detecting and treating maternal factors, including hypovolaemia, sepsis, obstructed labour and uterine rupture.

The woman should be placed (tilted) on her left side using a pillow or wedge to maintain this position to prevent aorto-caval compression.

Facial oxygen should be administered at a high flow rate.

Oxytocin should be discontinued if ongoing, and if still detected in situ, misoprostol tablets may be removed from the vagina.

Antibiotic therapy will be indicated if infection (including chorio-amnionitis) is suspected.

Vaginal examination should be performed to assess the feasibility of urgent vaginal delivery, either spontaneously or by using forceps or ventouse if there are no contraindications present (see Sections E3 and E4).

If suspected fetal distress continues despite the above measures and vaginal delivery is not rapidly achievable then a decision about whether to proceed to Caesarean section needs to be made. This is a difficult decision, which ideally takes into consideration a number of factors including: the obstetric history, the availability of neonatal care, the degree of fetal compromise suspected and the speed with which Caesarean section can be performed, the availability of hospital care and Caesarean section in subsequent deliveries, and the presence/absence of other relative indications for Caesarean section.

If a decision is made to deliver by Caesarean section and a delay is anticipated (> 30 minutes), then a tocolytic such as terbutaline 250 microgram s/c may be beneficial if the contractions are felt to be contributing to the fetal distress. However, this drug may increase the risk of PPH and preparations should be made to ensure PPH is prevented should it occur (for example preparation of an IV infusion of 40 IU of oxytocin in 500ml of 0.9% saline ready to be administered after delivery).

Section A+20 Resuscitation at birth of the newborn Infant

Introductory issues

The mother's needs come first if you are on your own. Most infants are quite good at looking after themselves, once they are breathing and wrapped. If possible, keep all newborn infants with their mothers.

Remember that parents need to be told what is happening to their newborn child.

When to cut and clamp the cord in an infant who needs resuscitation at birth
There are advantages to delaying clamping of the cord for 1 to 2 minutes after birth to allow placental transfer of blood to the infant (see Section A3). However, it is important to ensure that by doing this there is no harm to the mother (e.g. if she needs resuscitation) or to the infant (e.g. if he/she requires resuscitation). Usually **the umbilical cord is clamped and cut immediately if the infant needs active resuscitation.**

Evidence suggests that air is safer for initial resuscitation. However, where possible additional oxygen should be available for use in case there is not a rapid improvement in the infant's condition. Equally, hyperoxia should be avoided, especially in the preterm infant. If a pulse oximeter is available, supplementary oxygen is not needed if SaO_2 is >85% 5 minutes after birth. SaO_2 needs to be measured from the right sided wrist or hand. If oxygen is given, try to keep the SaO2 between 95 and 98 %.

Respiratory changes at birth in the newborn infant

The fetal lungs are fluid-filled, and the fetal circulation obtains oxygen from the placenta. At birth, the baby has to breathe air into the lungs to get oxygen into the circulation. To do this, fluid is removed from fetal lungs during labour and delivery:

Lung fluid is removed during labour and at birth by the following mechanisms:

- at the onset of labour, lung fluid production stops
- as labour progresses, re-absorption of lung fluid occurs
- fluid is removed from the lungs during vaginal delivery
- the first breaths generate relatively high pressures to inflate the lungs, which has the effect of pushing this fluid into the circulation. These first breaths establish the infant's resting lung volume, making breathing easier for the infant after these first breaths.

Caesarean section is associated with delayed clearance of fluid from the lungs, which reduces the initial resting lung volume.

Surfactant is produced in the fetal alveoli to prevent them collapsing and decreases the work of breathing for the newborn.

- Most surfactant is produced from 32 weeks to term so premature infants may need more breathing support for example nasal CPAP (Continuous Positive Airways Pressure).
- Surfactant production is reduced by hypothermia, hypoxia and acidosis.

Regarding resuscitation of the newborn Infant

Most infants breathe well and do not need active 'resuscitation' at birth. Simply drying the infant with a warm dry sheet/towel will in most cases stimulate a cry from the infant thus expanding the lungs. Attempts to clear the airway, to stimulate breathing, or to give facial oxygen are unnecessary. Therefore, **routine airway suctioning is not needed.**

The practice of routinely performing direct oropharyngeal and tracheal suctioning of non-vigorous infants after birth with meconium-stained amniotic fluid was based upon poor evidence. The presence of thick, viscous meconium in a non-vigorous infant is the **only** indication for initially **considering** visualising the oropharynx and suctioning material, which might obstruct the airway. If an infant born through meconium-stained amniotic fluid is also floppy and makes no immediate respiratory effort, then it is reasonable to ***rapidly*** inspect the oropharynx with a view to removing any particulate matter that might obstruct the airway. Tracheal intubation should not be routine in the presence of meconium and is performed only for suspected tracheal obstruction. The emphasis is on initiating ventilation within the first minute of life in non-breathing or ineffectively breathing infants and this should not be delayed, especially in the bradycardic infant.

In the presence of clear amniotic fluid, routine ONPS in infants born vaginally and by Cesarean section is associated with bradycardia, apnea, and delays in achieving normal oxygen saturations, with no benefit.

Intrapartum ONPS whilst the fetal head is on the perineum and post-natal endotracheal suctioning of vigorous infants born through meconium-stained amniotic fluid (MSAF) does not prevent Meconium Aspiration Syndrome (MAS). Although depressed infants born through meconium are at risk of developing MAS, there is no evidence that endotracheal suctioning of these infants reduces MAS.

Around 5% of infants do not breathe spontaneously after delivery. However, breathing can be started in almost all these infants by opening the airway and correctly applying bag-and-mask ventilation. With lung inflation there is an immediate and easily detectable rise in heart rate. It may be difficult to identify the infant's pulse rate by palpation at any site, so the best way to determine the heart rate is to listen over the chest with **a stethoscope**.

Far less commonly, infants are born cyanosed, shocked, limp and hypotonic. Around 1% do not respond to bag- and-mask ventilation and need further help with advanced resuscitation.

Recent recommendations to the Neonatal Life Support Guidelines from the 2010 and 2015 International Liaison Committee on Resuscitation (ILCOR) relevant to resource-limited countries have been included in the following guidelines:

1. If the newborn does not need resuscitation, delay in cord clamping for at least one to two minutes from complete delivery of the infant is recommended. 'Milking' of the cord is not recommended.

2. Meconium should **not** be suctioned from the nose and mouth of the baby while the head is still on the perineum.

3. The temperature of newly born infants should be maintained between 36.5^{o}C and 37.5^{o}C. Temperatures less than 36.5^{o}C have a strong association with increased morbidity and mortality. Even the mild hypothermia that was once felt to be inevitable and therefore clinically acceptable carries a risk. Therefore, the temperature in the delivery room should be at least 26 degrees C and immediately after birth the infant should be dried ideally in a warm towel and placed in dry towels and ideally a warm hat. However, this drying and wrapping should take less than 30 seconds, because rapid lung inflation is the key.

4. In very small preterm infants the use of clear food-grade plastic wrapping (cling film) of the baby's body is recommended to maintain body temperature. A heated mattress on the resuscitation platform can be helpful.

5. For infants needing resuscitation, rapid/immediate intervention by airway opening and ventilatory resuscitation (in low resource settings usually by bag and mask) is the main priority.

6. Ventilatory resuscitation is best started with air. However, where possible, additional oxygen should be added to the bag and mask if there is no rapid improvement in the infant's condition.

7. Early application after resuscitation of nasal continuous positive pressure (CPAP) should be used to provide breathing support to all breathing infants who show signs of respiratory distress. Early use of nasal CPAP of + 5cm H_2O should be specially considered to keep the small airways open and make it easier to breathe in those spontaneously breathing preterm infants who are at high risk of developing respiratory distress syndrome (RDS).

8. Adrenaline should be given by the IV route, as standard doses are likely to be ineffective if given via a tracheal tube.

9. If there are no signs of life after 20 minutes of continuous and adequate resuscitation efforts, the baby's prognosis is poor, and discontinuation of resuscitation is recommended.

Sequence of actions during resuscitation of the newborn
The order of actions is listed below with explanations. For a summary of newborn resuscitation see algorithm (Figure 6) at end of this chapter.

1 Call for help

2 Start the clock or note the time
This will help document timing of actions and duration of resuscitation.

3 Dry the infant including the head.
Infants are born small and wet. They get cold very easily, especially if they remain wet and in a draught. Whatever the problem, **dry the infant well, including the head.** Remove the wet towel and wrap the infant in a dry towel. It is helpful if the towels are warm. The room in which delivery takes place should be clean, warm and free of draughts. A clean, warm and well-lit area is needed for resuscitation. Although a source of radiant heat is helpful in keeping the infant warm, in low resource settings the provision of heat requires significant electrical power. The neonatal platform resuscitaires shown in Figure A+20.1 is inexpensive concerned with those used in well-resourced settings, does not have an overhead heater but is mobile, is safe from accidental falls of the infant, has a good low battery powered LED light, a large clockface and place for resuscitation together with places to keep the bag and masks, suction systems and towels. Because of its low cost and minimal power requirements it is suitable for all facilities in which babies are born rather than being limited to hospitals.

There is good evidence that for very preterm infants (30 weeks' gestation or earlier), immediately covering the body, apart from the face, with clean plastic wrapping, by reducing evaporative heat loss is an effective way of keeping these very small infants warm during resuscitation. A woollen cap is available can also reduce heat loss.

Drying the infant immediately after delivery will provide significant stimulation during which skin and mucous membrane colour, tone, breathing and heart rate can continue to be assessed. Observing the breathing, skin colour, heart rate and tone helps to document the infant's condition and assess their response to resuscitation.

Figure A+20.1 *Low cost mobile resuscitation platform for neonatal resuscitation*

However, stimulation is rarely sufficient for a baby who is not breathing, and no time should be wasted: if a baby is not breathing, ventilatory assistance within 30 seconds is mandatory.

Remember, that as soon as the baby is breathing or crying on their own, place immediately in skin-to-skin contact with the mother (providing she is well enough). If the mother is too ill, a relative or staff member can provide temporary skin to skin care and keep the baby warm.

4. Assess breathing effort and count the heart rate

If poor or no breathing effort, or only gasping, the baby will need help with breathing.

The heart rate should be counted over ONLY a few seconds with a stethoscope on the chest. A heart rate less than 100/min in a newborn infant is almost always due to hypoxia and effective airway opening and bag-and-mask ventilation will cause an increase in heart rate. The heart rate is used to assess effectiveness of resuscitation because chest movement in a newborn infant may be difficult to see initially. Reassess these observations regularly (particularly the heart rate), every 30 seconds or so, throughout the resuscitation process. The first sign of any improvement in the bradycardic infant will be an increase in heart rate.

A healthy infant may be born blue but will have good tone, will cry within a few seconds of delivery, will have a good heart rate (the heart rate of a healthy new-born infant is approximately 120–150 beats/minute) and will rapidly become pink during the first 90 seconds or so. An ill infant will be born pale and floppy, not breathing, and with a slow (<100) or very slow (<60) heart rate.

The heart rate of an infant is best judged by listening to the chest with a stethoscope. It can also sometimes be felt by palpating the base of the umbilical cord, but a slow rate at the cord is not always indicative of a truly slow heart rate, and, if the infant is not breathing, must not delay the immediate application of lung inflations. In addition, **if the infant is not breathing, feeling for peripheral pulses is potentially harmful as it delays the onset of life-saving lung inflations**. If a stethoscope is not available, you can listen to the heart by placing your ear on the infant's chest or using a Pinard stethoscope.

5. Airway: open the airway and keep it open

Before the infant can breathe effectively the airway must be open and must be kept open. This is one of the most important skills to learn to enable the newborn to get air into the lungs when he/she takes his/her first breath.
The upper airway of any infant who is born limp and hypotonic certainly needs to be opened and maintained in just the same way as the airway of any other unconscious patient. In an unconscious patient, pharyngeal tone decreases even more than it does during sleep, causing the upper airway to narrow or close. When such a patient is laid supine, the tongue also falls back, further obstructing the airway.
There are three ways to counteract this and open the airway

a. Hold the head in the neutral position *and*
b. Support the chin *or*
c. Push the lower jaw forward.

The best way to achieve this in an infant who is not breathing well is to place the infant on their back with the head in the neutral position (i.e. with the neck neither flexed nor extended and the face parallel with the surface the baby is lying on – Figure A+20.2). Most newborn infants will have a relatively prominent occiput, which will tend to flex the neck if the infant is placed on their back on a flat surface. This can be avoided by placing some support using a folded nappy or cloth under the shoulders of the infant (1 to 2 cm thick) but be careful not to overextend the neck.

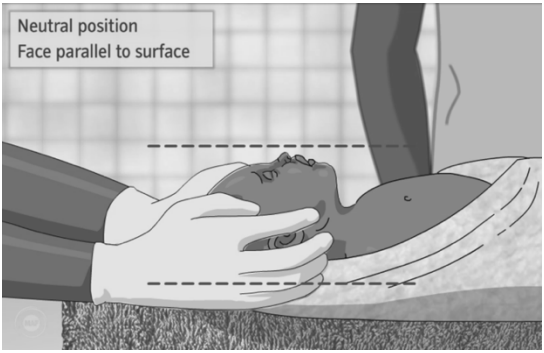


Figure A+20.2 *Neutral position of the head and neck in a new-born infant*

If the infant is floppy it may also be necessary to apply chin lift or jaw thrust (see Figures A+20.3 and A+20.4). It is important to support the bony part of the chin or jaw. *Pressure anywhere else may merely push the base of the tongue backwards, making matters worse.*

Figure* A+20.*3 *Chin lift in a new-born infant. If tone is poor it may also be necessary to support the chin.*

If tone is very poor it may be necessary to use one or two fingers under each side of the lower jaw, at its angle to push the jaw forwards and outwards ('jaw thrust') (see Figure A+20.4). A second person will then usually be needed to give the inflation and ventilation breaths by squeezing the bag (for which minimal training and skill is required).

Figure* A+20.*4 *Jaw thrust in a new-born infant. Note that the operator's thumbs are in a position to hold a mask in place.*

The best way to stabilise an infant's condition at birth is to ensure that the upper airway **remains** unobstructed. The infant will then have little difficulty in drawing air into the lungs when it takes its first spontaneous gasp or cry.

Unfortunately, books often talk of the need to keep the airway 'clear', giving the false impression that the infant is going to find it difficult to breathe unless all the fluid and mucus is first sucked out of the way. There is no evidence that this is ever necessary unless the infant has thick meconium within the nasal or oral airway. Moreover, blind deep suction of the nose or mouth can stimulate the vagus nerve, leading to bradycardia, apnoea and laryngospasm.

Routine **intrapartum (when the fetal face is on the perineum)** oropharyngeal and nasopharyngeal suctioning for infants born with clear and/or meconium-stained amniotic fluid is **not** recommended.

Tracheal obstruction
Although it is rare for debris to completely block the trachea, this should be suspected if an infant tries to breathe but remains cyanosed and bradycardic, with laboured breathing and marked inter-costal and/or sternal recession. This is one of the few situations where tracheal intubation can be lifesaving.

What to do if the trachea appears to be blocked by thick meconium
If the infant is born through meconium and is unresponsive at birth, the oropharynx should be inspected and cleared of meconium. If intubation skills are available, the larynx and trachea should also be cleared under direct vision.

If meconium has entered the trachea, resuscitation here is only possible if the accumulated debris can be immediately removed. The easiest way to do this is to pass an endotracheal tube and then remove the debris by direct suction to the endotracheal tube. Sometimes the meconium debris is so large that it cannot be sucked through the tube. The tube can then be removed and replaced with a clean tube to clear the remaining obstructive material. Suction may also make it easier to see the larynx during intubation.

Giving mask ventilation for the infant who is not breathing before the meconium has been cleared (as above) may force the meconium deeper into the lungs.

Breathing: Bag and mask inflation of the lungs
Having positioned the infant's airway correctly it is usually quite easy to use a self-inflating bag and mask to provide lung inflations.

If the infant is not breathing adequately give **five inflation breaths** as soon as possible. Until now the infant's lungs will have been filled with fluid. Aeration of the lungs in these circumstances is best with slow inflations at pressures of about 30 cmH_2O with the bag and mask; these are called 'inflation breaths'. These initial ventilation breaths should last 2–3 seconds each. The aim is to be the same as the initial breaths taken by a normal infant to open the airways, remove lung fluid and achieve its functional residual capacity. The chest may not move during the first one or two breaths as fluid is displaced.

If the baby is very preterm, such inflation breaths may injure immature lungs: give lower pressure ventilation breaths (see below) in this situation.

After 5 inflation breaths, check the heart rate. If the heart rate was below 100 beats/minute initially then it should rapidly increase as oxygenated blood reaches the heart. If the heart rate does increase, then you can assume that you have successfully aerated the lungs and there is adequate tissue oxygenation.

If the heart rate does not increase and/or is not greater than 100 beats per minute following 5 inflation breaths, the lungs have most likely not been aerated.
Consider adjusting the airway and /or mask

- Are the infant's head and neck in the neutral position?
- Do you need jaw thrust?
- Is the mask in the correct position on the face? that is covering the nose and mouth with no gap between the face and mask where air can escape

- Do you need a second person's help with the airway or to squeeze the bag? A relative or ward orderly can be asked to squeeze the self-inflating bag while you ensure that the mask is held firmly and in the best position on the face
- Is there an obstruction in the oropharynx (Inspect under direct vision)?

Check the airway is open and repeat 5 **inflation breaths** making sure that the chest expands with each breath.

If the heart rate increases but the infant does not start breathing, then continue to provide regular ventilation breaths at a rate of about 30–40 breaths/minute until the infant starts to breathe. Ventilation breaths resemble newborn infant's normal breathing normal and when undertaken through the bag and mask ensure sufficient pressures; that is just enough to see the chest move with each breath. Check every 30 to 60 seconds that the heart rate remains normal (above 100 beats/minute) and that there is no central cyanosis (best judged by looking at the colour of the tongue). If the tongue is not pink and oxygen is available, give additional inspired oxygen at 2Litres/min.

Continue ventilatory support until regular breathing is established.

Remember that the infant cannot breathe through the bag-valve-mask system, so do not leave the mask sealed to the face and expect the infant to breathe from the bag. The valve between the bag and the mask prevents this. When the infant is breathing, remove the mask and watch closely to ensure that adequate breathing continues.

Most infants will respond to bag-and-mask ventilation by gasping and then starting to breathe on their own without further support. If this does not happen, it is still easy to confirm that lung aeration has been achieved, because the heart rate will rise reliably and consistently above 100 beats/minute. If lung aeration has been achieved and the infant still has a slow heart rate, proceed to support the circulation (C).

If oxygen is available, applying this through the bag and mask may also help.

Correct application of bag-and-mask ventilation is the single most important skill needed to provide active resuscitation.

There is good evidence that most infants can be resuscitated using mask resuscitation without any need for tracheal intubation. However, a small proportion of such infants require early intubation, so the equipment and the skill to intubate should ideally be available.

Figure* A+20.*5 *Mouth-to-mouth and nose resuscitation*

Most current guidelines on neonatal care avoid discussing the role of mouth-to-mouth resuscitation. The risk of HIV infection or hepatitis has further supported that reluctance. However, there is no doubt that this can be an effective way of reviving an apparently lifeless infant in the absence of equipment. Remember the following:

- Keep the upper airway open by optimising the position of the head and jaw as described above.
- Cover the infant's nose and mouth with your mouth (or cover the mouth of a big infant and just pinch the nose).
- Use the pressure you can generate with your cheeks and try to aerate the lung by slow inflations for 2–3 seconds.
- Only use as much air for each breath as you can keep in your cheeks (i.e. do not 'blow' air into the infant, but just small puffs).
- Watch for chest movement and allow time for lung recoil.
- Once the chest starts to move, sustain what has been achieved with 20–25 artificial breaths/minute.

Checking progress with resuscitation before moving on

- If the heart rate has not risen to over 100 beats/minute after the five initial breaths or within 30 seconds of adequate ventilation, something is wrong. The most likely problem is that you have not successfully ventilated the infant. Never move on to deal with the issues covered under letter C of the resuscitation alphabet until you are quite sure you have achieved objectives A and B. To do so is quite futile. Chest compressions will never restore the circulation until the blood being massaged from the lung to the heart contains oxygen.

- Look to see whether the chest moves each time you apply mask pressure. Movement should not be difficult to see once the first few breaths have aerated the lungs. It is usually easier to judge success with your eyes than with a stethoscope. In a newborn, breath sounds can be heard when only the airway is being aerated, so are not a good way to judge ventilatory success.
- Check that the infant's head is well positioned. Check chin support and jaw thrust, and that the mask is correctly applied with no air leaks. Ask a second person to help you position the infant optimally and provide inflations by squeezing the bag while you hold the airway open and the mask in place.
- Few infants need support with their breathing once their lungs have been aerated. Most will gasp, cry or breathe just as soon as an attempt is made to get air into the lungs, and then continue breathing adequately.

– However, a few may benefit from further support if they do not start to breathe regularly, or only gasp occasionally. Some may have suffered severe hypoxia in utero, and a few may be drowsy because of drugs given to the mother during labour. Check that the heart rate remains normal (above 100 beats/minute) and that there is no central cyanosis (best judged by looking at the colour of the tongue).

– Try to assess whether there is hypoxemia (cyanosis or SaO_2 less than 95% with a pulse oximeter), if the infant's breathing remains laboured and irregular or if the infant's colour remains blue. Give oxygen then if it is available, preferably with SaO_2 monitoring. Hyaline membrane disease, meconium aspiration syndrome, pneumonia or transient tachypnoea of the newborn are most likely.

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Other possibilities include:

- intra-partum pneumonia (common)
- diaphragmatic hernia
- pneumothorax
- pulmonary hypoplasia (possibly associated with a skeletal or renal abnormality)
- cyanotic congenital heart disease (although this usually takes a little time to appear)
- persistent fetal circulation.

- If breathing requires continuous support, it is important to try and reduce mask inflation pressures to little more than half of what was needed to aerate the lung in the first place. It is easy to over-ventilate an infant with healthy lungs and to wash out so much of the carbon dioxide that normally provides the main stimulus to breathing that all such activity stops for a while. There is evidence that sustained over-ventilation can reduce cerebral blood flow.

Endotracheal intubation
As discussed earlier, most infants who need resuscitation can be managed with bag-valve-mask intubation. However, occasionally endotracheal intubation is required, but this must be done by someone skilled and practiced in the technique. It is most likely to be required for prolonged resuscitation, in meconium aspiration, and in preterm infants with surfactant deficiency. A straight-bladed laryngoscope is preferred, and tube sizes are around 3.5 mm for a term infant and 2.5 mm for a preterm infant. Sizes larger and smaller than these should be available.

Resuscitation of preterm infants
Infants with surfactant deficiency may have difficulty in expanding their lungs, and in developing a normal functional residual capacity at birth.
However, the preterm lung is quite a delicate structure with relatively little elastic support, and any use of undue pressure or excessive ventilation during resuscitation can damage the lungs.

While an inspiratory pressure of 30 cmH2O may well be necessary to begin aerating the lungs at birth, the pressure should be reduced as rapidly as possible to a level that ensures that the chest is moving adequately. The key aim must be to conserve such surfactant as already exists by sustaining the lung's functional residual capacity (an objective best achieved by providing at least 5 cmH_2O of Positive End-Expiratory Pressure (PEEP). Aim to achieve this consistently throughout transfer to the neonatal unit. This can be achieved using nasal prongs (nasal CPAP), thus avoiding tracheal intubation altogether.

Orogastric aspiration of air
If resuscitation is successful, there may be enough air inside and expanding the stomach to make it difficult for the baby to breathe. Passing an orogastric tube and aspirating air or placing it on open drainage may make it easier for the baby to breathe.

Circulation: chest compressions
Most infants needing help at birth will respond to successful lung inflation with an increase in heart rate followed quickly by normal breathing. Chest compression should be started only when you are sure that the lungs are being aerated successfully.

If the heart rate remains very slow (less than 60 beats/minute) or absent following 60 seconds of ventilation with good chest movements, start chest compressions.

In infants, the most efficient method of delivering chest compressions is to grip the chest in both hands in such a way that the two thumbs can press on the lower third of the sternum, just below an imaginary line joining the nipples, with the fingers over the spine at the back. This can only be done if there is a second operator ventilating the lungs (see Figure A+20.6).

If you are alone, the two-thumb method is not possible, as ventilations also need to be provided. In this situation, use the first two fingers of one hand to depress the lower sternum, while the other hand holds the mask in place (Figure A+20.7). Then move the hand from the sternum to squeeze the bag.

Compress the chest quickly and firmly, reducing the antero-posterior diameter of the chest by about one-third.

Because oxygenation is such an important part of neonatal resuscitation, the recommended ratio of compressions to inflations in newborn resuscitation is 3:1.

Chest compressions move oxygenated blood from the lungs back to the heart and out into the ascending aorta. From there the two coronary arteries will then quickly deliver oxygen to the failing anoxic heart muscle.

Chest compressions also can induce some air to enter the lungs.

It is important to allow enough time during the relaxation phase of each compression cycle for the heart to refill with blood, at the same time ensuring that the chest is inflating with each breath.

Figure* A+20.*6 *Two-thumb compression of the chest, with a second operator ventilating the lungs, here using a T-piece as an alternative to bag and mask.*

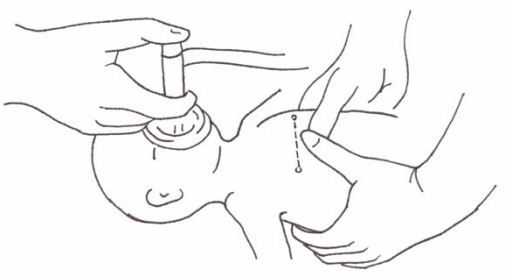


***Figure* A+20.7** *Two-finger chest compressions*

The rate of chest compressions is around 100/minute. However, with pauses for ventilation, the actual total number of compressions is less than 100/minute.

Check heart rate every 30 seconds – when heart rate reaches more than 60/min stop cardiac compressions
Continue ventilation breaths until baby is breathing.

If there no cardiac output despite effective lung ventilation and chest compressions, then the outlook for the infant is poor.

Drugs used in neonatal resuscitation
Rarely inflation of the lungs and effective chest compression will not be sufficient to produce adequate circulation and perfusion in infants. In these circumstances, drugs may be helpful. However, drugs are needed only if there is no significant cardiac output despite effective lung inflation and chest compression.

Very few drugs have proved to be of benefit. The most used drug is Adrenaline (1:10 000). This is best delivered via an umbilical venous catheter where peripheral IV access is not possible. The intra-osseous route may also be used. Each injection of a drug should be followed with a bolus of 2–3 mL of Ringer- lactate/ Hartmann's or 0.9% saline.

Unfortunately, most of the infants in whom cardiac output only returns after drug treatment require specialist neonatal care (often with mechanical ventilation) and do not survive to discharge. Most of those who do survive later develop profound disabling spastic quadriplegia.

Where the cause of the infant's terminal apnoea is a sudden and much more abrupt hypoxic event (such as shoulder dystocia or an occasional case of late cord prolapse) these reservations may be less valid. Here there is at least anecdotal evidence that the outlook is much less bleak if the circulation can be restarted.

Acidosis not serious enough to precipitate circulatory standstill (asystole) will nearly always correct itself spontaneously within 90 minutes once the circulation has been restored and the infant starts to breathe for him- or herself. It does not therefore call for sodium bicarbonate, the use of which is controversial. Indeed, giving bicarbonate may increase carbon dioxide levels, worsening intracellular acidosis, and increases the amount of sodium that the potentially compromised kidney will need to excrete over the next few days.

Adrenaline: The recommended dose of adrenaline is 10 micrograms/kg body weight (0.1 mL/kg body weight of 1:10,000 solution). If this is not effective, a dose of up to 30 micrograms/kg (0.3 mL/kg body weight of 1:10 000 solution) may be tried. Ideally, have ready-made and well-labelled 1:10 000 adrenaline solutions available on all emergency trolleys. In situations where this is not available in a ready-made state it could be prepared by adding 1 mL of 1:1000 solution to 9 mL of 0.9% saline or Ringer-lactate/Hartmann's solution. It is potentially dangerous to leave inadequately labelled and made up doses of adrenaline around, as giving the same volume of 1:10,000 as a 1:1000 solution could cause cardiac arrest. Do not use a higher dose by these routes (IV) as it is harmful. **Never give any drug into the umbilical artery.**

Naloxone (nalorphine) can be used to reverse profound opiate-induced respiratory depression in the newborn following high doses of morphine in the mother during pregnancy or delivery. If it does prove necessary, it is best to give it intramuscularly and give a full 200-microgram 'depot' dose irrespective of body weight. If naloxone is given as a single dose IV it will be eliminated from the body faster than the opioid drug, causing a return of the respiratory depression, and therefore the infant may stop breathing again without a naloxone infusion. Naloxone does not reverse the respiratory depressing effects of non-opiate drugs.

Acute blood loss as a cause of circulatory arrest

Sudden acute blood loss is a rare, but often unrecognised, cause of acute circulatory collapse. Bleeding from an aberrant placental blood vessel (vasa praevia) or snapped umbilical cord can rapidly lead to hypovolaemic death. Other less well-recognised causes of hypovolaemic collapse include acute feto–maternal blood loss, sudden twin-to-twin transfusion, and accidental incision of the placenta during Caesarean delivery and cord ligature that has come off and not been detected.

Circulatory collapse probably does not occur until the infant has lost 30–40 mL/kg of blood. The response to a rapid infusion of 10ml/Kg of 0.9% saline or Ringer Lactate /Hartmann's solution can be lifesaving. A more effective treatment is to take 20 to 30 ml of blood from a vein in the mother and inject 10 ml/kg of this blood intravenously (peripheral vein or umbilical vein) into the baby

An alternative if available is O Rh-negative blood) This can be repeated once if needed. A packed red cell transfusion using cross matched or group O Rh-negative blood can be given later to correct the associated anaemia.

Apart from the above specific indications, IV fluid boluses should not be used during neonatal resuscitation. There is no evidence to suggest benefit from routine use, which only compounds the problem of fluid balance that can develop over the next 2 to 3 days if severe intra-partum stress causes secondary renal failure.

Poor response to resuscitation

If the infant either fails to respond or shows a poor response to resuscitation, the most likely problem is inadequate oxygenation. The following steps should be considered:

1. Check the airway and ventilation.
2. Check for technical faults if using equipment.
    a. Is the oxygen attached?
    b. Is the airway blocked?
    c. Is the endotracheal tube in the correct place?
3. Re-examine the chest to see if a pneumothorax has developed. This is not common but may cause a problem. Drain a tension pneumothorax with a small cannula over needle (21 gauge) in the second intercostal space in the mid-clavicular line. This should be followed by the insertion of a chest drain (see Neonatal Handbook).
4. Consider the possibility of a congenital heart lesion if the infant remains cyanosed despite breathing and having a good heart rate.
5. Consider the possibility that excessive assisted ventilatory breaths may have driven blood carbon dioxide to a low level thereby removing one of the drives by the brain to breathe spontaneous.
6. Consider the possibility of maternal opiates or sedation, such as diazepam or phenobarbitone, if the infant is pink, well perfused, but requires assisted ventilation.
7. Shock, caused by acute blood loss, should respond to a rapid bolus of 10–20 mL/kg of O-negative blood (see above).
8. Consider the possibility of hypoglycaemia

Stopping resuscitation

Even with the most effective resuscitation, not all infants will survive. If the infant has been without a cardiac output after 20 minutes of resuscitation and does not respond despite effective ventilations and chest compressions, the outcome is unlikely to be altered by the use of drugs, although these should be considered. The decision to stop resuscitation should be taken by the most senior healthcare worker present, and the reason for the decision should be clearly documented. Explain sensitively to the parents that the infant has died. The infant should then be handled in accordance with cultural preference and practice.

Documentation

It is important to keep accurate records of the steps taken during resuscitation. The reason for any decision must be clearly documented, including the decision to start and end resuscitation. This is important irrespective of the immediate outcome of the resuscitation effort. As with any documentation, keep to the facts and make a complete record of all the steps taken, their timing, and the impact that they had on the infant's progress. Remember to sign and date the record.

Section A+21 Multiple births

Introduction

Twins occur in around 1 in 80 pregnancies. Non-identical twin rates vary depending on age, parity and racial background; in Africa, rates are higher than the world average. The incidence of monozygous (identical) twins is relatively constant worldwide, at 3.5 in 1000 births.

Multiple pregnancies are associated with higher risks for both the mother and the fetus. Ultrasound scanning should be undertaken if the uterine size is larger than expected, or if abdominal examination of fetal parts leads to suspicion of multiple fetuses.

If ultrasound scanning facilities are not available, abdominal examination after delivery of any first baby should be performed to exclude a second twin before oxytocin or other uterotonic drug is given to aid delivery of the placenta.

Maternal risks associated with multiple pregnancy

- miscarriage
- anaemia
- preterm labour
- pre-eclampsia
- polyhydramnios
- operative delivery
- postpartum haemorrhage.

Fetal risks associated with multiple pregnancy

- stillbirth or neonatal death
- preterm delivery
- intrauterine growth restriction
- congenital abnormalities
- cord accident
- specific complications of twin pregnancies (e.g. twin-to- twin transfusion syndrome)
- difficulties with delivery.

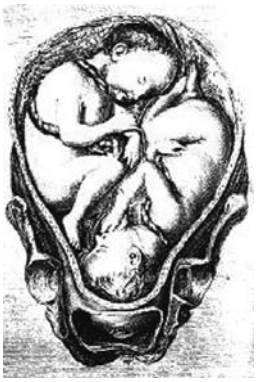


Figure *A+21.1* *Twin pregnancy.*

If a twin pregnancy is diagnosed, additional care should be provided. Iron and folate treatment must be ensured, due to the increased risk of anaemia. Preterm labour and delivery present the greatest risk of fetal illness and death.

Presentation of twins

- In 40% of cases both twins are cephalic.
- In 21% the second twin is a breech.
- In 14% the first twin is a breech.
- In 10% of cases both twins are breeches.
- In all remaining cases, one twin or the other, or occasion- ally both, are transverse.

In Figure *A+21.2*, the first twin is the lower one.

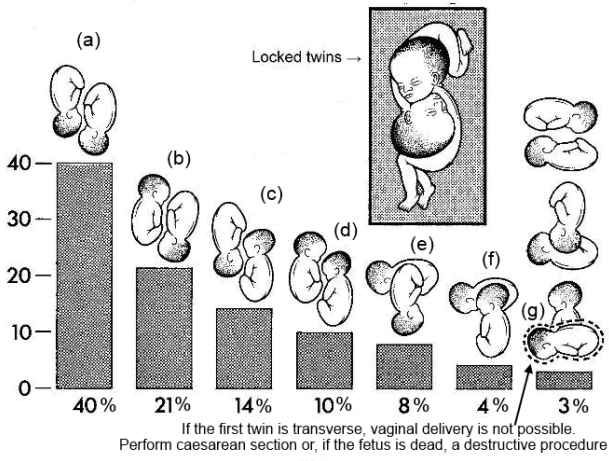


Figure A+21.2 *The range of different twin positions in utero at birth.*

Antenatal monitoring in multiple pregnancy

- A 2-weekly check-up, with urinalysis for protein, blood pressure and ultrasound if possible, is recommended from 28 to 36 weeks; warn the woman about the risk of preterm delivery.
- Iron and folate treatment must be ensured as increased risk of anaemia is present.
- A weekly check-up is recommended from 37 weeks.
- Be alert for signs of pre-eclampsia and premature labour.

Summary of management of Twin delivery

Vaginal delivery is usually safe but must be undertaken in a healthcare facility where comprehensive emergency obstetric care is available. If labour has not started by 39–40 weeks' gestation based on an accurate LMP or first trimester ultrasound, consider induction.

First stage:
Ensure that first twin lies longitudinally, with IV access and fetal heart rate monitoring of both twins

Oxytocin augmentation for poor contractions in nulliparous women

Second stage:
Set up two delivery packs with extra clamps and an amnihook
Always have an oxytocin infusion ready (40 IU in 500ml 0.9% saline) for the second twin, and IV fluids and drugs in case of PPH (it takes 10 minutes to prepare so best to have it ready in case needed to boost contraction for second twin or to deal with a PPH).

Management of the vaginal delivery of the first twin

1. insert an IV cannula. Maternal blood should be obtained for a full blood count and blood grouping. A blood sample should be kept for cross- matching. Ideally, identify a potential living donor.
2. Ensure lie of the first baby is longitudinal.
3. Augment contractions only when indicated.
4. Prepare two delivery packs with extra clamps. Remember there are almost always two membranes to rupture with twins, so have an amnihook ready.
5. Make sure cervix is fully dilated.
6. Ensure mother's bladder is empty.
7. Deliver first baby as normal.
8. Always clamp maternal end of the cord of first twin to prevent the second twin bleeding from It.

9. As the first baby is delivered you must ensure the lie of the second twin is kept in longitudinal lie by an assistant by placing the palms of their hands firmly on either side of the uterus in a longitudinal direction. The baby's lie should be kept in this way until the head or buttocks are fixed in the maternal pelvis. If the second twin is not longitudinal on assessment, undertake version (see below).
10. Tie a marker (e.g. gauze) to the clamp on the cord of the first baby to identify it.
11. Ensure expert on neonatal resus present at birth

Management of the vaginal delivery of a second twin

1. The second baby should preferably be born within 30 minutes.
2. Check the fetal heart rate of the second baby.
3. Stabilise the lie of the second twin, by external version if necessary.
4. Provided lie is longitudinal and contractions do not re-start almost immediately (within 5 minutes) after delivery of the first baby, start an oxytocin infusion, increasing carefully to achieve adequate contractions. Note contractions may not be felt by the mother, so keep your hand on the uterus to identify them.
5. When presenting part is well into the pelvis, rupture the membranes during a uterine contraction and ensure no cord prolapse.
6. Delivery of 2nd baby should not be rushed but assisted delivery should be considered if the second baby has not been delivered by 30 minutes after delivery of the first.
7. If lie of second twin is transverse and membranes intact **attempt external version to either cephalic or breech presentation.**
8. **If external version is successful**, or the second twin is longitudinal, wait for the presenting part to enter the pelvis, then perform artificial rupture of membranes and allow normal cephalic or breech delivery provided no fetal distress.
9. If **external version is unsuccessful,** carry-out internal podalic version with breech extraction.
10. If fetal distress or delay, **perform an assisted vaginal delivery if cephalic** and **internal podalic version delivery if breech**. Note that cephalo-pelvic disproportion is very uncommon in the case of the second twin.
11. Ensure expert on neonatal resus present at birth.

Delivery of a second twin where external version has failed and internal podalic version (IPV) is needed

1. Before starting internal podalic version the membranes should NOT ideally have ruptured. However, it is common for the membranes to rupture during IPV and, if so, continue to try and grab a foot (usually there will remain sufficient amniotic fluid around the baby to allow the version to occur).
2. The procedure must be sterile so wear sterile (ideally elbow length) gloves and if available use Chlorhexidine obstetric cream.

3. It is essential that as the fetus descends, rotation of the fetus is encouraged to obtain a back- up (back anterior) position (as with breech delivery).
4. Grasp a fetal foot. Make sure that it is a foot, not a hand (the foot has a right-angled ankle joint).
5. Accompanying contractions pull gently down into the birth canal so that the fetal back is encouraged to turn anteriorly. Use your other hand on the surface of the abdominal uterus to turn the fetal head to the top of the uterus.
6. Pull the fetal foot as gently as possible in an attempt to pull it as low as the vulva before the membranes rupture spontaneously.
7. It may be that maternal effort will be sufficient once the baby's leg has been brought down into the vagina to allow the remainder of the delivery to be managed as for an assisted breech delivery.
8. If maternal effort is not adequate, continued traction (avoiding soft tissues as for all breech deliveries) is permissible in this scenario, to facilitate descent of the buttocks, arm and head (breech extraction).
9. Give prophylactic antibiotics.
10. Ensure expert on neonatal resuscitation is present at the delivery.

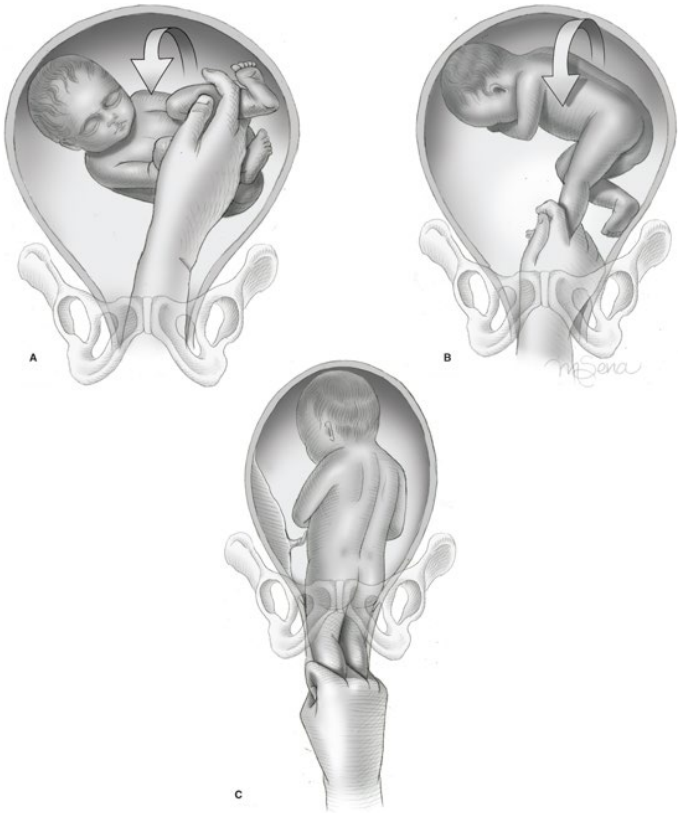


Figure A+21.3 *Internal podalic version for transverse lie in a second twin*

Management immediately after a multiple vaginal birth to prevent PPH and other complications

1. Observe vital signs including any vaginal bleeding closely, because of the **increased risk of PPH**.
2. After birth of the second baby, give 10 IU oxytocin IM after ensuring there is no third baby in the uterus.
3. Then give oxytocin 40 units IV in 500 ml of 0.9% saline over 4 hours, to reduce the risks of PPH due to atonic uterus.
4. Deliver the placentas by controlled cord traction after giving the oxytocin IM.
5. Examine and record on the patient's chart the number of placentas, amnions, chorions and cord vessels. Check the placentas and membranes for completeness.
6. Check and repair any cervical, vaginal and perineal damage.
7. Provide extra support to assist with the care of and feeding of the babies.
8. At least a 24- hour stay in hospital is required.

Hooking or locking of heads

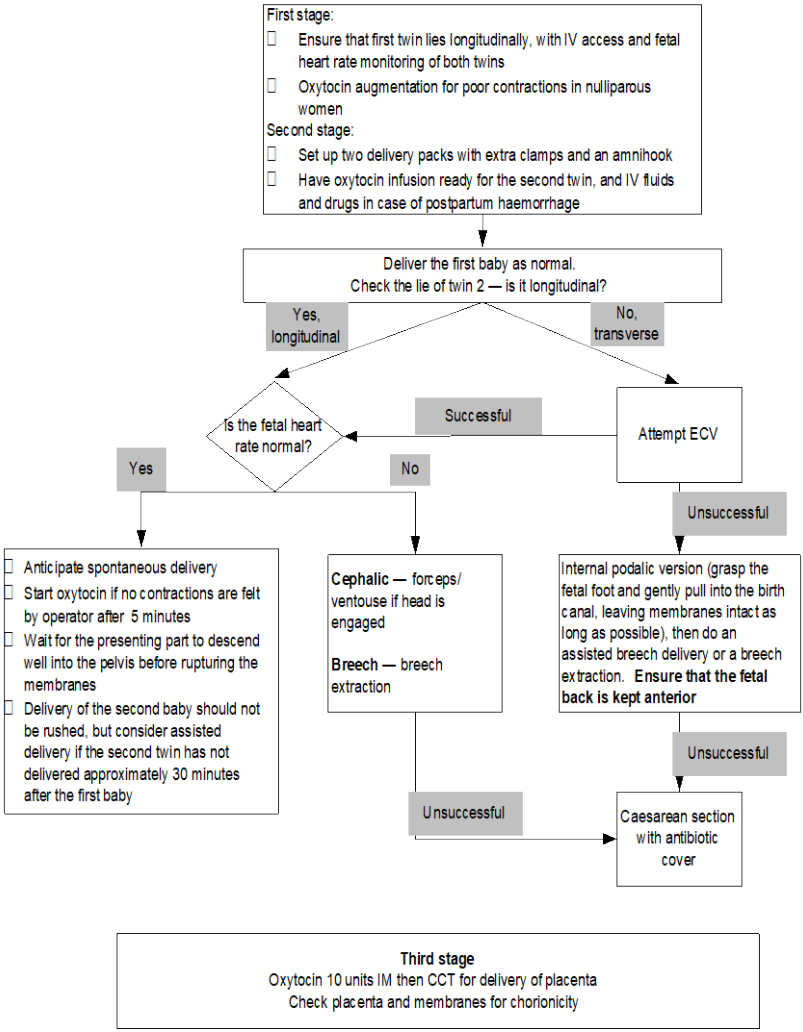
This is a rare complication during vaginal delivery of mono-amniotic twins.

Women may present with locked twins with the first trunk partially delivered. The head of the second twin will have entered the maternal pelvis and needs to be pushed upwards to allow descent of the head of the first twin. If the first baby is already dead, delivery can occur by decapitation. After delivery of the body, the head is disimpacted and the second twin is delivered. Finally, the first head is delivered with a vulsellum.

If the first baby is still alive (e.g. if the delivery is taking place in hospital), or if despite decapitation of the first baby the second one cannot be delivered, proceed immediately to Caesarean section if this is safe for the mother.

Figure A+21.4 *Locked twins.*

Figure A+21.5 *Pathway of care for delivery of twins. ECV, external cephalic version; CCT, controlled cord traction.*



Section A+22 Fetal malpresentations and malpositions

Introduction

Malpresentations are all presentations of the fetus other than a vertex presentation (includes face, brow, breech and transverse lie with shoulder presenting).

Malpositions are abnormal positions of the vertex of the fetal head (with the occiput as the reference point) relative to the maternal pelvis (namely occiput-posterior and occiput-transverse).

Fetal malpresentations or malpositions can result in prolonged or obstructed labour.

Malpresentations and malpositions can be due to maternal pathology (e.g. contracted pelvis, uterine fibroids) or fetal pathology (e.g. hydrocephalus), which ideally should be diagnosed antenatally.

Most often there is no apparent cause.

Management

Review the progress of labour using a partograph (*see* Section A3). Note: Observe the mother closely.

Assessment of the fetal position

Determining the presenting part

The most common presentation is the vertex of the fetal head. If the vertex is the presenting part, use landmarks of the fetal skull to determine the **position** of the fetal head (*see* Figure A+22.1). However, although the anterior fontanelle is larger than the posterior one and has four sutures leading from it, one of these is small and may be difficult to feel.

Determining the position of the fetal head

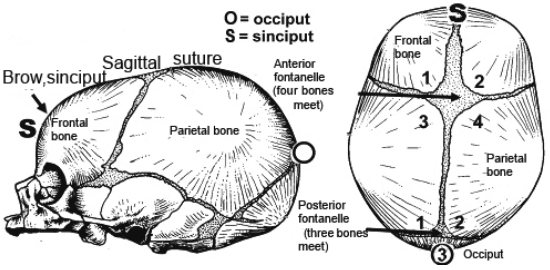
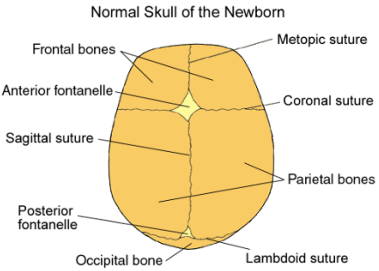


Figure A+22.1 *The fetal skull.*



The fetal head normally engages in the maternal pelvis in an occiput transverse position. With descent, the fetal head rotates so that the fetal occiput is anterior in the maternal pelvis (*see* Table A+22.1).

Failure of an occiput to rotate to an occiput anterior position results in a persistent transverse malposition. Rotation may also occur to an occiput posterior malposition.

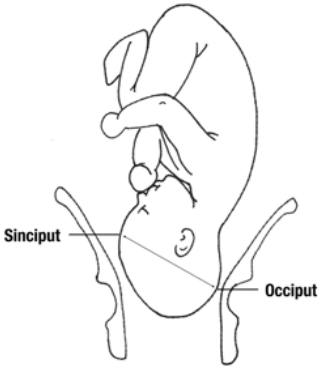


Figure A+22.2 *Well flexed vertex*

An additional feature of a normal position is a well-flexed vertex (*see* Figure A+22.2), with the fetal occiput lower in the vagina than the sinciput.

Table A+22.1 Diagnosis of normal position

Position	Observations	Picture from introitus
NORMAL POSITION		
Occiput anterior	On vaginal examination provided that the head is flexed, only the posterior fontanelle with three sutures entering it is felt	 **Occiput anterior**
		 **Left occiput anterior**
		 **Right occiput anterior**

Table A+22.2 malpositions

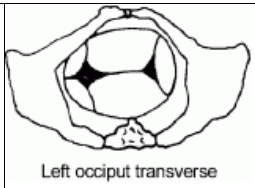
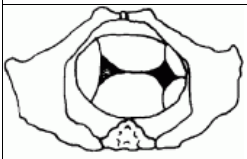
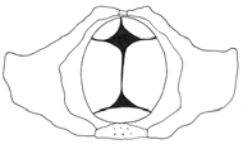
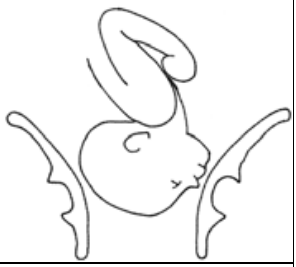
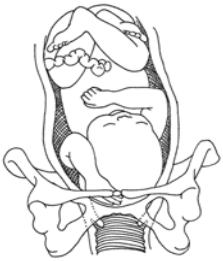
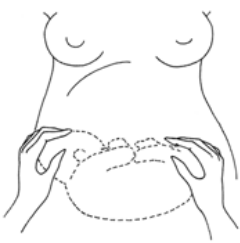
Position	Observations	Picture from introitus
MALPOSITIONS		
Occiput transverse	With descent, the fetal head rotates so that the fetal occiput is anterior in the maternal pelvis (see above). Failure of an occiput transverse position to rotate to an occiput anterior position should be managed as an occiput posterior position.	 Left occiput transverse  Right occiput transverse
Occiput posterior	On vaginal examination, the posterior fontanelle is towards the sacrum and the anterior fontanelle may be easily felt if the head is deflexed On abdominal examination the lower part of the abdomen is flattened, and the fetal limbs are palpable anteriorly	 **Occiput posterior**  **Left occiput posterior**

Table A+22.3 Diagnosis of malpresentation

Malpresentation	Observations	Pictures
Brow mal presentation is caused by partial extension of the fetal head so that the occiput is higher than the sinciput	On abdominal examination, more than half of the fetal head is above the symphysis pubis, and the occiput is palpable at a higher level than the sinciput On vaginal examination, the anterior fontanelle and the orbits are felt	
Face mal presentation is caused by hyper-extension of the fetal head so that neither the occiput nor the sinciput are palpable on vaginal examination	On abdominal examination, a large amount of head is palpable on the same side as the back, without a cephalic prominence on the same side as the limbs On vaginal examination, the face is palpated, the examiner's finger enters the mouth easily and the bony jaws are felt	 
Compound mal presentation occurs when an arm prolapses alongside the presenting part	Both the prolapsed arm and the fetal head present in the pelvis simultaneously	
Transverse lie and shoulder malpresentation	The fetus lies in the transverse position with usually the shoulder presenting On abdominal examination, neither the head nor the buttocks can be felt at the symphysis, and the head is usually in the flank On vaginal examination, a shoulder may sometimes be felt. An arm may prolapse and the elbow, arm or hand	

Malpresentation	Observations	Pictures
Breech malpresentation occurs when the buttocks and/or the feet are the presenting parts	On abdominal examination, the head is felt in the upper abdomen and the breech in the pelvic brim. Auscultation locates the fetal heart higher than expected when a vertex presentation is in place On vaginal examination during labour, the buttocks and/or feet are felt; meconium is normal	 **extended legs**  **flexed legs**  **footling**  **a single footling presentation**

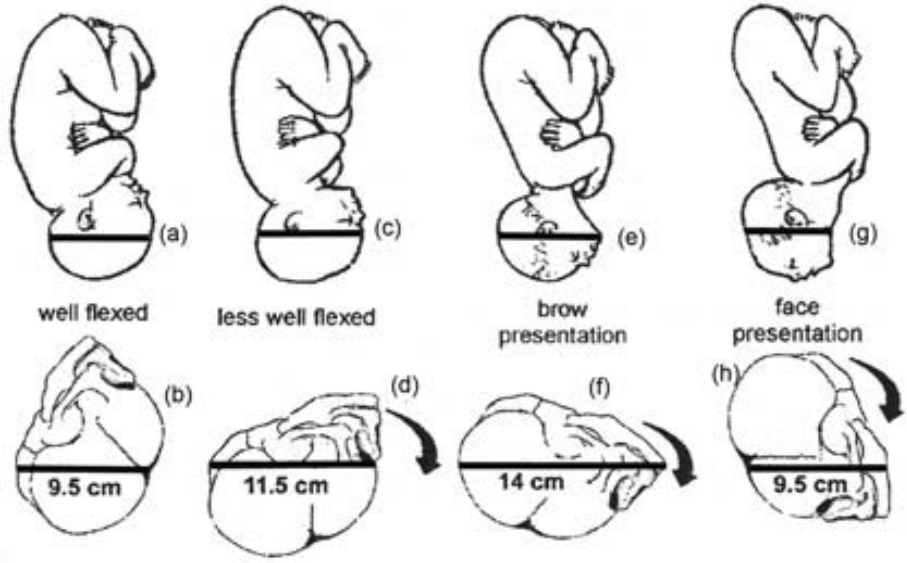


Figure A+22.4 *(a), (c), (e) and (g) are all vertex presentations. The only normal one is the well-flexed head (a). As (a) turns through to become (g), the baby's head becomes more and more extended (deflexed) and malpresentations occur.*

As the baby's head extends (deflexes), the diameter that has to pass through the mother's birth canal gets larger, until the baby becomes a brow presentation (14 cm). Then it gets smaller as the baby becomes a face presentation (*see* Figure ***A+22***.4).

Labour gets more difficult as the head extends, with brow and mento-posterior face presentations being impossible to deliver vaginally unless the baby is particularly small in relation to the mother's pelvis.

A face presentation is easier to deliver than a brow presentation. This is because the head has now become fully deflexed.

The vertex presentations in Figure ***A+22***.4 show the diameters of the skull. When the head is well flexed (a), the shortest diameter of the skull is entering the mother's pelvis. In a brow presentation (e), which is the most difficult type, the longest diameter is trying to enter the pelvis.

Management of malpositions

Occiput-posterior positions

Around 15–20% of term cephalic fetuses are in an occiput-posterior (OP) position before labour, and approximately 5% are OP at delivery. Most fetuses (around 90%) rotate to the occiput-anterior (OA) position, some maintain a persistent OP position, and others rotate from an OA to an OP position during labour and delivery.

Arrested labour may occur when the head does not rotate and descend. Delivery may be complicated by perineal tears or extension of an episiotomy because an instrumental delivery is performed or because a persistent OP presentation requires passage of a greater diameter. The newborn infant is more likely to need resuscitation.

Diagnosis of an OP position in the second stage is generally made by digital vaginal examination, but if there is uncertainty, ultrasound examination is both useful and accurate in the right hands.

Management

There is **no** effective method of facilitating rotation from OP to OA before labour begins.

First stage of labour

Manual rotation (see below) **must not be attempted** in the first stage of labour, as it can lead to a prolapsed cord or complex presentations (e.g. hand). It is also technically more difficult and may introduce infection.

1. If the membranes are intact, consider ARM
2. If there are no signs of obstruction, augment labour with oxytocin.
3. If there are signs of obstruction or the fetal heart rate or pattern is abnormal (< 110 beats/minute or > 160 beats/minute, or abnormal decelerations) at any stage, deliver by Caesarean section if this can be safely undertaken.

Second stage of labour

Provided the cervix is fully dilated:

If the fetal head is more than 3/5 palpable above the symphysis pubis, or the leading bony edge of the head is above –2 station and there is fetal distress or failure to descend, perform a Caesarean section.

If the fetal head is less than 3/5 above the symphysis pubis, or the leading bony edge of the head is between 0 station and –2 station, try manual rotation (see below) if there is no clear progress in the second stage with an OP position after 30 minutes of pushing.

However, expectant management of the OP position is appropriate in the presence of a reassuring fetal heart rate, adequate space on clinical examination of the pelvis, and continued progress in the second stage. More than 50% of multiparous women and more than 25% of nulliparous women with persistently OP fetuses achieve spontaneous vaginal delivery.

Therefore, it is not appropriate to routinely perform prophylactic rotation at the beginning of the second stage of labour.

Delivery from an OP position rather than rotation (see below) is more appropriate in women who, on clinical examination, are found to have ample room between the fetal occiput and the maternal sacrum/coccyx, and when the pelvis is too narrow to permit anterior rotation (women with an anthropoid pelvis with a narrow transverse diameter, and women with an android pelvis with a narrow arch).

Manual rotation of OP malpositions

Successful rotation after the onset of the second stage of labour is more likely to be successful if it is performed before transverse arrest occurs. Manual rotation can convert 90% of OP or transverse arrest situations to OA.

Manual rotation is more successful in multiparous women.

Rotation is important if there is a need for a fast delivery and/or if there is minimal or slow descent after a trial of pushing.

First empty the bladder.

There are two methods for rotating the fetus.

1. A hand is inserted into the vagina with the palm upward. Digital rotation is performed by placing the tips of the index and middle fingers in the anterior segment of the lambdoid suture near the posterior fontanelle (see Figure A+22.5).

The fingers are used to flex and slightly dislodge the vertex, rotating the fetal head to the OA position by rotation of the operator's hand and forearm. The thumb may also be used with gentle downward pressure more anteriorly on the parietal bone to aid this rotation. The fetal head should be held in place for a few contractions to prevent rotation back towards the posterior position.

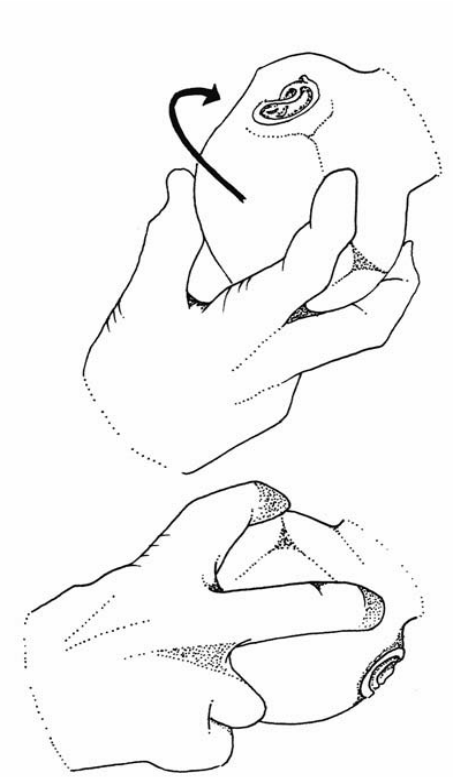


Figure A+22.5 *Finger rotation of occiput posterior to occiput anterior position. Reproduced with permission from Argani CH, Satin A. Management of the fetus in occiput posterior position. In: UpToDate, Post TW (ed.), UpToDate, Waltham, MA.*

2. The operator's four fingers are placed behind the posterior parietal bone with the palm up and the thumb over the anterior parietal bone. The right hand is used for the left OP position, and the left hand is used for the right OP position. The head is grasped with the tips of the fingers and thumb. During a contraction, the patient is encouraged to push and the operator attempts to flex and rotate the fetal head anteriorly. Occasional mild upward pressure may help to slightly displace the head and facilitate rotation (see Figure A+22.6).

If rapid delivery is indicated, failed manual rotation may be followed by vacuum delivery from the OP position. Manual rotation performed prior to instrumental birth is associated with little or no increase in risk to the pregnant woman or to the fetus. Ventouse or forceps delivery should never be attempted above 0 station or if the head is more than 1/5 above the symphysis pubis.

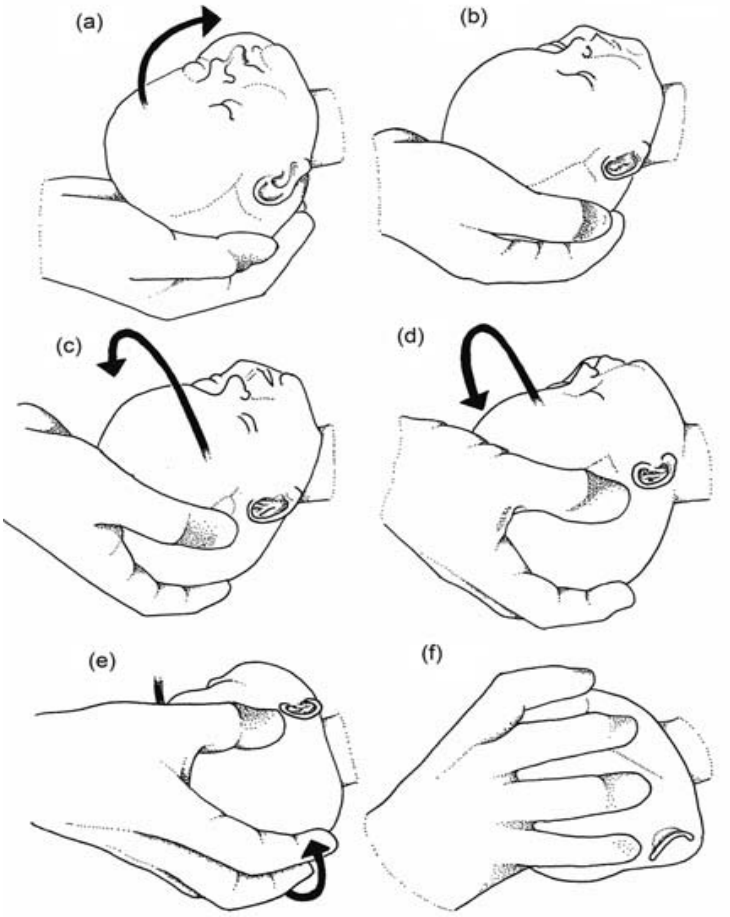


FIGURE A+22.6 *Manual rotation of occiput posterior to occiput anterior position. Manual rotation of occiput posterior to occiput anterior position. Reproduced with permission from Argani CH, Satin A. Management of the fetus in occiput posterior position.*

Delivery of a brow malpresentation

In brow malpresentation, engagement is usually impossible, and arrested labour is common. Spontaneous conversion to either vertex presentation or face presentation can rarely occur, particularly when the fetus is small or when there is fetal death with maceration. It is unusual for spontaneous conversion to occur with an average-sized live fetus once the membranes have ruptured.

If the fetus is alive, deliver by Caesarean section if this can safely be undertaken.

If the fetus is dead and:

- the cervix is not fully dilated, deliver by Caesarean section
- the cervix is fully dilated, deliver after craniotomy.

If the operator is not proficient in craniotomy, deliver by Caesarean section.

Only if the fetus is small or very low in the vagina, a brow presentation might be delivered by vacuum extraction, forceps delivery or symphysiotomy.

Delivery of a face malpresentation

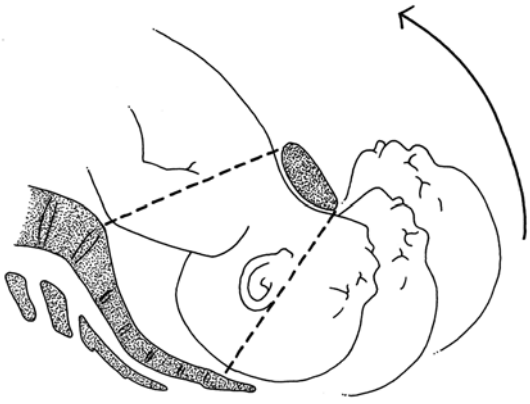


Figure A+22.7 *Mento-anterior malpresentation.*

Background

Face malpresentation occurs in 1 in 500–1000 pregnancies. It is due to extension of the fetal neck, caused by either a fetal abnormality or progression from a deflexed occiput-posterior position in labour. Accurate diagnosis is important, as a face malpresentation may be mistaken for breech malpresentation.

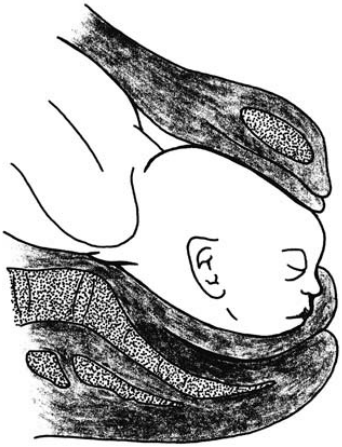


Figure A+22.8 *Mento-posterior malpresentation* ***Diagnosis***

Face malpresentation may be detected on ultrasound scan before labour, but the majority of cases are unpredictable because they arise in labour.

On abdominal examination, a large amount of head is palpable on the same side as the fetal back, without a cephalic prominence on the same side as the limbs.

On vaginal examination, in early labour the presenting part is high. Landmarks are the mouth, jaws, nose, and malar and orbital ridges. The presence of bony gums (alveolar margins) distinguishes the mouth from the anus. The mouth and the zygoma ridges of the maxillae (upper jawbone) form the corners of a triangle, whereas the anus is on a straight line between the ischial tuberosities.

Avoid damaging the eyes with trauma or use of antiseptics.

Ventouse must not be used.

In early labour, particularly with the occiput-posterior position and a multiparous patient, deflexion is common. In such cases, uterine contractions often cause increased flexion, and delivery will proceed as normal. However, if extension occurs, a brow malpresentation and finally the fully extended face will result. Most face malpresentations therefore only become obvious late in labour.

Descent is usually followed by internal rotation with the chin passing anteriorly. If the chin is towards the pubis (mento-anterior), the baby can often be delivered normally, although an episiotomy is usually necessary. If the chin lies towards the back, delivery will not occur, and a Caesarean section will be required.

For mento-anterior malpresentation, the widest biparietal diameter is 7 cm behind the advancing face, so even when the face is distending the vulva, the biparietal diameter has only just entered the pelvis. Descent is less advanced than vaginal examination suggests, even allowing for gross oedema. The head is always higher than you think. Abdominal examination is vital, when assessing progress during labour.

The head is born by flexion, causing considerable perineal distension in the process and risking considerable perineal trauma, so consider an episiotomy. Anterior rotation having occurred, the neck comes to lie behind the symphysis pubis and the head is born by flexion. The shoulders and body are born in the usual way.

With satisfactory uterine action and the mento-anterior (MA) malpresentation (*see* Figure A+22.7). spontaneous delivery or easy 'lift-out' (forceps-only) assisted delivery will ensue in 60–90% of cases.

If spontaneous delivery of a mento-anterior face malpresentation does not occur, a 'lift-out' forceps delivery can be performed (*see* Section E4) on forceps delivery.

In mento-posterior (MP) malpresentation (see Figure A+22.8), the neck is too short to span the 12 cm of the anterior aspect of the sacrum. In addition, the neck would have to be extended to pass under the symphysis, but it is already maximally extended. Delivery is impossible unless a very small fetus or one that is macerated allows the shoulders to enter the pelvis at the same time as the head. Even with MP malpresentations, anterior rotation will occur in the second stage in 45–65% of cases, so a persistent MP malpresentation or mento-transverse arrest is encountered in only 10% of face malpresentations.

Persistent MP malpresentations are usually delivered by Caesarean section (if this is possible and safe), in order to reduce fetal and maternal morbidity.

After birth, the oedema and bruising of the baby's face may persist for some days and may make feeding difficult.

Summary management of face malpresentation

1. Make a diagnosis.
2. Check for cord presentation or prolapse.
3. Continuously monitor the fetal heart rate.
4. Examine regularly to check that progress is adequate.
5. Give oxytocin if progress is not satisfactory. (Caesarean section may be preferred to augmentation if facilities are available.)
6. Do not use scalp electrodes or perform fetal blood sampling.
7. If the position is mento-anterior, vaginal delivery should be possible.
8. Perform an episiotomy.
9. If the fetus is persistently presenting in an MP position, deliver by Caesarean section (if appropriate resources are available and it is safe to do so).

Delivery of compound malpresentations

Here more than one part of the fetus is facing the cervix (e.g. an arm prolapsing alongside the presenting part). This situation is more common in prematurity.

Compound malpresentations, especially minor degrees involving just a hand can be managed expectantly in the early stages of labour, especially in the multiparous patient, and can sometimes be digitally encouraged back into the uterus. If they progress or persist and cause delay in the first or second stages of labour, then Caesarean section should be undertaken.

Transverse and oblique malpresentations/lie

Background

These are associated with prematurity, uterine fibroids and placenta praevia, and consequently are associated with high maternal and fetal morbidity. Always try to identify the underlying pathology, if any.

If the membranes are intact in early labour, it is worth attempting external cephalic version (see below under breech).

The presentation of shoulder, limb or cord in the presence of ruptured membranes means that Caesarean section is the only option for delivering a viable infant. If the fetus is dead, unless it is very small and macerated, it is safer to perform a destructive procedure if an operator experienced in the procedure is available.

Practical points to remember

1. Using ultrasound, try to identify the cause of the abnormal lie/malpresentation, if any.
2. Positively exclude placenta praevia with ultrasound before performing digital vaginal examination. If there has been no vaginal bleeding, placenta praevia is still possible.
3. Caesarean section can be extremely difficult:
4. The lower segment will be poorly formed.
5. Fibroids, when present, can distort the anatomy and inhibit access.
6. If placenta praevia is associated with the malpresentation, severe haemorrhage is likely.
7. A vertical uterine incision may sometimes be most appropriate for the above reasons.

Keep the membranes intact while making and extending the uterine incision, as this aids manipulation of the fetus into a longitudinal plane for delivery.

Delivery is usually best achieved by finding, grasping and bringing down a foot (recognised by the presence of the heel) into the incision. If the foot is difficult to find, the back and buttocks should be identified, and the legs followed until a foot is found.

If delivery is still impossible, the uterine incision can be extended upwards in the midline, making an ‘inverted T’. If an extended uterine incision has been used, it is essential to undertake an elective Caesarean section in subsequent pregnancies, because of the risk of uterine rupture during labour.

Section A+23 Breech malpresentation including external cephalic version and arrest of the aftercoming head

Background

At 28 weeks, 20% of babies are breech, but most fetuses will turn spontaneously so that only 3–4% will remain breech at term. There is a higher rate with prematurity. Vaginal delivery (although safer for the mother than Caesarean section) carries a higher risk of perinatal and neonatal mortality and morbidity due to birth asphyxia and trauma.

Hazards of vaginal breech delivery

Compared with the cephalic presentation at term, there is a greater risk of perinatal and neonatal mortality and morbidity, due principally to fetal congenital anomalies and birth trauma and asphyxia. In terms of maternal outcomes, vaginal birth is generally better for the mother than Caesarean section, as the operative complications associated with major abdominal surgery and the resulting uterine scar are avoided. All of these factors are especially relevant in resource-limited countries.

Reducing problems

Options

1. If there are no associated complications of pregnancy (e.g. previous Caesarean section, pre-eclampsia), explain the three options to the woman and her family:
    a. external cephalic version (ECV)
    b. trial of vaginal breech
    c. elective Caesarean section (only if this is safe).
2. On the basis of current evidence, all women with uncomplicated breech presentation at term should be offered ECV.
3. If it is decided that an elective Caesarean section is the best option, wait until at least 39 weeks (as babies may still turn spontaneously until then).
4. A trial of vaginal breech delivery is appropriate if both mother and baby are of normal proportions. The presentation before labour should be either frank (hips flexed, knees extended) or complete (hips flexed, knees flexed, but feet not below the fetal buttocks because of the risk of cord prolapse and delay in progress of labour).
5. There should be no evidence of feto–pelvic disproportion – that is, adequate pelvis (using clinical judgement) and estimated fetal weight < 4000 grams (by clinical measurement and ultrasound assessment).
6. In some smaller women it may be appropriate to exclude a vaginal breech option where the estimated fetal weight is > 4000 grams, provided that Caesarean section is safe.

7. There should be no evidence (on ultrasound) of hyper-extension of the fetal head.

Fetal complications of breech presentation

1. cord prolapse
2. birth trauma as a result of extended arm or head, incomplete dilatation of the cervix, or cephalo–pelvic disproportion
3. asphyxia due to cord prolapse, cord compression, placental detachment or arrested head
4. damage to abdominal organs
5. broken neck.

External cephalic version (ECV)

Background

Current recommendations in well-resourced countries are that ECV should be performed with the mother wide awake, but nil by mouth for 4 hours, having made her informed choice and having given consent for Caesarean section, if necessary. It should be carried out close to the operating theatre, after fetal monitoring has been carried out, and using ultrasound guidance, as well as short acting tocolysis where necessary. These safety guidelines minimise the risks of maternal injury and fetal distress, allowing early detection and treatment if necessary.

In resource-limited settings, the avoidance of breech delivery by ECV is highly beneficial and is summarised in the method described below.

ECV may be performed between 37- and 42-weeks' gestation if there is a single uncomplicated breech pregnancy. There should be no previous uterine scars, no previous antepartum bleeding, no fibroids and no placenta praevia. Around 50% should be successful. Inform anaesthetist and OR staff before attempting ECV, also Hb and blood for crossmatch in case needed.

Ultrasound **must** be performed to demonstrate the fetal presentation, an adequate amount of liquor, a flexed fetal head, a free loop of cord and the attitude of the fetal legs (extended or flexed). The mother should be awake and have given consent to the procedure. The membranes must be intact, with adequate amniotic fluid and no complications of pregnancy.

Procedure see figure A+23.1 below

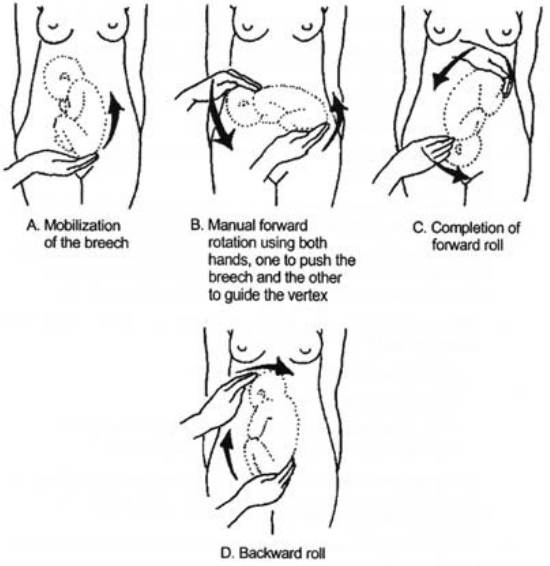


Figure* A+23.*1 *External Cephalic Version (ECV)*

1 Provided the uterus is relaxed, an attempt is made to turn the baby, by disengaging the breech with one hand and flexing the head further with the other. The mother lies on her side (usually her right side), which will allow a forward somersault (from 'left sacro-anterior' position, which is the commonest breech position).

2 The bed is tilted head down slightly to allow gravity to assist in disengaging the breech.

3 Figure A+23.1 illustrates how a right- handed person would turn a baby. If you are left- handed, turn the baby the other way.

4 Place one hand below the breech, and your other hand above the head. Lift the breech out of the pelvis. Bring the head and breech closer together so as to flex the baby.

5 Turn the baby by guiding the head forwards as you lift the buttocks up. In this way you make the baby do a forward somersault (i.e. turn head over heels).

6 If you fail to turn the baby, try turning them with a backward somersault.

7 This procedure should not hurt the mother, but it will be uncomfortable; the movement on her abdomen is made easier by using lubricant (e.g. sweet almond oil KY jelly or ultrasound gel).

8 The fetal heart rate should be listened to regularly during the procedure.

9 Whether ECV is successful or not, after the procedure listen carefully to the FHR every 5 minutes for 30–60 minutes. Ensure that the fetal heart rate is normal (110–160 beats/minute).
10 If the FHR is normal, the mother can go home.
11 In well-resourced settings only, and with relatively only slightly more success, and if the uterus is not relaxed, short-acting tocolysis may be helpful. Consider giving a dose of 250 micrograms terbutaline subcutaneously.
12 If the first attempt is unsuccessful, consider bringing the mother back the next day for a repeat trial.
13 If the fetal heart rate becomes abnormal, turn the woman on to her left side, and reassess every 5 minutes. If the fetal heart rate does not become normal within 30 minutes, insert IV cannula and give a bolus of 500 ml 0.9% saline or R/L and consider delivery by Caesarean section.
14 In well-resourced settings where blood group including rhesus factor is universally collected, and where the mother is rhesus negative, 500 IU of anti-D immuno- globulin should be given after ECV. Unfortunately, anti-D immunoglobulin is expensive.
15 All mothers should be warned about the possible subsequent risks of reduced fetal movements, vaginal bleeding, rupture of the membranes and onset of labour. If ECV is successful, the pregnancy can be managed as a cephalic presentation. If it is unsuccessful, future management should be discussed and a decision made regarding whether to opt for elective Caesarean section or trial of vaginal breech delivery.

Trial of vaginal breech delivery

This is a difficult situation whenever there is limited availability of safe surgery and where surgery may be complicated by delays.

Contraindications

1. The mother is very small and/or the baby is large
2. Evidence of fetal–pelvic disproportion; that is, an inadequate pelvis (using clinical judgement) and an estimated fetal weight exceeding 3800 grams
3. Evidence (on ultrasound) of hyper-extension of the fetal head.
4. Fetal hydrocephalus
5. Trial of vaginal breech delivery should only go ahead if complete or frank breech is the malpresentation (see Table A+22.3).
6. However, if a footling breech is presenting there is a risk of cord prolapse. However, if the cervix is already fully dilated, safe vaginal delivery may still be possible. Obviously if the baby is not viable, especially when very preterm wherein a footling presentation is more common, then deliver vaginally
7. All cases where vaginal delivery is being considered should have USS to confirm presentation (breech can feel very similar to the head) and to

exclude a placenta praevia which is more common with any malpresentation.

8. if there has been a previous Caesarean section or other scar in the uterus, a repeat Caesarean section may be preferable, although this will depend on the availability of safe surgery. Moving the woman close to a facility that provides comprehensive emergency obstetric care from 37 weeks' gestation is essential.

Procedure

1. The mother should confirm her informed choice of vaginal delivery.
2. If the mother is in hospital, an obstetrician, anaesthetist and operating theatre should be ready.
3. Careful fetal monitoring and documentation of the partograph should be undertaken. Check the FHR for 1 minute immediately following every contraction to identify any changes that might indicate fetal distress.
4. The bladder must be emptied either naturally or with an in–out catheter once the cervix is fully dilated.

Figure* A+23.*2 *position for breech delivery*

5. If spontaneous rupture of the membranes occurs, do a vaginal examination to check for cord prolapse. Meconium is common and not usually a sign of fetal distress.
6. Amniotomy may be used to accelerate labour, but only where indicated as there is a risk of cord prolapse.
7. Careful use of oxytocin may be used to correct poor uterine activity if the mother is having her first baby.
   However, oxytocin should only be used in a well-resourced hospital. It should not be used for poor progress due to poor uterine contractions in a mother who has previously given birth. Where available and safe, it is reasonable to perform a Caesarean section, rather than commencing oxytocin, even in primigravid women who are making inadequate spontaneous progress in labour.
8. Caesarean section should be considered if there is poor progress during labour or fetal distress.
9. A reliable intravenous cannula should be in place.
10. Ensure that a healthcare worker with adequate experience in delivering breech babies vaginally is present during the second stage.

11. Ensure an expert in neonatal resuscitation is present at the delivery.

The basic principles of delivering a breech vaginally is to not intervene unless progress is inadequate

1. Ensure bladder is empty at the onset of the second stage
2. Allow the breech to descend to the perineum without pushing.
3. Once the buttocks have delivered **you have 5 minutes only to safely complete the delivery** and prevent fetal compromise
4. Active pushing should be encouraged when the buttocks have reached the perineum and therefore the cervix is fully dilated and should never be delayed except for short, perhaps 10 second, periods, for the mother to gain her breaths. If contractions are becoming less frequent, constant pushing plus active breech assistance involving manoeuvres can reduce the risk of fetal compromise.
5. If the delivery is not progressing well, especially if there is evidence of fetal distress, and the perineum is holding up the delivery, an episiotomy may well be helpful but should not be performed until the fetal anus is visible or until the baby's buttocks are distending the perineum. You are more likely to require an episiotomy in a primigravida.
6. The fetus will usually rotate spontaneously to lie with the sacrum anteriorly. **Rarely the fetus will try to turn with the fetal back posteriorly, and this must be prevented** by holding the baby by the bony pelvis and rotating the baby to the back-anterior position as it descends with maternal effort.
7. **Delivery should ideally be complete by 5 minutes** after the breech reaches and distends the perineum
8. Extended legs are delivered by flexing the knee joint of the baby and then extending at the hips.
9. Do not handle the breech until delivered as far as the umbilicus
10. Only release a loop of the umbilical cord if it is under tension.
11. As the mother pushes, the shoulder blade will become visible. If the baby's sacrum remains transverse (shoulders in AP diameter) following descent to the scapula/nipple line then one or both arms are caught above the pelvic inlet and rotational manoeuvres are needed. Telling the woman to push harder or waiting for the next contraction wastes valuable time.
12. A finger is run over the shoulder and down to the elbow to deliver the arm, if this does not occur spontaneously. The other shoulder will rotate anteriorly spontaneously to allow similar delivery of the other arm. If the arms are not delivering spontaneously despite the shoulders being visible, the Løvset manoevre should be used (*see* Figure 35.3). Traction on the baby combined with rotations as shown (multiple rotations if necessary) will usually result in each arm dropping out of the cervix. Minimal assistance by the healthcare worker running a finger along the arm to disengage it may sometimes help.

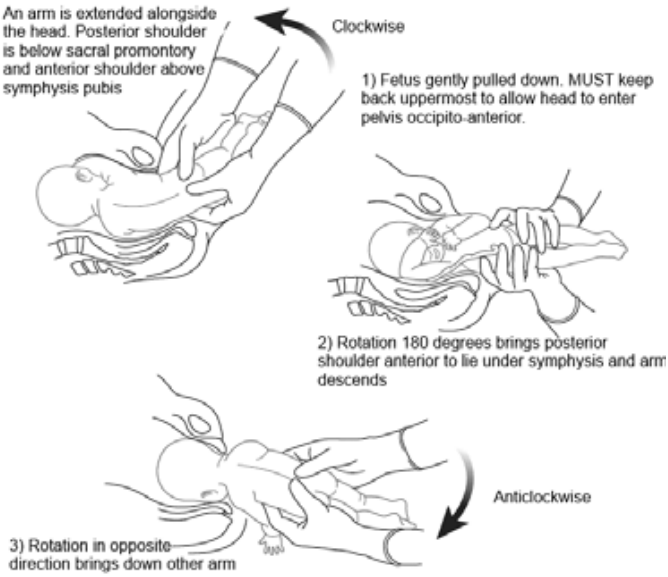


***Figure* A+23.3** *Breech delivery using Løvset method.*

***Figure* A+23.4** *Breech delivery: the baby should hang until the hair line at the back of the neck is seen.*

13. Allow the baby to hang by its own body weight to facilitate descent and flexion of the head, until the nape of the neck appears under the pubic arch.
14. Delivery of the baby should be completed within 5 minutes of the buttocks reaching the perineum
15. The baby is supported only when the arms are delivered, and the nape of the neck becomes visible (*See Figure A+23.4*). Avoid holding the baby's abdomen, as internal organs may be damaged; the bony pelvis should be held gently to support the weight of the baby and prevent hyperextension of the fetal neck.
16. Keep baby warm by wrapping in a dry towel.

Actions if the fetal head fails to descend after delivery of the baby's body and arms

1) Ask an assistant to apply firm constant suprapubic pressure in the midline to try and flex the head (Figure A+23.5 below)
2) If the head still fails to descend into the pelvis (i.e. the nape of the neck does not appear), first check that the cervix is fully dilated. If the cervix is not fully

dilated (especially likely in a preterm breech) try to massage the cervix using sterile procedure and make it dilate and try and get it to go over the fetal head.

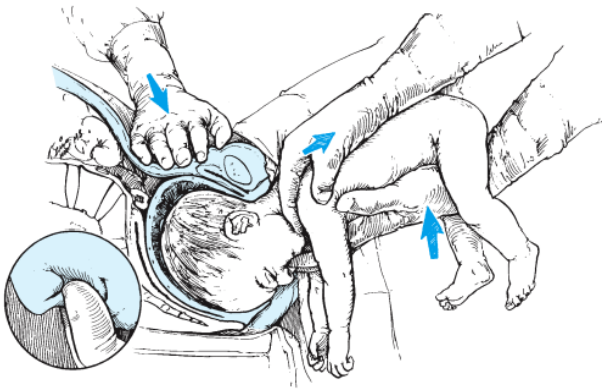


Figure* A+23.*5 *Breech delivery with suprapubic pressure to help flex the head*

3. If the cervix is still not fully dilated and cannot be dilated to allow the head to pass it may need to be incised. Undertake two small incisions (Duhrssen's). at the 2-oclock and 10-oclock position where there is least risk of major haemorrhage. Do not make deep incisions which could spread to the lower segment of the uterus.

4. Undertake Mauriceau-Smellie-Veit (MSV) manoeuvre (see Figures A+23.5 above and A+23.6 below) PLUS firm constant suprapubic pressure

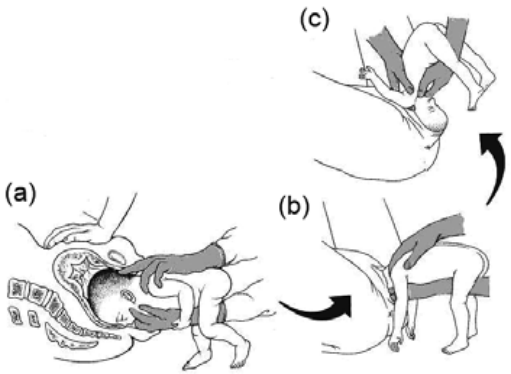


Figure A+23.6 *Mauriceau-Smellie-Veit (MSV) manoeuvre*

5. Lay the fetal body on your forearm supporting the baby's chest with palm of your hand.
6. Put index and middle fingers of your RIGHT hand (if you are right-handed: otherwise left hand if you are left-handed) on the bony ridges either side of the nose. The index (first) and third fingers are placed just below the bony ridges of the lower part of the orbits (the maxilla). The eyes must not be compressed.
7. Place your first and third fingers of your LEFT hand (if you are right-handed: otherwise right hand if you are left-handed) over the baby's shoulders to apply traction, whilst the middle finger presses on the occiput to aid flexion and descent. Flex the head and deliver the head slowly and in a controlled way to avoid any sudden change in intracranial pressure.
8. When the face distends the perineum apply upward traction until the mouth and nose are free.
9. Do not pull body of fetus as can hyperextend the fetal head and make it worse.
10. If the above measures fail, try McRoberts' manoeuvre (see Section A+5) and repeat MSV and suprapubic pressure
11. Consider trying the "all-fours" position and repeat the MSV manoeuvre
12. Alternatively, and providing the cervix is fully dilated, forceps (ideally Pipers: see Figure 35.7) may, if possible, be applied to the fetal head. An assistant should hold the baby's feet to elevate the body above the horizontal to allow the operator access to apply forceps. The nape of the neck must be in view before the baby's body is lifted upwards, or damage to the fetal neck may be caused. It is also essential that the baby is not lifted too high, as this will damage the neck.

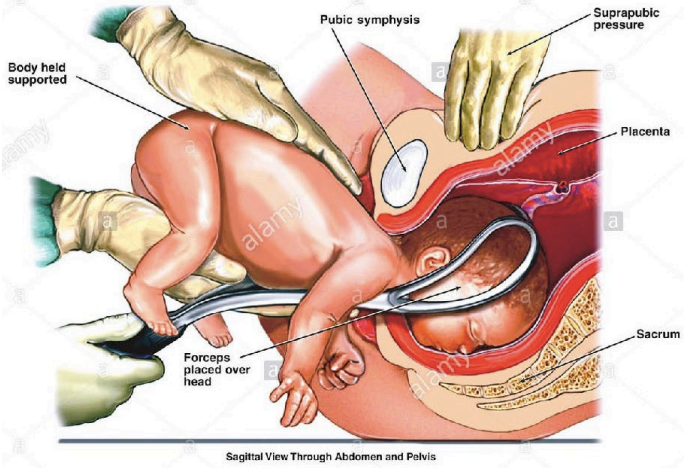


***Figure* A+23.7** *showing the use of Piper's forceps to deliver aftercoming head*

9. Another possible way of achieving delivery of the head is to undertake a symphysiotomy (see Section E9)

Symphyisiotomy and forceps delivery manoeuvres are potentially dangerous for the mother. If the fetus dies, a destructive procedure should be undertaken. Consider a craniotomy (see Section E10), although it would be reasonable to wait for 15 minutes after death as the head may become smaller during this time. Caesarean section is not appropriate if the fetus is dead.

Elective Caesarean section for breech

This is advisable for the following:

1. if vaginal birth is contraindicated
2. footling breech before the cervix is fully dilated
3. a very large fetus
4. a small or malformed maternal pelvis
5. a hyperextended or deflexed fetal head before labour confirmed by ultrasound scan
6. hydrocephalus and a live fetus

Before and at operation:

1. Explain to the woman that she will have a scarred uterus, which may create problems in future pregnancies where she MUST deliver in hospital.
2. Ensure that the presentation remains breech before anaesthetising the patient.
3. Note that if the uterine incision is too small, there can be difficulty delivering the after-coming head.
4. Remember to keep the fetal back upwards during delivery from inside the uterus.

Emergency Caesarean section should be undertaken if there is poor progress or fetal distress.

Note '*Hands off the breech'* was meant to stop health professionals from pulling the breech out and causing trouble. Unfortunately, it prevents professionals from putting hands **ON** when necessary.

Reference: http://www.all4maternity.com/no-more

Section A+24 Preterm pre-labour rupture of membranes (P-PROM) and/or preterm labour

Introduction

P-PROM is defined as spontaneous rupture of the membranes before the onset of labour and prior to 37 weeks' gestation. It occurs in 2–4% of single pregnancies and 7–20% of multiple pregnancies and accompanies 60% or more of preterm births.

P-PROM is associated with maternal and neonatal mortality and morbidity with neonatal complications, which include cord prolapse, neonatal sepsis and respiratory failure, pulmonary hypoplasia and malpresentations.

Preterm labour is defined as labour that begins before 37 weeks' gestation. It has increasingly serious implications for the neonate the earlier it occurs.

Preterm labour may occur without P-PROM. However, ruptured membranes are a common early consequence of premature labour. Likewise, P-PROM can occur before labour, but the risk of progression to labour following P-PROM is high (see below).

There are multiple risk factors for preterm labour and P-PROM. They include intrauterine infection, twin pregnancy, polyhydramnios, abruption, malaria, urinary tract infection/pyelonephritis and uterine anomalies (including large fibroids).

Clinical findings in the woman with PPROM and/or preterm labour

In P-PROM the fluid may come out quickly as a sudden large flow, or it may trickle out over 1–2 hours, after which recognition is more difficult. Around 50% of women go into labour within 24–48 hours, and 70–90% within 1 week. The gap is longer the earlier in pregnancy the rupture of membranes occurs.

Even if P-PROM has occurred there may be no history or signs to suggest that this has occurred, and therefore the woman may present clinically with preterm labour alone. However, preterm labour may also occur without P-PROM.

It is important, if possible, to distinguish P-PROM from urinary incontinence, bacterial/fungal vaginal infection or a 'show' of cervical mucus. Amniotic fluid has a characteristic odour and is alkaline. It can be detected by tests of the fluid for insulin-like growth factor binding protein-1 or placental alpha-microglobulin-1 but these tests are expensive and unlikely to be available in low resource settings.

Premature labour is considered to be present if there are regular contractions (usually at least one every 10 minutes) associated with cervical effacement and/or dilatation.

In its early stages it is very difficult to diagnose accurately, as the patient may present before cervical change has occurred, and it is then only with time that the cervical change becomes apparent.

Important differential diagnosis for premature labour, where cervical change has not yet occurred, include: Braxton Hicks contractions, urinary tract infection, musculoskeletal pain, constipation and gastroenteritis.

Systemic infection can itself result in premature labour and therefore patients presenting with threatened preterm labour should be assessed and treated for an underlying cause. Common examples of infections that precipitate premature labour include malaria and urinary tract infection/ pyelonephritis.

Management of P-PROM with or without preterm labour

Avoid doing a digital vaginal examination unless active labour is under way and/or birth is imminent, as it increases the risk of infection. Penetrative sexual intercourse should be strongly advised against.

A sterile speculum examination should be undertaken to look for amniotic fluid passing through the cervix or in the posterior fornix. A swab should be taken of the fluid and sent to the laboratory for microscopy and culture (if bacteriological facilities are available), looking especially for group B streptococcus.

Monitor 4 hourly vital signs (temperature, heart rate, respiratory rate and blood pressure), vaginal discharge (check sanitary towels regularly; do not use tampons), uterine activity and possible tenderness, and fetal heart rate.

Also check a full blood count, maternal blood group, malaria RDT +/– smear and a midstream specimen of urine (MSSU). If available, a CRP along with the white blood cell count, may help to indicate an underlying infection.

Ultrasound examination to assess the amniotic fluid, presentation, lie, gestation and placental site is helpful.

Inform the neonatal clinician.

When to consider antibiotics

Dangerous symptomatic infection *in utero* in the mother (fever 37.5 degrees C or more, maternal and/or fetal tachycardia, foul-smelling vaginal discharge, uterine tenderness and signs of systemic illness) needs urgent treatment with high dose IV antibiotics (ampicillin or penicillin **plus** gentamicin **plus** metronidazole). If this is overlooked, the lives of both the mother and the baby will be in danger:

1 Ampicillin 2 grams IV/IM, then 1 gram IV 6-hourly or Benzyl penicillin 2.4 G stat then 1.2 G 6 hourly
2 *plus* Gentamicin 80 mg IV/IM 8-hourly or 5 mg/kg body weight IV/IM once every 24 hours
3 *plus* Metronidazole (vial containing 500 mg in 100 mL) 500 mg or 100 mL IV infusion every 8 hours. Do not give metronidazole IM.

Continue IV antibiotics for 48 hours after delivery and if mother no longer systemically infected and is fever free give oral antibiotics for 1 week.

The newborn infant must also be treated with IV antibiotics immediately from birth without waiting for any signs of infection to appear.

Contractions will usually be present but, whether or not they are present, **the baby must be delivered as soon as the mother is stable via induction of labour or Caesarean Section** whichever is considered appropriate. **Never give a utero-relaxant drug in order to prolong a pregnancy with PPROM.**

Asymptomatic infection (no fever and no systemic signs of illness) is a more common problem which may progress to a life-threatening infection at any time. It is therefore essential that all women who have/or may have undergone rupture of membranes, are monitored regularly for the symptoms and signs of infection. These include: labour, generalised uterine pain, flushing and chills, body aches, fever ≥ 37.5ºC), tachycardia, tachypnoea and fetal tachycardia (see above).

If premature rupture of membranes is confirmed, the patient is stable, and a decision has been made to manage the patient expectantly (see below) then give prophylactic antibiotics as follows to help more safely to prolong the pregnancy:

If available give Erythromycin 250 mg four times a day until the woman is in established labour. If erythromycin is not available give penicillin V or amoxicillin 500 mg three times daily until delivery. Do not give women with P-PROM co-amoxiclav as prophylaxis for intrauterine infection.

The mother must reside in a health facility where CEmONC is immediately available.

Induce labour at 37+0 weeks' gestation.

if the patient goes into premature labour, give prophylactic antibiotics: IV ampicillin or IV benzyl penicillin and discontinue antibiotics immediately after delivery if there are no signs of infection in the mother. **Never try and stop contractions by using a tocolytic drug.**

WHO is currently considering its guidelines for low resource settings on the use of corticosteroids to reduce the risk of neonatal respiratory failure after preterm birth. At present we are not recommending this treatment because of resulting delays in delivery and possible increased risk of infection. The best way forward is to have a functioning neonatal unit.

How long should you wait before inducing labour when there is P-PROM?
The decision on timing of delivery is difficult, and it depends on the stage of pregnancy, the availability of comprehensive emergency obstetric care, the quality of neonatal care available, the obstetric history and wishes of the patient.

If expectant management is undertaken, women with P-PROM should be resident in a healthcare facility where comprehensive emergency obstetric care is available. Induction of labour should be undertaken by 37+0 weeks as prolonging the pregnancy beyond this stage is of reduced benefit to the fetus.

Patients should be monitored closely for any symptoms or signs of infection, and if any develop delivery should be achieved urgently (via induction or Caesarean section, whichever is indicated) regardless of gestation.
Suggested monitoring should include:

- Regular review for symptoms of infection, e.g. uterine pain, body aches, flushing, chills. The patient should be advised to report such symptoms as they occur.
- 2 to 4 times daily vital sign assessment – tachycardia (> 100 bpm), tachypnoea (> 20), and pyrexia ≥ 37.5º C) should raise suspicion of infection.
- At least twice weekly inflammatory marker assessment such as CRP (where available).

Preterm labour

The major long-term consequence of premature birth is neurodevelopmental disability. The risk for the individual child is greatest for those born at the earliest gestational ages.

This guideline has observed the NICE guideline 2019 but has been modified for low-resource settings and considers the best way to provide treatment for women who present with symptoms and signs of preterm labour and women who are needing urgent preterm delivery because of maternal complications. One of the most appropriate actions that can be taken in low-resource settings is the provision of advanced neonatal care where appropriate with task-sharing undertaken by nurses trained in advanced neonatal care (neonatal clinicians).

Note that some women thought to be in preterm labour on a clinical assessment will not give birth preterm.

Recommendations

- Try and provided information and support to mothers and their families when preterm labour occurs. Include information about the likelihood of the baby surviving and other outcomes (including long-term outcomes) and risks for the baby.
- Explain the neonatal care of preterm babies, including location of care, that is available, if it exists.
- Explain the immediate problems that can arise when a baby is born preterm
- Explain the possible long-term consequences of prematurity for the baby (how premature babies might grow and develop)
- Provide ongoing opportunities for mothers and families to talk about and state their wishes regarding the resuscitation of the baby, especially those likely to be born before 28 weeks' gestation
- Provide an opportunity to tour the neonatal unit and to speak to a neonatal clinician.

Diagnosing preterm prelabour rupture of membranes (P-PROM) (see above)

Diagnosing preterm labour for women with intact membranes

Offer a clinical assessment to women reporting symptoms of preterm labour who have intact membranes. This should include:

- clinical history taking
- the observations described for the initial assessment of a woman in labour
- a sterile speculum examination to assess cervical dilatation.

Confirm whether clinical assessment suggests that the woman is in preterm labour.

Fetal monitoring. Discuss whether the mother would like to use a doppler probe to intermittently listen to and monitor their fetal heart rates immediately after the end of every contraction. Explain the purpose of fetal monitoring and what it involves, the clinical decisions it informs at different gestational ages and, if appropriate, the option not to monitor the fetal heart rate (for example, at the threshold of viability: a situation where the fetus is so preterm that survival after birth is extremely unlikely).

Mode of birth

Discuss the general benefits and risks of caesarean section and vaginal birth with women in suspected, diagnosed or established preterm labour and women with P-PROM (and their family members or carers as appropriate).

Explain to women in suspected, diagnosed, or established preterm labour and women with P-PROM about the benefits and risks of caesarean section that are specific to gestational age. In particular, highlight the difficulties associated with performing a caesarean section for a preterm birth, especially the increased likelihood of a vertical uterine incision and the implications of this for future pregnancies, especially relevant in low resource settings.

Explain to women in suspected, diagnosed or established preterm labour that there are no known benefits or harms for the baby from caesarean section, but the evidence is very limited.

Timing of cord clamping for preterm babies (born vaginally or by caesarean section)

If a preterm baby needs to be moved away from the mother for resuscitation, or there is significant maternal bleeding:

- consider milking the cord and
- clamping the cord as soon as possible.

Wait at least 30 seconds, but no longer than 3 minutes, before clamping the cord of preterm babies if the mother and baby are stable and resuscitation at birth is not required.

Position the baby at or below the level of the placenta before clamping the cord. [recommended in 2015]

Antibiotic treatment

All patients with confirmed premature labour should receive prophylactic antibiotics when in active labour as follows:

If no signs of infection, IV ampicillin 2 grams IV/IM, then 1 gram IV 6-hourly.

Discontinue antibiotics immediately after delivery if there are no signs of infection in the mother.

If signs of infection. If there is maternal fever (≥37.5°C), or other indication of infection in labour (e.g. offensive liquor), the mother must be treated with high doses of IV penicillin/ampicillin plus metronidazole and plus gentamicin as for infected P-PROM above. If this is the case, the newborn infant should also be treated with IV antibiotics from birth without waiting for any signs of infection to appear.

Stopping premature labour

Although labour can sometimes be delayed by treating the mother with tocolytic drugs, **there is no evidence that tocolysis alone is beneficial to the baby or mother**. Especially in low resource settings, their use is potentially dangerous, as delaying delivery may result in progression of the process which caused the premature labour in the first place, e.g. infection or abruption.

It is always **unsafe to try to stop labour if the membranes are ruptured.**

Clinical problems in the neonate associated with preterm birth

These include the following:

- Surfactant deficiency leads to increasing levels of respiratory difficulty with decreasing gestational age.
- Increased risk of infection and hypothermia.
- Nutritional problems: maturity is more important than birthweight with regard to the ability to feed and digest milk. Babies who are born before 36 weeks' gestation nearly always need some help with feeding.
- Breast milk is ideal, and everything possible should be done to help the mother to sustain her lactation until the baby is ready to feed reliably from the breast. A limited ability to suck and swallow usually appears from 32 weeks' gestation, but it remains unpredictable, unreliable and uncoordinated until 36 weeks' gestation.
- In the event that breastfeeding cannot be initiated immediately after birth, the mother should be encouraged to start expressing breast milk, to be given by nasogastric tube or cup and spoon. Partial breastfeeding can also help the mother to sustain her lactation, but in any event she should regularly express milk.

Section A+25 Management of umbilical cord prolapse

Prolapse of the umbilical cord occurs in approximately 1 in 500 births, mostly in multiparous mothers. There is significant risk of fetal death due to mechanical compression of the cord and spasm of the cord vessels when they are handled or exposed to cold air.

Figure A+25. 1 *Knee elbow position to relieve pressure on the prolapsed cord. Reproduced with permission from Macdonald S, Magill-Cuerden J (ed.) Mayes' Midwifery: a textbook for midwives. Elsevier Health Sciences; 2010. © Elsevier*

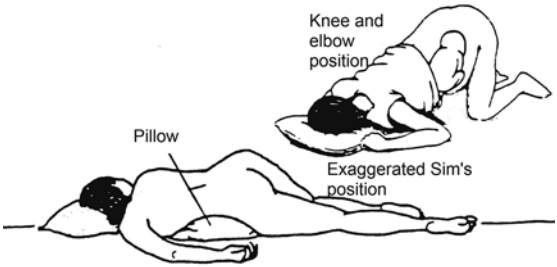


Figure A+25.2 *Exaggerated Sim's position and Knee elbow position to relieve pressure on prolapsed cord*

Predisposing risk factors:

1 Fetal causes:

- malpresentations (e.g. complete or footling breech, transverse and oblique lie),
- prematurity or low birth weight
- multiple pregnancy
- anencephaly
- high head
- long cord

2. Maternal causes:

- ARM (especially if presenting part is high and poorly applied to the cervix) contracted pelvis
- manual rotation fetal head
- polyhydramnios with sudden rupture membranes
- low-grade placenta praevia
- pelvic tumors.

Management if the fetus is alive

The longer the time between diagnosis of cord prolapse and delivery, the greater the risk of stillbirth and neonatal death.

Assess fetal viability.

If the baby is alive and of a viable gestation, and fetal heart sounds are heard with a Pinard's stethoscope or ideally a hand-held ultrasound fetal heart rate detector (e.g. Sonicaid), urgently relieve pressure on the cord by placing the woman in the knee–elbow (Figure *A+25.*1)or exaggerated Sims' position (Figure *A+25.*2).

Management of the delivery where fetus is alive

If the presenting part is cephalic or breech, wearing sterile gloves, insert a hand into the vagina. Push the presenting part up to decrease pressure on the cord and dislodge the presenting part from the pelvis. - place the other hand on the abdomen in the suprapubic region to keep the presenting part out of the pelvis. - once the presenting part is firmly held above the pelvic brim, remove the other hand from the vagina.

If a transverse mal-presentation is present, CS will usually be needed.

If CS is safe and the only option (i.e. the cervix is not fully dilated, and the fetus is alive and viable), transfer the woman to the operating theatre in the exaggerated Sims' position or knee-elbow position on a trolley.

If delay in beginning CS is likely, insert 500 ml of sterile IV fluid into the bladder using an IV giving set attached to a Foley catheter. Do not leave the patient alone as the bladder will continue to fill through natural renal output and may bypass catheter and empty. Inflate the small balloon of the Foley catheter to keep it in place. Clamp the catheter and attach drainage tubing and a urine bag.

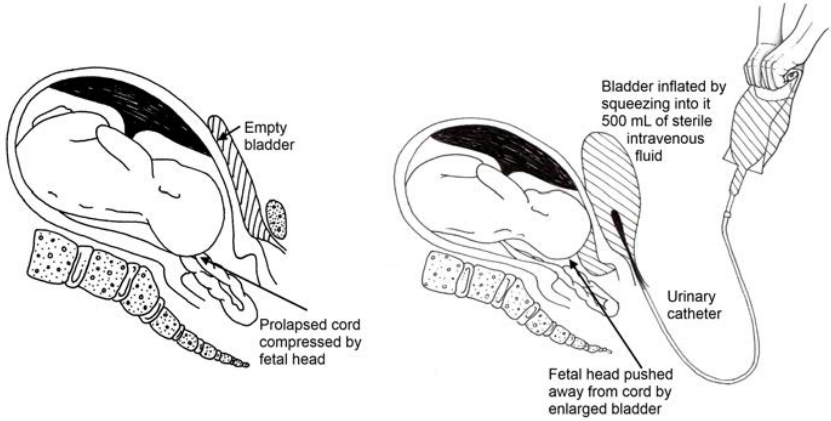
The bladder must be emptied by unclamping the catheter at skin incision before opening the peritoneal cavity for CS. Mark with a pen the mother's abdomen to ensure that this is not forgotten.

Ensure reliable venous access.

Minimise handling of the cord. Exposure to low temperatures should also be prevented if possible: cover with a sterile gauze.

Discontinue oxytocin if it is being used.

Figure A+25.4 Use of bladder inflation to give time for CS.



You can also give more time to allow the baby to be delivered by giving short-acting tocolysis with terbutaline 250 micrograms subcutaneously.

If cervix is fully dilated, and delivery is likely to be achieved rapidly, encourage the patient to push and prepare to expedite the delivery by ventouse if presentation is cephalic. If breech, undertake rapid breech extraction.

Have an **expert in neonatal resuscitation available** at delivery.

Where the fetus is dead
Deliver in the safest way for the mother.

Await spontaneous vaginal delivery unless infection is present where induce after stabilizing with IV antibiotics.

If transverse mal-presentation, consider external version followed by induction of labour, unless contra-indicated.

A destructive procedure may be needed (see Section E10)

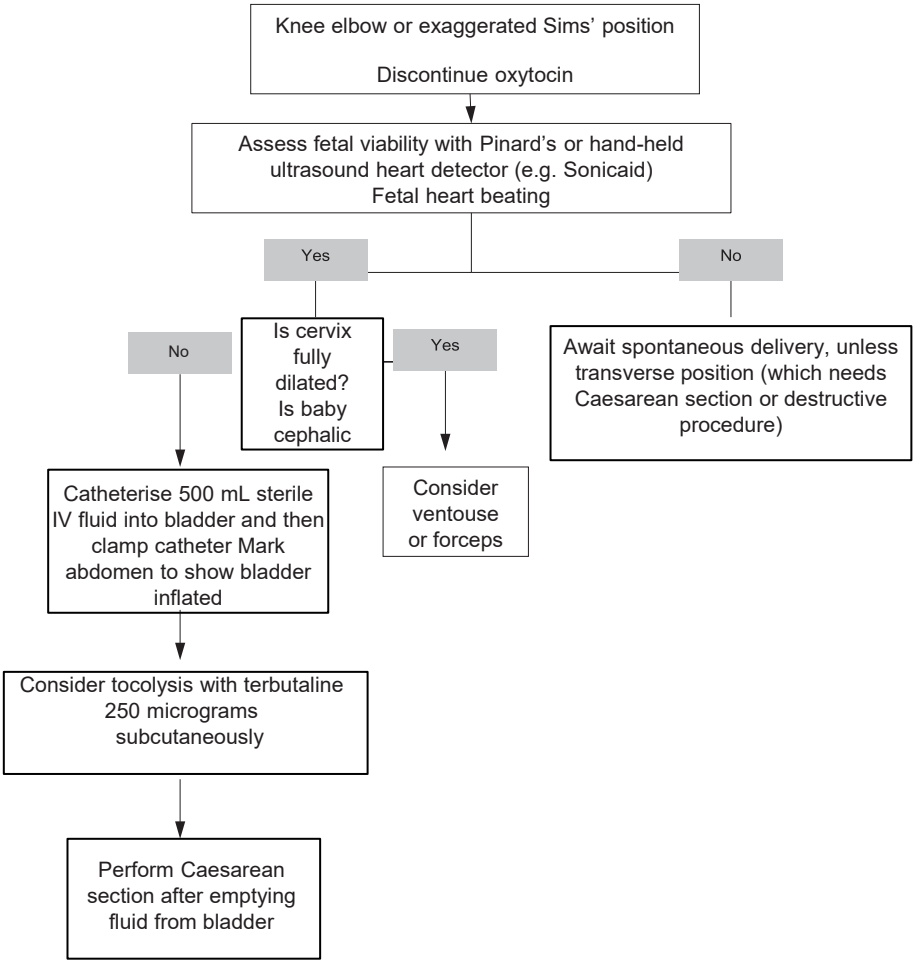


Figure A+25.5 *Pathway of care for prolapsed cord.*

Section A+26 Inverted uterus

Prevention
Prevent an inverted uterus by avoiding cord traction until the uterus is contracted and placental separation has occurred and ensuring that the uterus is held back with one hand on the abdomen during cord traction.

Symptoms and clinical signs
An inverted uterus most commonly presents as a pelvic mass, sometimes protruding from the vagina. If the inverted uterus does not protrude from the vagina, it may go undetected, resulting in a sub-acute or chronic inversion which is very dangerous and may even present as a sudden unexpected maternal death.

Other findings include severe lower abdominal pain in the third stage of labour, haemorrhage, shock out of proportion to blood loss, the uterus not being palpable on abdominal examination, and vaginal examination revealing a mass in the vagina.

Early recognition is vital, as shock is the most common complication. Shock out of proportion to blood loss may be due to increased vagal tone, which may also produce a bradycardia (< 60 beats/minute), worsening the shock and confusing its diagnosis.

Inversion is associated with haemorrhage in over 90% of cases. Alternatively, concealed bleeding may produce tachycardia and other signs of shock.

Incomplete inversion presents more subtly with continuing postpartum haemorrhage despite a contracted uterus. The fundus of the uterus may feel dimpled.

Suspect a diagnosis of inverted uterus if there is:
- shock with little obvious bleeding
- continuing postpartum haemorrhage despite an apparently well-contracted uterus
- associated lower abdominal pain
- a dimpled uterine fundus
- a fundus that is not palpable abdominally.

Management of uterine inversion

Call for help and include an anesthetist
The uterus must be replaced as soon as inversion is recognised, as a matter of urgency, as this becomes more difficult over time. Call for help and try to push it back while CABC resuscitation is being undertaken.

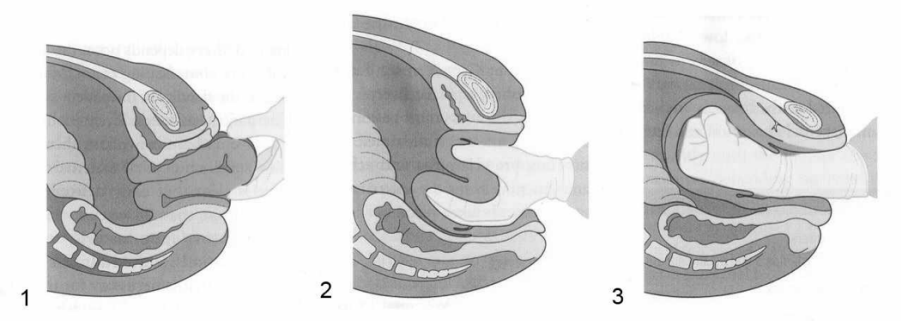
Call for senior help, including a surgeon and an anaesthetist. If shock is present, manage CABC as described below.

Manual replacement of the uterus

As soon as possible, and wearing sterile, ideally, long obstetric gloves (gauntlets), attempt manual replacement of the uterus by pushing the fundus back through the cervix (the longer the delay, the more difficult it will be to achieve resolution).

It is important that the part of the uterus that came out last (the part closest to the cervix) goes in first.

Figure A+26.1 *Bimanual replacement of inverted uterus*



Do not attempt to separate the placenta until the inversion has been corrected.

Hydrostatic correction

1. If manual replacement is unsuccessful, hydrostatic correction should be attempted.
2. Place the woman in the steep Trendelenburg position (lower her head about 0.5 metres below the level of the perineum).
3. Prepare a high-level sterile douche system with a large nozzle, long tubing (2 metres) and a reservoir (1–2 litres of sterile Ringer-lactate/Hartmann's solution/0.9% saline at room temperature, not from a refrigerator). Note: This can also be done using Ringer-lactate/ Hartmann's / 0.9% saline and an ordinary IV administration set.
4. Identify the posterior fornix. This is easily done in partial inversion when the inverted uterus is still in the vagina. In other cases, the posterior fornix is recognised by the place where the ridged vagina becomes the smooth vagina.
5. Place the nozzle of the douche in the posterior fornix.
6. At the same time, with the other hand, hold the labia sealed over the nozzle and use the forearm to support the nozzle.

7. Ask an assistant to start the douche at full pressure (raise the water reservoir to at least 2 metres). The Ringer Lactate/0.9% saline will distend the posterior fornix of the vagina gradually so that it stretches. This causes the circumference of the cervical orifice to increase, relieves cervical constriction, and results in correction of the inversion.
8. If a Silc Cup ventouse is available, this can be used to occlude the vagina and give a seal. Two IV infusion sets are inserted into the narrow-end while the wide- end lies against the inverted uterus vaginally.
9. Terbutaline, 250 micrograms subcutaneously, may help to stop any uterine contractions that prevent correction of the inversion.

Manual correction under general anaesthesia

If hydrostatic correction is not successful, try manual repositioning under general anaesthesia, using halothane. Halothane is recommended because it relaxes the uterus but be aware of the risk of possible atonic uterus and haemorrhage.

Summary of CABC resuscitation if patient is shocked

A and B Provide a high concentration of oxygen through a face mask with a reservoir bag if there is adequate spontaneous respiration. Give 100% oxygen (mask with reservoir and a flow rate of at least 6 litres/minute) regardless of SaO_2. For inadequate ventilation or depressed conscious level (P or U on the AVPU scale), respiration should be supported with oxygen via a bag-mask, and nurse anaesthetist should be summoned.

Circulation

Primary assessment suggesting shock:

- Fast, weak pulse (≥ 100–110 beats/minute). Normal heart rates in a pregnant mother at rest are 60–90 beats/ minute. Tachycardia is the first sign of shock.
- Bradycardia (< 60 beats/minute) may occur as a result of increased vagal tone due to the inversion.
- Low-volume (weak) pulse.
- Pallor (especially of the inner eyelid, palms or around the mouth).
- Sweatiness or cold clammy skin.
- Prolonged capillary refill time (> 3 seconds).
- Rapid breathing (> 30 breaths/minute). Normal respiratory rates in a pregnant mother at rest are 15–20 breaths/ minute. Tachypnoea can be due to acidosis.
- Low blood pressure (systolic < 90–100 mmHg) is a very late sign. Healthy women and girls can maintain a normal or even high blood pressure while large volumes of blood are lost.
- Anxiety, confusion or reduced conscious level.

If shock is present, obtain vascular access to give large volumes quickly. Insert two wide-bore IV cannulae (14- to 16G) and send blood for a full blood count, cross-matching (2 units) and clotting. If peripheral veins are difficult to access, the external jugular vein, long saphenous vein cut-down or intra-osseous needle are good alternatives.

1. Give an initial rapid bolus of 500 mL to 1 litre of Ringer- lactate/ Hartmann's or 0.9% saline or blood if available. It is essential that the bolus is given as rapidly as possible.
2. Further 500- to 1000-mL boluses may be required in the first hour. Once more than 2 litres have been given IV, complications such as pulmonary or cerebral oedema may occur. If available, expert help if available is essential.
3. A blood pressure cuff can be used to speed up infusions in emergency situations. Wrap the cuff around the blood/ fluid bag and place it inside a non-compressible bag.
4. Keep the patient warm but do not overheat them, as this will cause peripheral vasodilatation and reduce the blood supply to vital centres. Hypothermia will exacerbate poor peripheral perfusion, acidosis and coagulation abnormalities.
5. Elevate the legs (raise the foot of the bed).
6. Give O-negative or group-specific blood if there is not time for full cross-matching. Have O-negative blood ready in the ward at all times if possible.
7. If bradycardia is < 60 beats/minute due to vagal stimulation is present, consider giving atropine 100 micrograms IV, and repeat every 2 minutes up to a maximum of 400 micrograms IV.
8. Providing it does not detract from other procedures described above, consider using the non-pneumatic anti-shock garment (NASG) without inflation of the pelvic and abdominal segments. Once the leg segments are in place, it is not necessary to elevate the legs. (see Section A+11)

Post-procedure care

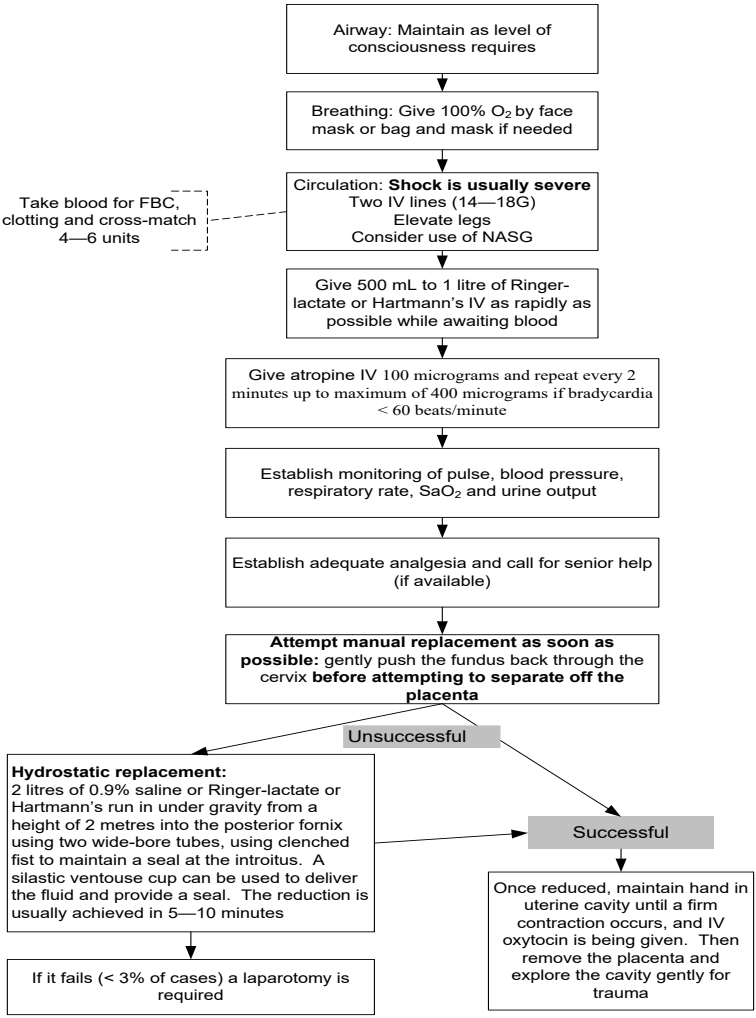
Once the inversion is corrected, infuse IV oxytocin, 40 units in 500 mL of Ringer-lactate or Hartmann's solution, over 4 hours. If the uterus does not contract after oxytocin, give misoprostol 4 tablets each of 200 micrograms orally if the patient is conscious, or 4 × 200 micrograms rectally if she is drowsy. The patient must be observed closely for haemorrhage.

Give a single dose of prophylactic antibiotics after correcting the inverted uterus. Use ampicillin 2 grams IV **plus** metronidazole 500 mg IV.

If all of the above fail

A laparotomy and possible hysterectomy may be required. Do not leave too long to make this decision.

Figure A+26.2 *Pathway of care for inverted uterus. NASG = non-pneumatic anti-shock garment*



Section A+27 Hyperemesis gravidarum

Introduction

Some nausea and vomiting are common in early pregnancy, with nausea affecting 70–85% of women. Around 50% of pregnant women experience vomiting. However, in a small proportion of patients severe vomiting (hyperemesis) can occur. This condition is more common if there is a larger than normal placental mass (e.g. in multiple pregnancy and molar pregnancy). Hyperemesis peaks at 11 weeks, with 90% of cases resolved at 16 weeks.

Associated conditions

Severe hyperemesis requiring hospital care is associated with the following:

- depression and severe stress
- multiple pregnancy
- molar pregnancy.

Consequences of hyperemesis

Consequences that are severe enough to require hospital care include the following:

- ketosis
- hypochloraemic alkalosis, hypokalaemia and hyponatraemia
- malnutrition with anaemia and hypo-albuminaemia
- ulcerative oesophagitis
- Wernicke's encephalopathy from thiamine deficiency
- worsened depression, may result in the patient seeking a termination of pregnancy
- hyperemesis is dangerous in type 1 diabetes and can result in ketoacidosis.

Investigations

- Ultrasound examination to exclude molar or multiple pregnancy.
- Urine for ketones and to exclude urinary tract infection.
- Blood for haemoglobin, urea and electrolytes.
- Special investigations as indicated to exclude serious medical problems affecting the gastrointestinal, genitourinary, neurological, metabolic or endocrine and psychological systems.

Treatment of severe hyperemesis

Intravenous 0.9% saline or Ringer Lactate/Hartmann's, 1 litre given over 4 hours initially and then repeated as required, is the most effective treatment for severe hyperemesis with dehydration. If safe, also add potassium chloride to this 1 litre infusion at the rate of 0.1 to 0.5 mmol/kg/hour (6 to12 mmol/hour for a woman

weighing 60 kg) and if possible check the serum K+ level checked after 4 hours. The potassium for injection must be diluted before use and thoroughly mixed before being given. Remember that Ringer lactate/Hartmanns does contain 5 mmol of potassium/litre and will provide some replacement if potassium is not available.

Small volumes (100–200 mL every 2–3 hours) of WHO oral rehydration salts (ORS) powder dissolved in 1 litre of water giving Na^+ 75 mmol/litre, K^+ 20 mmol/litre and glucose 75 mmol/litre can be given in addition to IV fluids until vomiting settles and if tolerated.

After IV fluids have been started, anti-emetic drugs may not be required, but if vomiting continues try prochlorperazine 12.5 mg IM and then orally 5 to 10 mg three times daily. Alternatives include:

Cyclizine, 50 mg IM, IV or orally three times daily

Domperidone 10 mg orally or 30–60 mg rectally four times a day

Metoclopramide 10 mg IM, IV or orally three times a day.

If suppositories are available, rectal administration is ideal as it can be self-administrated and avoids the oral route in the nauseous and vomiting patient.

It is often necessary to use a combination of anti-emetics. If this is done it is often best to combine drugs with different mechanisms of action (e.g. cyclizine plus metoclopramide) and to stagger their administration.

Be aware of possible oculogyric crisis (characterized by a prolonged involuntary upward deviation of the eyes) with metoclopramide and if present discontinue this drug.

Supplements with thiamine should be given (IV if available) if there is evidence suggesting a severe deficiency may be present (Wernicke–Korsakoff syndrome). It should also be used prophylactically if the vomiting has been severe and/or protracted. See below for dosing.

If available, urea and electrolytes should be monitored (ideally daily) in women with severe hyperemesis. Women are at particular risk of hypokalaemia if the vomiting is severe and protracted. In a vomiting patient who is not tolerating any diet, potassium replacement should be considered even where blood measurement is not available. The daily requirement of potassium is approximately 60 mmol in a 60 kg woman and will be higher in the vomiting patient. Replacement of potassium IV should be undertaken with great care as too rapid replacement is dangerous.

A reasonable and safe approach would be to add 20 mmol to 1 litre of 0.9% saline and to administer over 8 hours (42 drops per minute when using a standard giving set with a drop factor of 20).

Ringer Lactate/Hartmann's does contain 5 mmol of potassium/litre and will provide some replacement if potassium is not available.

Hyperemesis is a risk factor for venous thrombo-embolism (DVT and pulmonary embolus). If a patient is admitted with severe hyperemesis she should be treated with anti-embolic stockings (if available).

Wernicke–Korsakoff syndrome

Symptoms of Wernicke's encephalopathy include the following:

- confusion
- loss of muscle coordination (ataxia)
- leg tremor
- vision changes
- abnormal eye movements (rapid sideways movements called nystagmus)
- double vision
- eyelid drooping.

Symptoms of Korsakoff syndrome include the following:

- inability to form new memories
- loss of memory, which can be severe
- making up stories (confabulation)
- seeing or hearing things that are not really there (hallucinations).

Treatment of severe hyperemesis where possible symptoms or signs of Wernicke– Korsakoff syndrome are present

Give an IV infusion of 10 mL of Pabrinex (Vials 1+2) in 100 mL of 0.9% saline over 1 hour (vials contain thiamine, ascorbic acid, nicotinamide, pyridoxine and riboflavin).

Subsequently, give oral thiamine 50 mg three times daily until vomiting has stopped.

Other management on discharge from hospital

Withhold iron tablets until vomiting has resolved, but ensure that they are taken subsequently, as iron-deficiency anaemia may have been an important consequence of the hyperemesis.

Try to help with any depression that is present and also make sensitive inquiries of the woman or adolescent girl in case intimate partner violence is a contributing factor.

Section A+28. Mental health problems associated with pregnancy and the postnatal period

Risk factors

- Poverty and high levels of economic stress
- Low levels of social support
- Domestic violence
- Chronic maternal illness
- Maternal anaemia
- Lack of awareness among primary healthcare workers of depression as an illness
- Social stigma associated with a family member being diagnosed with a mental illness
- Families with 4 or more children, especially when the children are under 7 years of age
- Having a preterm infant or an infant with a low birth weight
- Having a child with a developmental disability
- Having an unplanned or unwanted infant
- Having a female child in a culture where there is a strong preference for male children
- Lack of participation in family financial decisions, control of resources and reproductive health
- Lack of pain control during labour
- Caesarean section

Maintaining the mental health of a pregnant woman benefits the family, and in some cases, if undertaken before birth, can prevent problems from developing postnatally. The onset of depression and anxiety in pregnancy or postnatally can be especially worrying for a woman and her family, because it is contrary to their expectations that this will be a happy time. The woman may not want to admit how she is feeling, being ashamed both of her inability to feel joy about her newborn baby, and of her perceived inability to cope, and fearing that she will be judged harshly for these feelings. This is especially important in countries and cultures where women and girls are undervalued, and their main role is perceived to be the production of healthy babies.

Mild antenatal and postnatal depression can be managed with minimal resources and does not require medication. Recognition of the condition, and practical help from family and friends, can be enough to prevent depression affecting the care of the baby. Reassurance from healthcare professionals can help the mother and her family to realise that she is not on her own in her feelings. To a depressed new mother, it can feel as if every other mother is better than her, and to know that this is

not the case can be extremely helpful.

However, there are some serious psychiatric conditions associated with childbirth that need prompt psychiatric treatment. The most serious of these conditions, puerperal psychosis, is a psychiatric emergency. Usually rare, this condition is more common in women who have had a previous manic episode and have been diagnosed with having bipolar affective disorder (also called manic depressive illness). A history of a previous episode of puerperal psychosis considerably increases the risk of having another episode following subsequent pregnancies.

Antepartum mental health disorders

Psychiatric symptoms occur as frequently antenatally as postnatally, with an estimated prevalence of 10–15%.

The symptoms are often of mild depression and anxiety. Careful enquiry may reveal that the symptoms were present before conception.

The development of a serious psychiatric condition in the antenatal period is no more common than at other times, but if a diagnosis is made during pregnancy, the decision to start medication has to balance the severity of the mother's illness against the possible adverse effects of medication on the fetus. Mild symptoms often present early in pregnancy and may improve as the pregnancy progresses.

Hyperemesis can make the first trimester miserable, and lead women to express thoughts of rejecting the pregnancy. Sometimes this is mistaken for evidence of depression. The third trimester can be a time of anxiety about labour and the impending birth, especially for first-time mothers or those who have had previous complicated deliveries.

Factors that increase the risk of antenatal depression and/or anxiety are:

- Previous pregnancy loss
- Previous fertility problems
- Anxiety about the viability of the pregnancy
- Social and interpersonal adversity
- Feelings of ambivalence about the pregnancy
- Previous depression and/or anxiety associated with pregnancy
- Anaemia

Supportive counselling is often sufficient to improve pregnant women's mental health, but if antidepressants are indicated, there needs to be a discussion about the risks and benefits before they are prescribed.

The Selective Serotonin Reuptake Inhibitors drugs (SSRIs) Citalopram and Sertraline are at present the most effective and safe drugs. However, if they are taken during early pregnancy when the embryo is developing (embryogenesis), there are risks of congenital abnormalities, which have to be balanced against the risks to the pregnancy if the depression is left untreated. Babies of women who take SSRIs in the third trimester may develop a transient neonatal withdrawal phenomenon, characterized by jitteriness, respiratory difficulties and problems with feeding.

A woman with an established diagnosis of bipolar disorder may, during early pregnancy, be taking a mood-stabilizing drug such as Lithium, Sodium Valproate or Carbamazepine. These are associated with an increased risk of fetal malformations, so consideration needs to be given to stopping them prior to conception. In women in whom relapse has occurred when stopping Lithium, the balance between risks and benefits is probably in favour of continuing the drug. This is less likely to be the case for Sodium Valproate or Carbamazepine.

Postpartum mental health disorders

There are 3 main types:

1. Short-lived mild depression (called *maternity blues*)
2. Postnatal depression
    a. Mild
    b. Moderate
    c. Severe
3. Puerperal psychosis

Importance of diagnosing physical causes for depression or psychosis in the postpartum period

It is essential to rule out physical causes before diagnosing mental illness as the cause of the mother's symptoms.

Such physical causes include sepsis, shock from bleeding, anaemia, and the taking of traditional medicines.

These conditions must be considered in every woman presenting with either depression or psychosis in the puerperium.

1. Mild temporary depression: Maternity blues

This is a mild and self-limiting condition that affects over 50% of women, usually between day 3 and day 10 postnatally.

A hormonal cause has been considered responsible. There is marked variability of mood, feelings of confusion, irritability, difficulty sleeping and a feeling of not being able to cope. It is generally self-limiting, although if it is longer-lasting or more severe than usual, it can merge into postnatal depression (see below).

Reassurance, as well as practical and psychological support from family members and staff, is usually sufficient to help the woman through this period, which usually lasts about 48 hours.

2. Postnatal depression

Around 10% of woman develop symptoms of depression postnatally. The majority will be relatively mild and overlap with the process of adjusting to having a baby, particularly (although not exclusively) following the birth of a first child. It is common for a diagnosis of postnatal depression not to be made until about 6 weeks after the onset of the depression.

Symptoms are similar to those that occur in non-pregnancy-related depression but sleep and meals are often disrupted because of the baby's presence, so different questions may need to be asked in order to elicit a diagnosis. The mother may not recognise that she is depressed, and so does not share how she is feeling.

The commonly experienced symptom of inability to feel pleasure is particularly difficult at this time, when the mother (as well as those around her) feels that she should be happy. This can lead her to conclude that she is a poor mother. Obsessional symptoms and irritability are also often reported.

The Edinburgh Postnatal Depression Scale (EPDS) is a screening tool (see below) which requires no psychiatric training to administer, and so can be used by healthcare workers to identify mothers who may be depressed.

2a Mild depression

Simple interventions can be effective, including listening to the mother's concerns, reassuring her that her feelings do not mean she is a bad

mother, and giving practical help with the baby, allowing her to rest as much as possible. Antidepressants are not usually indicated in mild depression.

2b Moderate depression

Here there is a persistent low mood, disturbed and reduced sleep and appetite, poor concentration, feelings of not being able to cope, and lack of improvement when practical help and support are given. Antidepressants are likely to be needed. If available, Sertraline or Citalopram are the SSRIs with the lowest relative infant dose (i.e. the amount passing to the infant through breast milk), so are the safest ones for breastfeeding mothers.

Sertraline: starting dose is 50 mg once daily, then increased in steps of 50mg at intervals of at least 1 week if required, with a maximum dose of 200 mg daily.

OR

Citalopram: starting dose is 20mg once daily. Do not expect any improvement in symptoms before 14 days of treatment. If there is no improvement in symptoms after 3 weeks, increase the dose to 40mg daily (max dose).
If there is only mild improvement in symptoms at 3 weeks, wait another week (4 weeks from starting treatment).

If no further improvement has occurred by then, increase the Citalopram to the maximum dose of 40mg daily.

The most commonly reported side effect for both of these drugs is nausea, which wears off after 2 to 3 weeks.
This is same time that it takes for the therapeutic effects to begin to appear.
The mother must be appropriately counselled, in order to maximise the chances of adherence to treatment.

2c. Severe postnatal depression

This affects about 3% of women who have recently delivered and can occur in combination with puerperal psychosis (see below). It is crucial to be aware that distinguishing between postnatal depression and postnatal psychosis can be very difficult, even for a healthcare professional with experience of dealing with serious mental health conditions.

Severe postnatal depression often occurs early in the postnatal phase, but it may be of more gradual onset, presenting when the woman has returned home.

It may or may not be obvious that the mother is unwell. Sleep is difficult to achieve, even when the baby sleeps well through the night. Appetite may be seriously reduced, with marked weight loss. Most mothers, even when very depressed, will use all their energies on the baby and neglect themselves.

Depressive delusions (false beliefs) can develop, with the mother believing that the baby would be better off without her, and this leads to a significant maternal suicide risk. The risk of the mother taking the baby with her in a suicide attempt has to be considered. It is very important not to leave the mother and baby alone together, and to provide supportive surveillance round the clock. Separating the mother from the baby can increase the woman's sense of desperation and feelings of failure as a mother, but it may sometimes be the most practicable way of ensuring the safety of both mother and baby.

Admission of the mother and baby to a suitable hospital setting (if available) is the ideal way to manage a woman with severe postnatal depression. Antidepressants should be given (see above for doses; the SSRI group is likely to be the best and safest option if available), and also antipsychotic drugs (see below) if these are needed.

The mother will always benefit from the additional supportive measures described above for milder types of postnatal depression.
It is not only possible but desirable to continue breastfeeding, whether or not the mother is being treated with antidepressants. If antipsychotics are also required, breastfeeding can also continue. Adequate sleep for the mother can be facilitated by her expressing breast milk, and other family members giving this to the baby from a cup and spoon whenever the baby wakes during the night.

2. Puerperal psychosis

This is the most severe postpartum mental illness, and it occurs in approximately 1 in 500 deliveries.
Symptoms may appear rapidly or may evolve gradually over the space of a few days. It is frightening and worrying for both the mother and her family. A previous diagnosis of bipolar disorder or puerperal psychosis increases the risk to as much as

1 in 2. This presents the clinician with an opportunity to identify a woman at risk antenatally, to consider the options for prevention, and to develop a plan of management for the puerperium, should the mother become unwell.

There may be a sudden onset of symptoms, sometimes overnight, but the symptomatology may sometimes evolve more slowly. It presents most commonly in the first 2 weeks following childbirth.
The symptoms vary, but characteristically include the following:

- confusion
- hyperactivity
- insomnia
- marked behavioral changes, including bizarre behaviour

These symptoms are often accompanied by a fear that something will happen to the mother herself or to the baby, or sometimes a false belief (delusion) that the baby is not her own. The woman is usually easily distracted, with grossly impaired concentration, and is unable to finish one task before trying to start another, in a markedly disorganised way.

This significantly interferes with her ability to look after her baby. Pointing this out often causes her even more distress. This can reinforce delusional beliefs that the

baby is not her own, or that others are going to take her baby away, especially if she is separated from the baby because of her illness.

Hypomania (excessively high mood and hyperactivity) may occur and may be followed rapidly by severe depression.

During the acute phase, there is a significant risk of harm to the mother or child.

This may occur as a consequence of the mother's chaotic behaviour which may lead to self-neglect and neglect of the infant.

It may also occur as a result of harmful actions on her part, sometimes involving delusional beliefs, plus or minus auditory hallucinations.

Wherever possible, the mother and baby should be kept together, with close supportive surveillance by family members and healthcare workers. Even when the mother is very unwell and unable to manage much of the baby's care herself, both mother and baby benefit from being in close proximity. The mother can then be encouraged to take over more of the baby's care as her mental state improves, re-establishing the mother–child bond.

Patients with puerperal psychosis may need medication. In settings where the choice of medication is limited, the older antipsychotic drugs can be just as effective as more modern drugs, and, with monitoring, breastfeeding can be continued.

It should be remembered that the disorganised behaviour of the mother can make breastfeeding difficult, and it is therefore very important to supervise and support the woman with this task.

Initially, the drug treatment may need to be given by injection, especially if the mother is unwilling or unable to take oral medication. Injections can be given until she is calm enough and can understand that she does need medication. The treatment can then be changed to regular oral medication.

As with any patient with serious psychiatric illness, a woman with postpartum psychosis may need to be detained against her wishes, for the purpose of psychiatric treatment. It is important for healthcare professionals to become familiar themselves with local legislation and processes in relation to this.

Anti-psychotic drugs by injection

Either Chlorpromazine: 25mg every 6 to 8 hours by deep IM injection

OR

Haloperidol: 5 mg IM 12 hourly, with a maximum daily dose of 15mg IM

Oral Anti-psychotic medication

Chlorpromazine is an inexpensive and generally widely available 'typical' antipsychotic drug. It tends to have been superseded in well-resourced countries by the so called **'atypical' antipsychotic drugs**, which have a more acceptable side-effect profile.

Nevertheless, oral Chlorpromazine is effective, and the dose can be titrated up quite rapidly from 50 mg four times daily to as high as 1000 mg daily. Three main side effects can occur:

1. Sedation (which can be beneficial in the acute stages of illness)
2. Dry mouth and nausea
3. Parkinsonism (difficulties in movement of facial muscles, slowing and stiffness of walking, and tremor)

An alternative drug is **Haloperidol,** given orally at a dose of 0.5–3 mg two to three times daily, with a maximum daily dose of 30 mg orally.

The **atypical antipsychotic drugs** include Risperidone, for which the starting dose is 1 mg orally twice daily, with a maximum daily dose of 6 mg. Although Risperidone has a low incidence of Parkinsonism, it is associated with weight gain and an increased risk of type 2 diabetes.

As the psychotic symptoms improve and insight develops, the mother may experience a period of depressed mood as she adjusts to what has happened. However, recovery is usually complete by 6 months, although there is a risk of relapse at other times, particularly in a subsequent pregnancy.

In a woman with a pre-existing diagnosis of bipolar disorder (previously called manic-depressive illness), attention should be paid to interventions which may reduce the risk of the development of puerperal psychosis.

Prevention of sleep deprivation is very important in this regard, and this should be emphasised to the family, encouraging the woman's partner or other relative to undertake as much care as possible during the night.

The effectiveness of using prophylactic antipsychotic drugs to prevent the onset of puerperal psychosis has yet to be established. The trigger for puerperal psychosis appears to be biological, but so far the condition has proved difficult to prevent, even when treatment is continued through pregnancy. It is therefore essential to have a plan in place for what to do if the mother becomes unwell, and this can also reduce stress for the family.

It is of crucial importance for healthcare workers and the woman's family to be vigilant in looking out for symptoms which may point to the development of postnatal psychosis. Once detected, these symptoms must be reported, and appropriate action taken.

Risk of recurrence of severe depression or puerperal psychosis in a subsequent pregnancy

All women suffering either severe depression or puerperal psychosis should be counselled on the very high risk of these serious mental health problems recurring in a subsequent pregnancy. Family planning techniques must be of the most effective standard possible. Ideally another pregnancy should not occur.

Instructions for using the Edinburgh Postnatal Depression Scale (see below) (NB an antenatal version of this tool is also available)

1. The mother is asked to check the response that comes closest to how she has been feeling in the previous 7 days.
2. All of the items must be completed.
3. Care should be taken to avoid the possibility of the mother discussing her answers with others. Answers must come from the mother herself.
4. The mother should complete the scale herself, unless she has limited English or has difficulty with reading.

Mothers who score above 13 are likely to be suffering from a depressive illness of varying severity. The EPDS score should not override clinical judgement. A careful clinical assessment should be undertaken to confirm the diagnosis. The scale indicates how the mother has felt during the previous week. In doubtful cases it may be useful to repeat the tool after 2 weeks.

Scoring

Questions 1, 2 and 4 (without an asterisk) are scored 0, 1, 2 or 3, with the top box scored as 0 and the bottom box scored as 3.

Questions 3, 5, 6, 7, 8, 9 and 10 (marked with an asterisk) are reverse scored, with the top box scored as 3 and the bottom box scored as 0.

The maximum possible score is 30. **Possible depression is indicated by a score of 10 or more.** Always look at item 10 (suicidal thoughts).

Questions 3, 5, 6, 7, 8, 9 and 10 (marked with an asterisk) are reverse scored, with the top box scored as 3 and the bottom box scored as 0.

Always look at item 10 (suicidal thoughts).

Edinburgh Postnatal Depression Scale (EPDS)

Name:
……
……
Address:
……
……

Your date of birth:
……

Baby's date of birth:
……..

Phone number:
……
….

Instructions
As you have recently had a baby, we would like to know how you are feeling now. Please choose the answer that comes closest to how you have felt IN THE PAST WEEK, not just how you feel today.

In the past 7 days:

Question 1
In the past week I have been able to laugh and see the funny side of things:

- ☐ As much as I always could
- ☐ Not quite so much now
- ☐ Definitely not so much now
- ☐ Not at all

Question 2
In the past week I have looked forward with enjoyment to things:

- ☐ As much as I ever did
- ☐ Rather less than I used to
- ☐ Definitely less than I used to
- ☐ Hardly at all

Question 3*
In the past week I have blamed myself unnecessarily when things went wrong:

- ☐ Yes, most of the time
- ☐ Yes, some of the time
- ☐ Not very often
- ☐ No, never

Question 4
In the past week I have been anxious or worried for no good reason:

- ☐ No, not at all
- ☐ Hardly ever
- ☐ Yes, sometimes
- ☐ Yes, very often

Question 5*
In the last week I have felt scared or panicky for no very good reason:

- ☐ Yes, quite a lot
- ☐ Yes, sometimes
- ☐ No, not much
- ☐ No, not at all

Question 6*
In the past week things have been getting on top of me:

- ☐ Yes, most of the time I haven't been able to cope at all
- ☐ Yes, sometimes I haven't been coping as well as usual
- ☐ No, most of the time I have coped quite well
- ☐ No, I have been coping as well as ever

Question 7*
In the past week I have been so unhappy that I have difficulty sleeping:

- ☐ Yes, most of the time
- ☐ Yes, sometimes
- ☐ Not very often
- ☐ No, not at all

Question 8*
In the past week I have felt sad or miserable:

- ☐ Yes, quite often
- ☐ Sometimes
- ☐ Hardly ever
- ☐ Never

Question 9*
In the past week I have been so unhappy that I have been crying:

- ☐ Yes, most of the time
- ☐ Yes, quite often
- ☐ Only occasionally
- ☐ No, never

Question 10*
In the past week the thought of harming myself has occurred to me:

- ☐ Yes, most of the time
- ☐ Yes, quite often
- ☐ Not very often
- ☐ No, not at all

Administered/reviewed by:
……
Date: ……

Source: Cox JL, Holden JM and Sagovsky R (1987)

Section A+29. Female Genital Mutilation/Cutting (FGM/FGC) and Pregnancy

Introduction

What is female genital mutilation (cutting)?

Female genital cutting (FGC), also known as female circumcision or female genital mutilation, refers to all procedures involving partial or total removal of the external female genitalia, or other injury to the female organs for non-therapeutic reasons. It ranges from very simple to radical, and may be carried out between birth and puberty, or can be performed just before marriage or childbirth.

FGC/FGM varies across cultures, ethnic groups and tribal affiliations. Globally, over 200 million women and girls are affected by FGM. Most of them are African.
https://www.28toomany.org

Who performs FGC?

FGC is commonly performed by traditional medicine practitioners, including traditional birth attendants, local women or men, or female family members. Such individuals do not have formal medical training, and usually perform cutting without anaesthesia or asepsis, with crude instruments such as kitchen knives or razor blades. It is not uncommon for those who perform FGC to cut or damage more of the genital area than they intended to. Increasingly, doctors are also undertaking these procedures.

Types of FGC

The WHO has classified FGC into four types.

Type 1: excision of the prepuce, with or without excision of the clitoris, entirely or in part
Type 2: excision of the clitoris with partial or total excision of the labia minora
Type 3: excision of part or all of the external genitalia and stitching/narrowing of the vaginal opening (also known as infibulation). This type is most common in countries in the Horn of Africa, namely Sudan, Eritrea, Djibouti, Ethiopia and Somalia
Type 4: unclassified – includes pricking or incising of the clitoris or labia, cauterisation by burning of the clitoris, or introduction of corrosive substances or herbs into the vagina; sometimes the clitoris is buried rather than excised.

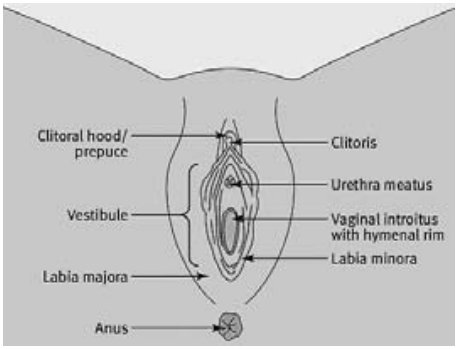


Figure A+29.1 Normal female external genitalia.

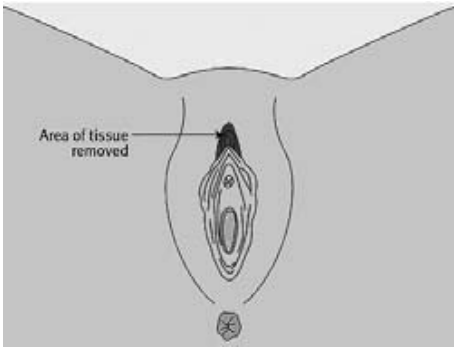


Figure A+29.2 Area of tissue removed in type 1 female genital cutting.

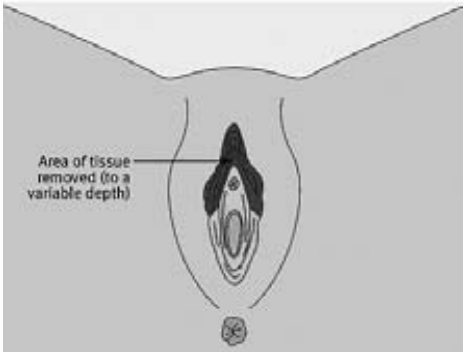


Figure A+29.3 Area of tissue removed in type 2 female genital cutting.

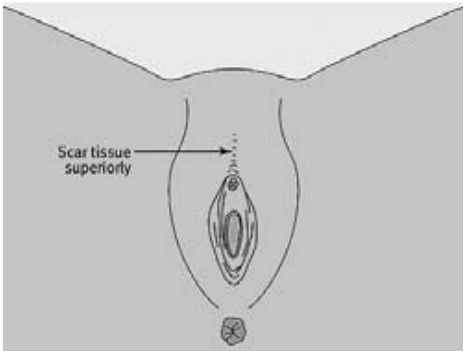
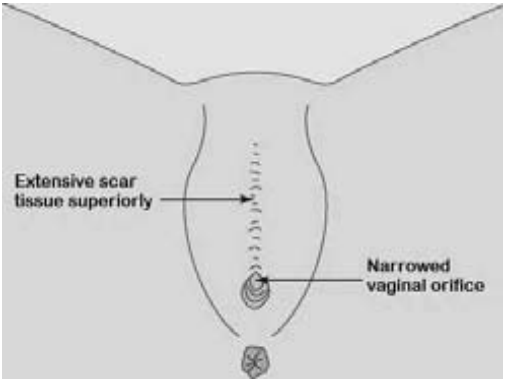


Figure A+29.4 Appearance of genitalia after type 2 female genital cutting.

Figure A+29.5 Appearance of genitalia after type 3 female genital cutting.



Implications and complications of FGC

The health problems associated with FGC are life-threatening haemorrhage, sometimes death during or shortly after the procedure (from haemorrhage or infection), death during pregnancy, the need for assistance during childbirth due to interference with normal delivery, and the spread of HIV/AIDS and hepatitis due to the frequent use of unclean and unsterile instruments. There are also links to mental illness in the victims and to intimate partner violence.

FGC is dangerous to girls' and women's health and psychological well-being. It can cause urological, gynaecological and obstetric problems. Around 10% of girls and women are estimated to die from the short-term complications of FGC, such as haemorrhage, shock and infection. Another 25% die in the long term as a result of recurrent urinary and vaginal infections, as well as complications during childbirth, such as severe bleeding and obstructed labour.

Short-term complications

1. haemorrhage and anaemia
2. severe pain (it is almost always the case that no local anaesthetic is given)
3. shock (due to haemorrhage and/or pain)
4. death from shock (due to haemorrhage and/or pain)
5. difficulty passing urine or faeces
6. urinary tract infection
7. urethral meatus injuries, prolonged micturition, and dysuria
8. injury to adjacent tissues
9. damage to other organs
10. fractures or dislocation due to restraint during the procedure

11. infection due to tetanus, and bloodborne viruses such as HIV, hepatitis B and C
12. vulval abscess.

Long-term complications

1) chronic pain
2) chronic pelvic infection
3) haematocolpos (obstruction to menstrual flow, leading to dangerous swelling of the vagina)
4) keloid scarring
5) vulval epithelial inclusion cysts
1) decreased quality of sexual life, including pain on intercourse
2) complications in pregnancy and childbirth, including obstructed labour (see below)
3) psychological damage, including fear and anxiety during labour and delivery, as well as post-traumatic stress disorder and depression
4) psychosexual effects; fear of, and anxiety about, sexual intercourse, difficulties with penetration, marital break-down and divorce.

Complications during childbirth

Women who have undergone FGC are more likely to experience difficulties during childbirth, and their babies are more likely to die. A WHO study conducted in 2006 in six African countries showed an increased risk of possible obstetric complications in women who had been subjected to FGC compared with women who had not undergone this procedure. The same study showed an increased incidence of maternal death, Caesarean section, postpartum haemorrhage and neonatal resuscitation, as well as prolonged hospital stays, in women who had undergone FGC.

Management during pregnancy, labour and the postnatal period

1. In the antenatal period

All women and girls who have been subjected to FGC may, if considered helpful in the particular country involved, be identified at antenatal booking by asking questions such as '*Have you been closed?*' or '*Did you have the cut or operation as a child?*' Most women will then assume that you know about FGC, and further questions can be asked, such as *'Do you have any problems with passing urine or menstruation?'* or *'How long does it take to pass urine?'* Once the issue is raised, the woman may then feel comfortable discussing it further with the midwife or doctor.

'Reversal' of FGC (de-infibulation)

'Reversal' (de-infibulation) is best undertaken at 17–18 weeks' gestation (mid-trimester) by a specialist midwife or surgeon, to enable easy access to the vaginal orifice and urethra during labour. Performing reversal in the second trimester ensures complete healing prior to labour. Reversal is not recommended in the first trimester, as the procedure may be wrongly blamed for fetal loss.

Antenatal reversal is essential to assist in vaginal examinations using a speculum, and in urinary catheterisation. It may also prevent recurrent urinary tract infection. Local anaesthesia is encouraged for reversal, but general anaesthesia may be necessary if the woman suffers from flashbacks to childhood trauma.

Post-reversal care during the antenatal period should include adequate pain relief, and promotion of personal hygiene. Some re-education may be necessary, as some women will have forgotten, or may never have known, what normal micturition or menstruation is like.

It is important to be aware that 'reversal' of FGC/FGM is not always possible, as in many cases excision of tissue has taken place, notably the clitoris and/or the labia minora.

Even in cases where no tissue has been removed, the scarring which has taken place will not disappear with 'reversal' surgery.

2. In labour

The aim is a normal delivery, with Caesarean section only for the usual obstetric indications. The woman should receive standard care in labour.

If the woman has not been seen antenatally, or if she has chosen not to have reversal undertaken, an individual assessment should be made on admission in labour, regarding the need for reversal and/or episiotomy to facilitate delivery.

If she has sustained FGC type 3 (infibulation), **a midline incision** should be made to expose the introitus and urethra, after infiltration with 1% lignocaine.

Infibulated women should have a midline incision, but also have a medio-lateral episiotomy, only if necessary, because of specific delivery problems, such as the need for vacuum delivery or shoulder dystocia.

Adequate pain relief is very important, especially as flashbacks may occur.

Bladder care is very important during labour, to avoid damage to the bladder and the urethra. (Catheterisation is not usually necessary; instead encourage frequent voiding).

3. Immediate care following delivery

If suturing is needed, it should occur promptly. **Re-infibulation of FGC type 3 must not be carried out.**

If a midline incision has been made to open a type 2 or 3 FGC to enable delivery, then each side of the incision can be over-sewn separately and laterally on either side.

4. Postnatal period

Immediate care following delivery should include the following:

- adequate pain relief
- perineal care
- re-education. Some women will have forgotten or will never have known what normal micturition or menstruation is like.

Following discharge from the healthcare facility, continued support for the woman should be provided.

If the woman has delivered a baby girl, support and information should be given, encouraging her not to inflict, or allow others to inflict, the same procedure on her daughter.

Safeguarding children who are at risk of FGC/FGM

- The safety and welfare of the child is paramount.
- All agencies must act in the best interests of the rights of the child as stated in the UN Convention on the Rights of the Child (1989).
- In some countries, FGC/FGM is illegal, and it should be known in the country where you are practicing what the law actually states.

The situation for FGC/FGM in Liberia

"President Ellen Johnson Sirleaf left office in January 2018 with a tremendous, if overdue, parting gift for the girls of Liberia. During her final hours in office, Africa's first woman elected head of state signed an executive order abolishing female genital cutting, an ancient practice that had been endured by more than half of Liberia's girls.

The fight is not quite over. Lawmakers have a year to enshrine the ban into law, and it may be many years before the law is properly enforced. But it is a momentous step that seemed unthinkable just six years ago, when an explosive newspaper article propelled the issue onto the national agenda".
https://www.cjr.org/first_person/liberia-female-mutilation.php

It is acknowledged that some families see FGC/FGM as an act of love rather than of cruelty. However, FGC/FGM causes significant harm in both the short term and long term and constitutes physical and emotional abuse of children.

All decisions or plans for the child(ren) should be based on good-quality assessments. They should be sensitive to issues of race, culture, gender, religion and sexuality, and should avoid stigmatising the child or the practicing community as far as possible. Accessible, acceptable and sensitive involvement with the health, education, police, children's social care and voluntary-sector services may be needed.

All agencies should work in partnership with members of local communities, to empower individuals and groups to develop support networks and education programmes.

Appropriate care for women and girls who have been subjected to FGC/FGM

- Provide access to information, support and services.
- Provide care pathways and guidelines for professionals.
- Ensure that information is accurate and up to date.
- Empower women and girls and encourage them to speak out and seek help.
- Engage and mobilise all concerned and develop an understanding of cultural diversity.
- Be open and supporting, sensitive and non-judgmental.
- Encourage alternative rites to FGC/FGM. This is a strategy that retains all of the rites of passage or initiation that the girls would traditionally undergo, except for the genital cutting. The girls are still encouraged to learn essential domestic duties that would be useful when they are married.

Conclusion

FGC/FGM is a violation of human rights. It is essential to empower women and girls, to encourage women to have a voice, and to raise awareness of the dangers of FGC/FGM. Engagement with all concerned local communities is crucial, including community and religious leaders.

As has been expressed so beautifully by Uche Umeh, ***'When culture kills, when culture silences, when culture is complicit then culture must be changed.'***

It is essential to work with all professionals. We all have a duty and a responsibility to safeguard girls who are at risk of FGC/FGM, as the welfare of children is paramount.

Section A+30 Domestic/intimate partner violence during pregnancy

Introduction

Everyone has a fundamental right to be, and remain, safe from harm. Domestic violence, also described as intimate partner violence, is defined as 'any incident of threatening behaviour, violence or abuse (psychological, physical, sexual, financial or emotional) between adults who are, or have been, intimate partner or family members, regardless of gender or sexuality'. Family members are defined as mother, father, son, daughter, brother, sister and grand- parents, whether directly related, in-laws or stepfamily.

The main characteristic of domestic violence is that the behaviour is intentional and is calculated to exercise power and control within a relationship.

Domestic violence is reported in up to one in five pregnancies, often beginning or getting worse at this time. The risk of moderate to severe violence appears to be greatest in the postpartum period.

Injuries to the abdomen, genitals and breasts are most frequent in pregnancy, but can be multiple, affecting any part of the woman's body.

Women and adolescent girls who suffer domestic violence are at increased risk of miscarriage, premature labour, placental abruption, low-birth-weight infants, fetal injury and intrauterine fetal death. As a result of violence, women are five times more likely to attempt suicide.

The impact of domestic violence is devastating, and creates long-term consequences for women and adolescent girls, such as anxiety and mistrust. The impact on children in the family must also be considered, as domestic violence and child abuse are often linked to the same perpetrator.

Recognising domestic violence in pregnancy

Studies show that around 30% of women will suffer from domestic violence in their lifetime. The first incident of violence commonly occurs during pregnancy. For some of these women, the pregnancy might be unwanted, due to abuse, rape, or as a result of not having access to or not being able to negotiate contraceptive use.

Domestic violence in pregnancy may be suspected on the basis of the type of injury, as well as the mental health and emotional status of the woman.

Women who are being abused may book late and be poor attendees at antenatal clinics. They may attend repeatedly with trivial symptoms and appear reluctant to be discharged home. The partner may be constantly present, not allowing private discussion. The woman may seem reluctant to speak in front of her partner, or to appear to contradict him.

Abusive partners often seek to minimise the evidence of their violence (e.g. by targeting areas that are normally clothed). As with child abuse, the stated mechanism of injury often does not fit with the apparent injury. There may be untended injuries of different ages, or the sometimes dangerously late presentation of injuries.

Multiple injuries and bruising (especially to the face, arms, breasts and abdomen), loss of consciousness, and drunkenness are significant but non-specific markers of domestic violence.

A history of behavioral problems, or abuse of children or pets in the family, may be suggestive of domestic violence.

Diagnosing domestic violence

Routinely ask mothers whether they have been subjected to violence. Questions such as the following may allow the woman to disclose that she is being subjected to violence:

- I have noticed you have a number of bruises. Did someone hit you?
- You seemed frightened by your partner. Has he ever hurt you?
- You mention that your partner loses his temper with the children. Does he ever do that with you?
- How does your partner act when he is drinking alcohol or on drugs?

Other strategies such as the use of questionnaires in the women's toilets/rest rooms may help those women whose partner is constantly by their side.

Community midwives and traditional birth attendants visiting women at home may have more privacy to discuss such sensitive issues.

The provision of interpreters is essential. **Family members should not act as interpreters in this situation, as free dialogue will probably not occur.**

A system for caring for and protecting women and adolescent girls subject to violence should be advocated for by all healthcare professionals undertaking maternal and child healthcare. Multi-agency working is crucial, and should include liaison with police, social services and the judicial system.

The recent PSEA (Preventing Sexual Exploitation and Abuse) programme of UNICEF cab provide a valuable way forward (see for details: https://agora.unicef.org/course/info.php?id=7380)

Protection

All professionals must take any available steps to seek a safe haven and to protect and support women who are experiencing domestic violence. The impact of domestic violence on the unborn child should be acknowledged, as well as the potential impact on existing children. It is very important to perform a risk assessment on women. Access to information and support must be easily and readily available to pregnant women.

It is equally crucial to empower and counsel women to make their own choices. Underlying issues such as finance and housing should be addressed, and the woman should be directed to the appropriate agency or support group, or to a legal adviser.

Appendix

How do I know if I am experiencing abuse?

If you answer yes to one or more of the following questions, you may be in an abusive relationship.

- Has your partner tried to keep you from seeing your friends or family?
- Has your partner prevented you from continuing or starting a college course, or from going to work?
- Does your partner constantly check up on you or follow you?
- Does your partner accuse you unjustly of flirting or of having affairs?
- Does your partner constantly belittle or humiliate you, or regularly criticise or insult you in front of other people?
- Are you ever scared of your partner?
- Have you ever changed your behaviour because you're afraid of what your partner might do or say to you?
- Has your partner ever deliberately destroyed any of your possessions?
- Has your partner ever hurt or threatened you or your children?
- Has your partner ever kept you short of money so that you were unable to buy food and other necessary items for yourself and your children?
- Has your partner ever forced you to do something that you really didn't want to do, including sexually?

Further reading

Wellbeing Foundation Africa. *Eliminating Domestic Violence*. https://issuu.com/wellbeingafrica/docs/15.09.01_-_a_moment_of_obligation_-

Section B1 Heart failure during pregnancy

Introduction

Serious cardiac pathology may present either as heart failure where respiratory distress is the most obvious finding, or as cardiogenic shock (see shock Section C6).

Main causes of heart failure with pulmonary oedema during pregnancy

- hypertension and severe pre-eclampsia, especially immediately after delivery
- severe anaemia
- structural heart disease
- circulatory overload (e.g. excessive IV fluids)
- hypertrophic cardiomyopathy (HCM)
- peripartum cardiomyopathy.

The following are useful investigations if available:

- Full blood count (to exclude severe anaemia)
- Creatine, urea and electrolytes
- Infection screen, including blood cultures
- 12-lead electrocardiogram
- Chest X-ray
- Echocardiogram if available.

Diagnosis of pulmonary oedema.

- Sudden onset of breathlessness
- Breathlessness on lying flat
- Agitation
- ↑ BP >140/90 ↑ Respiratory rate ↑ Heart rate
- ↓ O_2 saturation < 95%
- Crackles, crepitations and wheeze on auscultation of lung bases
- Gallop rhythm or heart murmur heard on listening to the heart sounds with a stethoscope
- Enlarged possibly tender liver
- Raised jugular venous pressure (see Figure 40. 1)
- Chest X ray (if available) shows upper lobe vessel redistribution, Kerley B lines and pulmonary infiltrates.

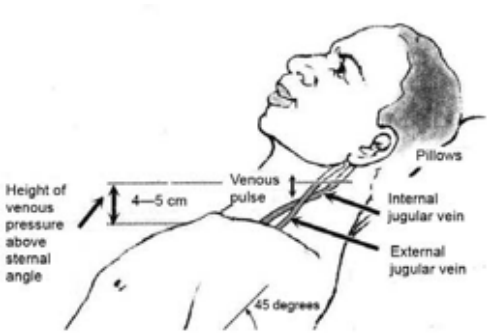


Figure B1.1 *Clinical measurement of jugular venous pressure. Normal levels of jugular venous pressure (JVP) are 4–5 cm above the sternal angle. In heart failure the JVP can be raised so that the external jugular vein is filled up to or above the angle of the jaw*

Management of heart failure with pulmonary oedema

Stabilise patient;

- Sit patient upright and ensure bed rest.
- Give O_2 by mask with reservoir or nasal cannulae at 4-6 l/min.
- 15-minute observations of B.P. Resp. rate, Heart rate, SpO_2, level of consciousness. Fetal heart rate monitoring if not post -natal.
- Strict fluid balance. Restrict fluids; stop I.V. fluids, monitor input and output. Consider bladder catheterisation. Minimise dilution of magnesium sulphate or other drugs if being given I.V.
- DO NOT GIVE non-steroidal analgesic drugs such as diclofenac or indomethacin.

Treat pulmonary oedema**;** aim for BP 140/90, and diuresis.

- Provided the patient is not hypotensive (systolic blood pressure NOT below 90 mmHg) and has no serious obstructive heart valvular disease give Glyceryl Trinitrate (G.T.N.) by sublingual spray (400micrograms/puff) at a dose of 2 puffs every 5 minutes. Aim to reduce systolic BP by 30mmHg over 5 minutes, then a slower reduction to a target of 140/90.
- If GTN spray is not available give a glyceryl trinitrate (GTN) tablet 500 micrograms sublingually and repeat one tablet every 15 minutes up to a total of 3 tablets
- I.V. furosemide 40mg over 2 minutes. Repeat after 30 minutes if there is an inadequate diuretic response. (Max dose 120mg/hour)
- If hypertension persists after GTN and furosemide, calcium channel blockers such as nifedipine can be used. Nifedipine 10mg orally, repeated after 30 minutes until optimal B.P. achieved. Maximum dose is 30 mg in the acute setting.
- I.V. morphine 5 mg over 5 minutes can be given as a dilator of veins and anxiolytic.
- If still pregnant, ensure delivery as soon as patient is stabilised.

Management of heart failure with shock

Check for severe anaemia (especially if the haemoglobin concentration is < 5.0 g/dL), for which partial exchange transfusion may be helpful. Partial exchange transfusion can be achieved with a cannula in a large vein in the antecubital fossa. Withdraw 25 mL of anaemic blood and infuse 50 mL of new packed red cells over 5 minutes and repeat up to 10 times.

> An alternative is careful transfusion of 1 unit of packed red blood cells (hang the bag vertically for 15 minutes) to allow the red blood cells to separate from the plasma. Transfuse only the red blood cell component with 40 mg IV furosemide.

If there are signs of shock (poor pulse volume or low blood pressure with extreme pallor and depressed conscious level), treat for cardiogenic shock with inotropes (if available) (see Section 16).

Longer term treatment of heart failure (seek medical specialist advice)

Management of heart failure during labour

- The mother must deliver sitting up.
- Give oxygen from a face mask throughout labour.
- Limit infusion of IV fluids to decrease the risk of circulatory overload and maintain a strict fluid balance chart.
- Ensure adequate analgesia (IV paracetamol see Section 6).
- If an oxytocin IV infusion is required, use a higher concentration at a slower rate while maintaining a fluid balance chart (e.g. the concentration may be doubled with the resulting number of drops per minute decreased by half).
- Avoid sustained, bearing-down efforts (Valsalva manoeuvres) during the second stage if possible.
- If it is necessary to decrease the woman's workload during delivery, perform an episiotomy and assist delivery by vacuum extraction or forceps.
- Ensure active management of the third stage of labour. Oxytocin given on delivery of the baby must be given very slowly IV (5 units diluted in 10 mL of 0.9% saline over 5–10 minutes) to avoid hypotension.
- **Do not give ergometrine**.

Note: Heart failure is not an indication for Caesarean section.

Management of anaesthesia if Caesarean section is needed in a patient with a cardiac problem

Avoid spinal anaesthesia if there is a fixed cardiac output, such as aortic/mitral stenosis or heart failure associated with valvular disease. Otherwise spinal anaesthesia is probably the best option in low resource settings.

If you are giving a general anaesthetic, take precautions against aspiration and minimise the risk of an increase in blood pressure associated with intubation by premedication with either morphine (5 mg initially IV) or lignocaine (1 mg/kg IV). Ketamine may not always be safe.

If the patient is considered to have insufficient cardiovascular stability for general anaesthesia, consider Caesarean section under local infiltration anaesthesia.

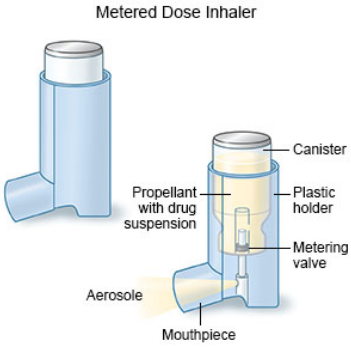
In all of the above situations the surgeon should be ready to start operating immediately when anaesthesia is established, so that the operating time is as short as possible. As above, oxytocin given for active management of third stage must be given very slowly IV (5 units diluted in 10 mL of 0.9% saline over 5–10 minutes) to avoid hypotension.

Post-operative management must ensure adequate analgesia with IV paracetamol and/or oral or IV morphine.

Section B2. Management of acute asthma in pregnancy

Background and management of asthma in pregnancy

Figure B2.1 Metered dose inhalors



- Asthma complicates 3–4% of pregnancies. Pregnancy is associated with worsening of the symptoms in one-third of affected mothers.
- A chest X-ray (if available) is indicated only if there is severe dyspnoea, uncertainty about the diagnosis, asymmetry of chest signs (possible pneumothorax) or signs of severe infection.
- Transcutaneous carbon dioxide levels (PCO_2), arterial or capillary blood gases (if available) can be helpful in very severe asthma.
- Continuous pulse oximetry is valuable, as hypoxaemia is a major feature of all severe asthma attacks.
- Do not give prostaglandins other than misoprostol (the latter is safe in pregnancy). For the prevention and treatment of PPH, give oxytocin or ergometrine or misoprostol
- Do not give labetalol for hypertension in patients with asthma.
- The priority of treatment is to maintain good control of the patient's asthma. This will reduce the likelihood of acute exacerbations which can be life-threatening.
- In order that control is maintained emphasise that inhaled salbutamol (using a metered dose inhaler: see Figure B2.1) and inhaled steroids are not harmful to the fetus and should be continued in pregnancy.
- The aim should be for the patient to need her salbutamol inhaler no more than 1-2 times/day. If use in excess of this occurs, the patient should be commenced on inhaled steroids or have her current dose of inhaled steroids increased.
- If the maximum dose of inhaled steroids is reached, then long acting B2-agonists and slow release theophylline should be considered if available.
- **A short maximum 10-day course of oral prednisolone** (30 mg daily after food) can be given if asthma is not controlled by inhalers or long acting B2 agonists. Oral prednisolone is associated with an increased risk of infection and gestational diabetes and complicates control of established diabetes. Its long-

term use has other potential side-effects for the mother, such as osteoporosis, but it should not be withheld if required to deal with severe exacerbations.

Features of severe asthma

- Too breathless to talk.
- Rib-cage recession/use of accessory muscles.
- Respiratory rate > 40 breaths/minute.
- Pulse rate > 120 beats/minute
- SaO_2 < 95% in air/cyanosis.

Features of life-threatening asthma

- Conscious level depressed/agitated.
- Exhaustion.
- Poor respiratory effort.
- SaO_2 < 90% in air/cyanosis.
- Silent chest.

Emergency treatment of severe asthma

1. **Call for help and assess ABC** and resuscitate as needed. **Call for nurse anaesthetist.**
2. **Give high flow oxygen** via a facemask with reservoir bag **PLUS humidity** or nasal cannula.
3. Attach a pulse oximeter and **maintain SaO_2 above 95%**
4. **Sit the patient up**.
5. **Give beta-2-agonist salbutamol from inhaler by giving 2 puffs (100 micrograms per each puff) at a time using a face mask or mouth piece.** Repeat as often as is needed until breathing improves. A total of 20 puffs may be needed.
6. If the inhaler does not work give **nebulised salbutamol 5 mg driven with oxygen** half-hourly to 4-hourly.
7. Give **IV/IM hydrocortisone 100 mg**, **followed by 100 mg 6-hourly**. (Note: steroids will not improve condition for a number of hours). Change to oral prednisolone of 30 mg daily after 24 hours provided patient is improved and give a 5 day course.

If the patient is not responding, or their condition is deteriorating:

1. **Inhaled salbutamol from a metered dose inhaler or nebulised salbutamol may be given continuously**.

2. **In acute severe asthma, 2 g of magnesium sulphate IV in 50 mL of R/Lactate or 0.9% saline over 10–15 minutes** can produce significant bronchial relaxation and improve breathing.
3. As an alternative to magnesium sulphate, and if the patient is **not** already on oral theophylline or other methylxanthines, give a loading dose of IV aminophylline 250 mg over 15 minutes, monitoring the ECG for arrhythmias (if possible), followed by 1 mg/kg/hour by IV infusion.
4. *ONLY IN AN ICU, IV salbutamol 250 micrograms over 10 minutes is an alternative to magnesium sulphate or aminophylline, followed by IV infusion of 1–5 micrograms/kg/minute (but monitoring ECG and checking K+ levels regularly is essential; extra potassium may be needed, and monitoring of plasma K+ levels is essential if this drug is given IV).*
5. If the above measures fail and a nurse anaesthetist if present, ketamine can be used. It is an effective bronchodilator and has been used in life-threatening asthma. **Give IV ketamine, 0.3-0.5mg/kg**
6. In severe cases, in the absence of other measures, **adrenaline can be effective**. It should be given **subcutaneously or IM (dose = 500 micrograms to 1 mg**), but may be given IV in life-threatening asthma as follows:
   Place 1 mg of adrenaline in 10 mL of 0.9% saline and give 1 mL of this solution. Wait for 1 minute and then keep on repeating 1 mL doses IV every minute until the patient improves or until the whole 1 mg (10 mL) has been given. The risk of cardiac side effects (tachycardia, cardiac arrhythmias) is low if adrenaline is given in this way.
7. In patients with poor respiratory effort, depressed conscious level and poor oxygenation despite maximum oxygen therapy:
   - Attempt to support ventilation using a bag-valve-mask and reservoir bag with high flow 0_2.
   - Summon experienced support (an anaesthetist) and consider intubation.

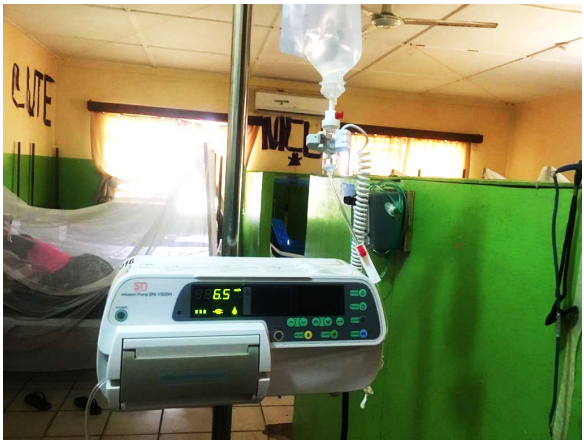
Other measures

1. If the patient is responding and improving, continue inhaled salbutamol as often as indicated.
2. Reassure the patient. Avoid upsetting them by performing unnecessary invasive procedures.
3. Give antibiotics only if there are signs of infection (fever and other signs of pneumonia; chest
   X-ray may be helpful).
4. When the patient has recovered, review their maintenance treatment and inhaler technique.

How to give drugs such as aminophylline or magnesium sulphate safely IV without syringe drivers

Ideally, as with intensive care for newborn babies, infusion devices which accurately monitor the drip rate from standard intravenous giving sets allowing accurate and safe levels of potentially dangerous drugs (see Figure B2.2).

Figure B2. 2 *Drip monitor infusion device for Safe intravenous administration of drugs Available from Diamedica*



Section B3 Anaphylaxis in pregnancy

Anaphylaxis is an allergic reaction to ingested, inhaled or topical substances, which may present as one or more of stridor, shock or respiratory distress. Common causes include allergy to penicillin, to blood transfusion, to insect bites, and to certain foods, especially nuts. Anaphylaxis can occur with any drug.
This condition is potentially life-threatening, and may result in wheezing, stridor, shock, reduced conscious level, collapse, and respiratory or cardiac arrest.

Clinical features
Consider the possibility of anaphylaxis in a patient with any of the symptoms and signs listed in *Table B3.1,* especially when any of the following are present:

- a history of previous severe reaction
- rapidly progressive or increasingly severe symptoms
- a history of asthma, eczema or rhinitis (atopy)

This condition is potentially life-threatening, and may result in a change in conscious level, collapse, and respiratory or cardiac arrest. Some patients carry their own adrenaline.

Table B3.1

Mild	
Symptoms	Burning sensation in mouth Itching of lips, mouth and throat Feeling of warmth Nausea
Signs	Urticarial rash Angio-oedema Conjunctivitis
Moderate	
Symptoms	Coughing and/or wheezing Diarrhoea Sweating Irritability
Signs	Bronchospasm Stridor Shock Pallor
Severe	
Symptoms	Difficulty breathing Collapse Vomiting Uncontrolled defecation
Signs	Severe bronchospasm Severe stridor Shock Respiratory arrest Cardiac arrest

Treatment
Key treatments for anaphylaxis are OXYGEN, ADRENALINE AND IV FLUIDS
Call for help (including nurse anaesthetist) assess and manage ABC

Remove or stop the allergen if possible. (remember any drugs being given, blood Transfusion, latex e.g. gloves, catheters and antiseptics e.g. Iodine, chlorhexidine)

Give Adrenaline 1 mg IM, and then 0.5mg IM repeated every 5 minutes until pulse and blood pressure improves.

If patient is shocked, has a pulse and is breathing: give high flow oxygen via face mask

Give rapid 500ml to 1 litre **IV fluid bolus** of 0.9% saline or R/L/Hartmann's if **shock** and repeat as necessary until BP and pulse improve. A large volume of IV fluid may be needed to restore circulation.

Uterine displacement or left lateral tilt are needed for gestational age (> 20 weeks)

If **cardiac arrest is definitely present,** start chest compressions and ventilation with bag-valve-mask and oxygen at rate of 15 compressions: 2 breaths.

If pulse and blood pressure not improving and/or anaesthetist present, give adrenaline IV as follows: *place 1 ml of 1:1000 adrenaline in 10 mL of 0.9% saline and give 0.5–1 mL of this Solution IV. Repeat 1 mL doses IV every minute until the pulse and blood pressure improve or the whole 1 mg (10 mL) has been given.*

IV/IM hydrocortisone, 100 mg (if IV by slow injection) or oral prednisolone 40 mg stat. Repeat hydrocortisone 6 hourly for 24-48 hours. Not an emergency drug because it takes time to work.

Nebulised adrenaline if there is **stridor** (laryngeal oedema) - 5 ml of 1 in 1000 adrenaline driven by oxygen.

If there is bronchospasm: **wheezing,** give salbutamol from inhaler by giving 2 puffs (100 micrograms per each puff) at a time. Repeat as often as is needed every 10 minutes until breathing improves.

If the inhaler does not work and, if available, give nebulised salbutamol 5 mg driven with oxygen half-hourly to 4-hourly.

If salbutamol not available give nebulised adrenaline (5 ml of 1 in 1000) driven by oxygen

Give antihistamine: chlorphenamine 10–20 mg by slow intravenous injection.

Symptoms and signs of anaphylaxis may recur so monitor closely for 24 hours and be prepared to give more adrenaline if this happens.

Section B4 Diabetes mellitus in pregnancy

Introduction

Diabetes mellitus is associated with increased maternal mortality and morbidity, as well as increased perinatal mortality and morbidity, including congenital malformations. Pregnancy causes changes in the maternal physiology to predispose to the development of diabetes. Women who have pre-existing diabetes have an increased insulin requirement in pregnancy. Previously healthy women may develop gestational diabetes. Both type 2 diabetes and gestational diabetes are more common in certain ethnic groups, including South Asians, and are more common in those with a high body mass index (BMI).

Before the discovery of insulin, maternal mortality in diabetic patients and perinatal mortality in their infants were extremely high. Insulin has led to a dramatic improvement in maternal survival, but in comparison with non-diabetic pregnancy there is still a three- to fivefold increase in perinatal mortality, and an increase in congenital malformations. These risks can be reduced by strict attention to the control of the diabetes both before and during pregnancy.

Diabetes also predisposes to pre-eclampsia.

Management

Before pregnancy

1. Advise any diabetic patients of reproductive age about the importance of close monitoring and modified treatment in pregnancy.
2. Obesity: give dietary advice.
3. Tight control of diabetes: aim for blood glucose levels of less than 7.5 mmol/litre and HbA1c levels within normal limits.
4. The mother should take folic acid 5 mg daily for several months if planning pregnancy.

In early pregnancy

- Nausea and vomiting are common.
- Hypoglycaemia is common in insulin-treated diabetes. Provide glucagon at home if possible, and explain its use to other household members. Alternatively, counsel the patient to keep sugar-containing foods close by. Inform the patient and others about the signs of hypoglycaemia.
- It is not always necessary to convert mothers treated with oral hypoglycaemic agents to insulin. Metformin is commonly used in these circumstances (initially 500 mg with breakfast for 1 week, then 500 mg twice daily with breakfast and tea, and

then 500 mg three times daily with breakfast, lunch and tea).
- As soon as possible, assess the gestational age. Early ultrasound scan is helpful in diagnosing congenital malformations.

During pregnancy

Type 1 diabetes (insulin dependent)
Close control of diabetes is needed. Expect insulin requirements to increase by up to 50% above pre-pregnant levels. There is an increased risk of congenital abnormalities, macrosomia, polyhydramnios, preterm labour and pre- eclampsia. Plan delivery with care. The risks of infection and development of diabetic ketoacidosis are high.

Signs of hyperglycaemia include a gradual onset of drowsiness and polyuria, dehydration, hypotension, difficulty breathing, and a ketotic smell to the breath.

Signs and symptoms of hypoglycaemia may be of rapid onset, leading to unconsciousness, particularly if the mother has taken insulin but has not taken her usual food. Awareness of impending hypoglycaemia in those with type 1 diabetes is often reduced in pregnancy. These patients must be advised about the possible effects on safety during driving.

The insulin requirement often escalates rapidly, especially in the late second and early third trimester, and in order to maintain control of the blood glucose, frequent medical review every 1 to 2 weeks coupled with frequent self-assessment of blood glucose levels, is likely to be required for women with type 1 diabetes.

Type 2 diabetes
Women who are diet-controlled before pregnancy require careful monitoring of blood sugar levels in pregnancy and may need metformin and/or insulin.

Gestational diabetes
This is often undiagnosed, and should be suspected if any of the following are present:
- a family history of diabetes
- a past history of a large baby, stillbirth or gestational diabetes
- recurrent glycosuria
- a high BMI (overweight)
- a relevant ethnic background.

All women with diabetes should ideally be monitored more regularly in the antenatal clinic for complications such as pre-eclampsia, polyhydramnios and large or small for dates development.

Diagnosis of diabetes with a glucose tolerance test

TABLE B4.1 Seventy-five-gram oral glucose loading dose results

	Fasting plasma glucose concentration (mmol/litre)	2-hour plasma glucose concentration (mmol/litre)
Diabetes	> 8	> 11
Gestational impaired glucose tolerance	6–8	9–11
Normal	< 6	< 9

Management of delivery in women with diabetes

For spontaneous labour, induction of labour and elective Caesarean section:

1. Measure glucose on admission and hourly during labour.
2. Site an IV line with 500 mL of 0.9% saline containing 10% dextrose and potassium chloride 10 mmol and give at a rate of 60 mL/hour.

Avoid the routine use of insulin in labour in low resource settings because of lack of experience and lack of blood glucose stick tests. In mothers who were using insulin during pregnancy and those where blood glucose is > 7 mmol/ litre on two successive occasions one hour apart in labour, the insulin requirements shown in *Table B4 2* below can be used.

TABLE B4.2 Insulin requirements

Blood glucose concentration (mmol/litre)	Hourly subcutaneous injections of insulin
< 2.0	No insulin; dextrose only
2.0–4.0	1 unit
4.1–9.0	2 units
9.1–11.0	3 units
11.1–16.9	4 units

NOTE: for blood glucose, 1 mmol/litre = 18 mg/dL

- If the glucose level is > 17 mmol/litre, expert advice, if available, should be sought.
- Aim for a glucose level of 4–9 mmol/litre.

● Reduce insulin by half at delivery and aim to resume the pre-pregnancy insulin dosage 24 hours after delivery. If the mother is breastfeeding, her insulin requirement may be lower.
● Women who have developed gestational diabetes usually have normal blood glucose levels soon after the delivery of the placenta. Their diabetic medication should be stopped postnatally, and their blood sugar levels should be monitored.
● Mothers who have had gestational diabetes should have a glucose tolerance test at 6 weeks postnatally. They are at risk of developing type 2 diabetes, and appropriate dietary and lifestyle advice should be provided. A fasting blood glucose test annually should also be recommended.

Diabetic ketoacidosis (DKA)
Diagnosis
History:
- polydipsia
- polyuria
- weight loss.

Clinical signs:
- acidotic respiration
- dehydration
- drowsiness
- abdominal pain and/or vomiting
- unexplained coma.

Biochemical findings:
- high blood glucose on finger-prick test
- ketones and glucose in urine.

Patients die from hypokalaemia and cerebral oedema.
Patients who are 5% dehydrated or less and are not clinically unwell usually tolerate oral rehydration and subcutaneous insulin.
Patients who are more than 5% dehydrated, or who are vomiting or drowsy or clinically acidotic, need resuscitation and emergency care as follows.

Primary assessment and resuscitation ABC approach
Airway
If the patient is unconscious and the airway is unprotected, the recovery position should be adopted to minimise the risk of aspiration of vomit.

Breathing
Give a high concentration of oxygen through a facemask with a reservoir, if the airway is adequate.
If breathing is inadequate, ventilate with oxygen via a bag-valve-mask-reservoir device, and ask for experienced anaesthetist to intubate (if this is available and sustainable).
Circulation
● Gain IV access using a short wide-bore cannula (14- to 16G)

● External jugular vein access is an option if peripheral access is impossible. Long saphenous vein cut-down or intraosseous needle may also be considered.
● Take blood for a full blood count, urea and electrolytes, blood culture, cross-matching, glucose stick test and laboratory blood glucose (if available).
● Give a 500-mL rapid IV bolus of 0.9% saline.
● An antibiotic such as Ceftriaxone 1 gram IV 24-hourly, or the locally available equivalent, is an appropriate antibiotic for those in whom an infection is likely to have precipitated the DKA. Although, of course, antibiotic therapy must be tailored to the specific cause.

Secondary assessment and emergency treatment
Observations
● Strict fluid balance and urine testing of every sample.
● Hourly capillary blood glucose measurements.
● Initially hourly or more frequent neurological observations.
● Report immediately to medical staff (even at night) symptoms of headache or any change in either conscious level or behaviour.
● Report any changes in the ECG trace if available, especially T-wave changes (monitoring for hypokalaemia).

Investigations
● When it is safe to do so, weigh the patient. If this is not possible, use recent clinic weight or an estimated weight.
● Blood glucose.
● Urea and electrolytes (if available).
● Bicarbonate or arterial blood gases (if available).
● Haematocrit and full blood count.
● Blood culture (if available).
● Urine microscopy, culture and sensitivity; check for ketones.
● Monitor the ECG to observe T waves (if available):
    - hypokalaemia causes flat T waves
    - hyperkalaemia causes peaked T waves.

Assess degree of dehydration
No dehydration (< 3% weight loss)
There are no clinical signs with this degree of dehydration, although there will be thirst in the fully conscious patient.

Some dehydration (3–9% weight loss)
The following clinical signs are seen:
- increased thirst
- dry mucous membranes
- loss of skin turgor, tenting when pinched
- sunken eyes
- restless or irritable behaviour.

Severe dehydration (≥ 10% weight loss)
The following clinical signs are seen:
- more pronounced effects of the signs seen in moderate dehydration

- lack of urine output
- hypovolaemic shock, including:
  - rapid and feeble pulse (radial pulse may be undetectable)
  - low or undetectable blood pressure
  - cool and poorly perfused extremities
  - decreased capillary refill time (> 3 seconds): test this on the sternum of patients with light skins and on the thumbnail of those with dark skins
  - peripheral cyanosis
- rapid deep breathing (from acidosis)
- altered level of consciousness or coma.

Fluid and electrolyte management

- Calculate the patient's fluid requirement. This is equal to maintenance plus deficit (see Sections13 and 46).
  Maintenance = 2400 mL per 24 hours
  Deficit (in mL) = percentage dehydration × body weight (kg) x 10
  (Only plan to correct up to an 8% deficit, as any more risks over-infusion).
- Ignore the volume of fluids used to resuscitate/treat shock.
- Give the total fluid requirement over 24 hours:
  - Glucose > 12 mmol/litre: give 0.9% saline
  - Glucose < 12 mmol/litre: give 0.9% saline containing 5% dextrose (by adding 100 mL of 50% glucose to 900 mL of 0.9% saline or 50 ml of 50% glucose to 450 ml of 0.9% saline).

- Sodium 135–155 mmol/litre: correct by rehydration over 24 hours.
- Sodium > 155 mmol/litre: correct by rehydration over 48 hours using 0.9% saline.

Expect the sodium level to rise initially as the glucose level falls and water is removed from the circulation.
If the plasma sodium level initially falls (as well as the glucose level), this may precipitate cerebral oedema.
- Continue to give IV fluids until the patient is tolerating enteral fluids.

Insulin

In resource-limited settings, give subcutaneous doses of short-acting soluble insulin 6-hourly at 0.6 units/kg/dose (i.e. 0.1 units/kg/hour). Give half the dose if the blood sugar level is falling too fast.
Always have an IV glucose solution (10% or 50%) available to treat any hypoglycaemia that develops.

Do not add insulin directly to the intravenous fluid bags.
Do not give IV infusion of insulin unless expert care is available throughout.

- If the blood glucose level falls by more than 5 mmol/ litre/hour, reduce the dose of subcutaneous insulin

- If the blood glucose level is less than 12 mmol/litre, and a dextrose-containing fluid has been started, also consider reducing the size of subcutaneous insulin doses.
- Do not stop insulin while dextrose is being infused, as insulin is required to switch off ketone production.
- If the blood glucose level rises out of control, re-evaluate the patient for sepsis or another condition.

Potassium

In diabetic ketoacidosis there is always massive depletion of total body potassium, although initial plasma levels may be low, normal or even high. Levels in the blood will fall once insulin is started.

Do not give potassium if any of the following are present:

- anuria
- peaked T waves on the ECG
- serum potassium level > 7.0 mmol/litre.

If biochemical assessment of the K+ is not possible, it should be assumed that K+ replacement is necessary as long as the urine output is adequate, and there are no peaked T-waves present on the ECG (where available).

In resource-limited settings, hypokalaemia is most safely corrected orally or via nasogastric tube using ORS with or without additional oral potassium supplements (aim for a total of 60 mmol of potassium/day).

Potassium rich foods may also be given, e.g. coconut milk and bananas.

If oral supplementation is not possible or the patient is severely ill: start IV potassium supplements with 20 mmol/litre of IV fluid given after the start of initiating therapy with insulin and fluids as long as sufficient urine is being passed at > 30 mL/hour.

Run the IV infusion (20 mmol in 1 litre over 4 to 8 hours (42 to 84 drops per minute (dpm) if using a standard IV giving set with a drop factor of 20). It should not be given at a rate exceeding 20 mmol in 2 hours (126 dpm) as this is dangerous. Given the difficulty in accurately monitoring transfusion rates without an electronic pump, extreme care should be used.

Stop IV supplementation when the patient can take oral supplements.

Bicarbonate

- Administration of bicarbonate is rarely necessary.
- Continuing acidosis usually indicates insufficient fluid resuscitation.
- Consider the use of bicarbonate in patients who are profoundly acidotic (pH < 7.0 if measurable) and shocked. Its only purpose is to improve cardiac contractility in severe shock.

The maximum volume of 8.4% sodium bicarbonate for half-correction of acidosis is calculated according to the following formula, and given over 60 minutes:

Volume (mL 8.4% $NaHCO_3$) = 1/3 × weight (kg) × base deficit (mmol/litre)

Additional emergency treatment

General

- After resuscitation with fluid boluses, calculate the fluid requirement (see below).
- Avoid excessive fluid replacement, as this is a risk factor for cerebral oedema.
- **Do not give hypotonic IV solutions (e.g. 0.18% saline with 4% glucose, or 5% glucose): they are risk factors for cerebral oedema.**
- Continue to give IV fluids until the patient is drinking.
- The kidneys will resolve the acidosis (if they are working) if the patient r eceives adequate fluid and insulin therapy.

Other management

Ensure adequate urine output

- Urinary catheterisation may be useful in patients with impaired consciousness.
- Document all fluid input and output.
- Test all urine samples for glucose and ketones.
- If a massive diuresis continues, the fluid input may need to be increased.

Ileus (lack of bowel sounds)

- Insert a nasogastric tube.
- Ensure by clinical assessment, and by abdominal X-ray if appropriate, that there is no other cause of the acute abdomen, including intestinal obstruction.

Gastric aspirate

- If large volumes of gastric aspirate occur, replace these volume-for-volume with 0.9% saline plus 5 mmol/litre potassium chloride (KCl).

Biochemistry

- Check urea and electrolytes, blood pH/bicarbonate (if available), and laboratory blood glucose 2 hours after the start of resuscitation, and then at least 4-hourly.
- Do not expect ketones to have disappeared completely before changing to subcutaneous insulin.

Assess conscious level regularly

- Assess AVPU.
- Institute hourly neurological observations.
- If the patient is less than Alert on admission, or their conscious level deteriorates, record the Glasgow Coma Scale score.
- Consider instituting cerebral oedema management (if available).

Cerebral oedema

Signs and symptoms include the following:

- headache
- confusion

- irritability
- reduced conscious level
- fits
- small pupils
- increasing blood pressure
- slowing pulse
- papilloedema (a late sign).
- respiratory impairment.

Management

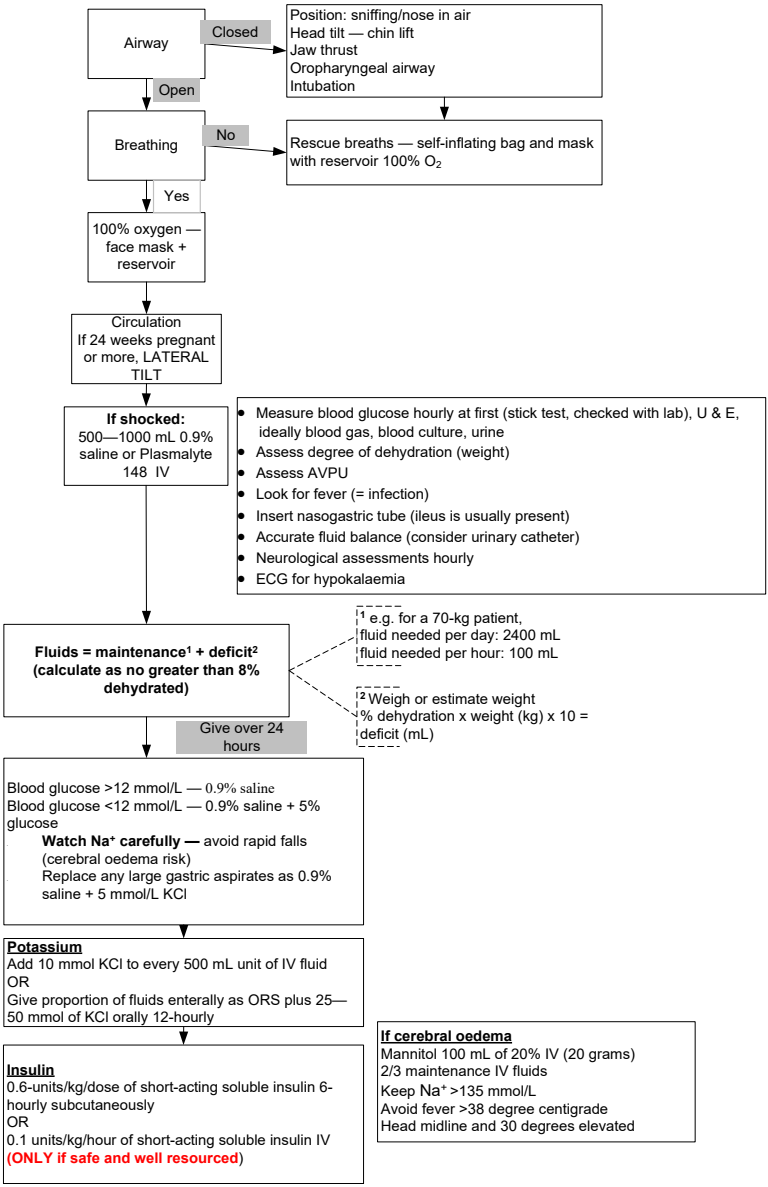
1. Exclude hypoglycaemia.
2. Give 20 grams of 20% mannitol over 15 minutes as soon as cerebral oedema is suspected. Repeat every 4–6 hours.
3. Restrict IV fluids to two-thirds maintenance and replace the deficit over 72 hours rather than 24 hours.
4. Keep the sodium (Na+) concentration higher than 135 mmol/litre.
5. Keep the head in the midline and 30-degrees elevated.
6. Involve an anesthetist at all times

Fever

If there is a fever, treat it actively with environmental measures, or with paracetamol, if more than 38.0°C.

DKA can cause a leucocytosis but not fever. If fever is present, look for and treat infection.

Figure B4.2 *Pathway of care for severe diabetic ketoacidosis in pregnancy ORS, oral rehydration solution*



Section B5 Reduced consciousness and coma in pregnancy

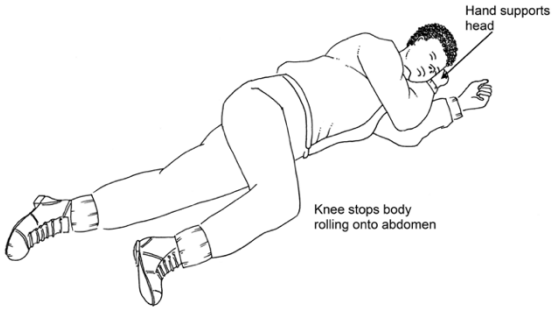
The most important situation in pregnancy is immediately after an eclamptic seizure.

Raised intracranial pressure (RICP)
In a patient with impaired conscious level or with a Glasgow Coma Scale score of < 9, who was previously well and is not post-ictal, the following signs indicate RICP:

Table B5.1 Clinical signs indicating raised intracranial pressure (RICP)

Signs suggesting raised ICP:	
Absolute signs = papilloedema and/or absence of pulsation of retinal vessels	
Abnormal oculo-cephalic reflexes **Do not test patients with neck injuries in this way**	**(a)** Rotation of the head to the left or right normally causes the eyes to move in the opposite direction; abnormal if there is no response or a random response (b) Flexure of neck usually causes eye gaze deviation upwards; abnormal if there is loss of this reflex
Abnormal posture May need to be elicited by a painful stimulus	(a) Decorticate: arms flexed, legs extended (b) Decerebrate: arms extended, legs extended
Abnormal pupillary responses	Unilateral or bilateral suggests RICP
Abnormal breathing patterns	Ranges from hyperventilation to Cheyne–Stokes breathing to apnoea
Cushing's triad	Slow pulse, raised blood pressure and abnormal pattern of breathing – a late sign of raised ICP

Figure B5.1 *The recovery position*



Primary assessment and resuscitation ABCD

Call for help. Ideally an anaesthetist should be present to manage the airway and support breathing.

Airway

The patient with a reduced level of consciousness is more likely to have a compromised airway as the tongue falls into the back of the mouth. There is also a risk of aspiration

Look, listen and feel

Assess the airway, open it if closed and keep it open, either by assigning someone to continue airway-opening manoeuvres or by using adjuncts such as an oropharyngeal airway (see Section C8). Never use such an airway if the patient is conscious enough to have a gag reflex, as it may worsen airway obstruction and cause vomiting. Give oxygen at a rate of 15 litre/minute or as high a flow rate as is available, via a tight-fitting facemask with a reservoir bag. If an anaesthetist is present, intubation can be performed to protect the airway; otherwise adopt **the recovery position** (*see Figure B5.1*). Careful suction of the nose and/ or mouth may be helpful.

Breathing

If the airway is adequate, give high concentration O_2 via a face mask and reservoir bag and support breathing if required.

The patient will require support if:

- breathing is insufficient
- gag or cough reflex is absent
- AVPU score is P or U
- there is impending herniation due to raised ICP
- there is evidence of effects of inadequate breathing on other systems.

If breathing is absent or inadequate (gasping or agonal breaths only), provide assisted ventilation using a bag-valve- mask with a reservoir and oxygen.

Inadequate airway and breathing in coma can lead to a rise in arterial pCO2 that can cause a dangerous rise in intracranial pressure.

Circulation

Inadequate perfusion of blood to the brain initially produces confusion and later causes coma. Measurement of the blood pressure in addition to other markers for shock is crucial in recognising hypovolaemia after haemorrhage, or unconsciousness after an eclamptic fit with hypertension.

If the intracranial pressure is high, cerebral perfusion will be compromised if hypotension occurs. However, excessive fluid administration should be avoided.

- Establish IV access quickly.

- Take blood samples and send them to the lab for a full blood count, blood smear for malarial parasites, electrolytes, liver function tests, blood glucose and blood culture.

Neurological failure
Assess neurological failure as follows:

- Use the AVPU scale
- Check blood glucose levels: If the blood sugar level is low or suspected to be low (< 2.5 mmol/litre or < 45 mg/dL), give 100 mL of 25% glucose IV over 15 minutes (dilute 50 mL of 50% glucose with 50 mL of Ringer-lactate or Hartmann's solution) and then give 10% dextrose in Ringer-lactate or Hartmann's solution over 4 hours (add 100 mL of 50% glucose to each 400 mL of Ringer-lactate or Hartmann's solution infused).
- Check the pupils for signs suggesting raised intracranial pressure (RICP) or opiate overdose.
- Check for neck stiffness which may suggest meningitis.
- Look for other signs of raised intracranial pressure, as outlined above

Table B5.2 Pupillary changes

Pupil size and reactivity	Causes
Small reactive pupils	Metabolic disorders Medullary lesion
Pinpoint pupil	Metabolic disorders Narcotic/organophosphate ingestion
Fixed mid-sized pupils	Midbrain lesion
Fixed dilated pupils	Hypothermia Severe hypoxaemic/ischaemic brain injury Barbiturate ingestion (late sign) During and post seizure Anticholinergic drugs
Unilateral dilated pupil	Rapidly expanding ipsilateral lesion Tentorial herniation Third cranial nerve lesion Epileptic seizures

Secondary assessment and emergency treatment
Secondary assessment occurs after stabilisation of ABCD. During secondary assessment, continue to monitor the patient, and if there is any change, reassess ABC and treat any residual problems.

Diagnostic pointers

1. As soon as possible during resuscitation, gain as much information about the history as possible:
2. the possibility of eclampsia, which means that magnesium sulphate may be required
3. recent trauma
4. endemic area for infections such as malaria, sleeping sickness and encephalitis
5. pre-existing neurological problem
6. past history of epilepsy
7. ingestion of poisons or traditional medicines
8. underlying chronic condition (renal, cardiac, diabetes).

Remember to treat the treatable components. The cause of coma may not be certain, so it is always important to address ABC. If the patient's condition is unstable or deteriorating, return to ABC.

Always consider the possibility of eclampsia and the need for magnesium sulphate.

If there is no other clear cause for the coma, especially if there is fever 37.5 degrees C or more, treat with antibiotics for presumed meningitis (usually a third- generation cephalosporin, or whatever is locally available and appropriate), and in endemic areas, also treat as for cerebral malaria (see Section B8).
Take the patient's temperature (core and peripheral).
Fever may be associated with sepsis (but lack of fever does not exclude sepsis) or poisoning (ecstasy, cocaine or salicylates).
Hypothermia is found in poisoning with ethanol or barbiturates.
Rash: purpura suggests meningococcal disease; bruises suggest trauma (consider domestic violence).
Evidence of poisoning, ingestion or drug use: smell, residue around nose/mouth, needle tracks.(Section D3)

Other issues in addition to ABC regarding the management of coma

The prognosis depends on the cause of coma and the state of the patient, in particular the level of consciousness on admission, and the initial response to appropriate interventions. Consider the following interventions:

● Assess and maintain electrolyte balance (avoid hyponatraemia; use Ringer-lactate or Hartmann's solution plus added 5% glucose, not 1/5 N dextrose saline. Add 50 mL of 50% glucose to each 450 mL of Ringer-lactate or Hartmann's solution infused). If possible keep the serum sodium level in the normal range (135–145 mmol/litre).

● Treat seizures if present

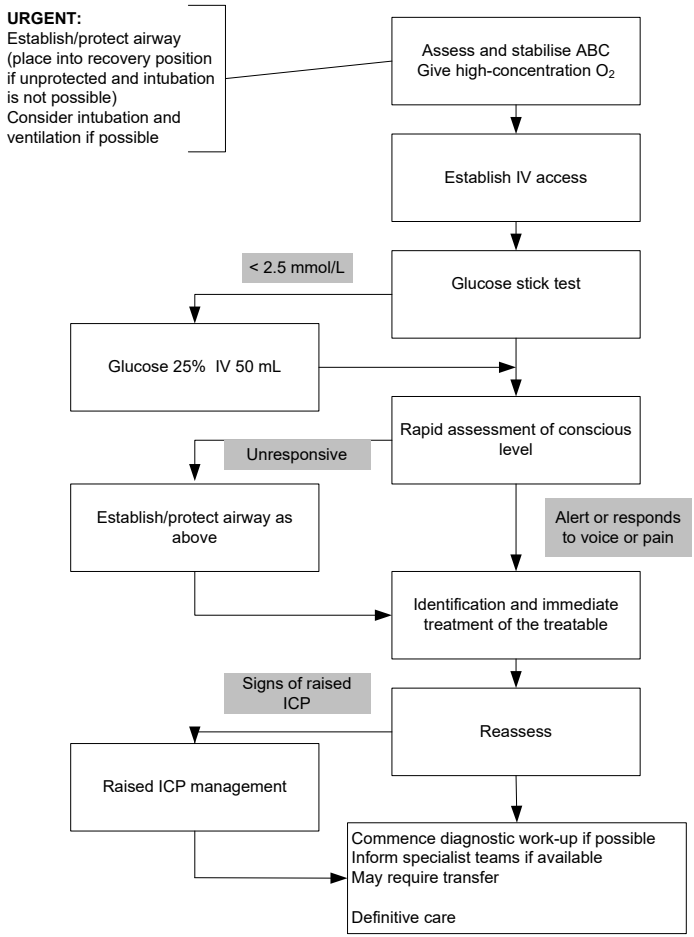
● Insert a nasogastric tube to aspirate the stomach contents. Give activated charcoal if poisoning is likely (see Section 60).

● Regulate the body temperature and avoid hyperthermia (temperatures above 37°C).
● Undertake appropriate medical management of RICP, if present:
  - Support ventilation (maintain a pCO2 of 3.5–5.0 kPa, if measurable).
  - Give mannitol, 20 grams of 20% mannitol IV over 15 minutes, 2-hourly as required, provided that the serum osmolality is not greater than 325 mOsm/litre (if measurable).
  - Give dexamethasone (for oedema surrounding a space-occupying lesion) 10 mg initially IV, then 4 mg IV 6-hourly for 48 hours.
● Catheterisation is needed for bladder care and output

Meningitis or encephalitis
There is a risk of coning and death if a diagnostic lumbar puncture is performed in a patient with significantly raised intracranial pressure.
Diagnosis of meningitis or encephalitis
Classic signs and symptoms include the following:
- headache
- vomiting
- neck stiffness
- opisthotonus
- photophobia
- rash
- altered consciousness.

Poisoning (see Section D3).
Malaria in pregnancy (see Section B8).
Eclamptic coma (see Section A+13).

Figure B5.2 *Pathway of care in coma. ICP, intracranial pressure.*



Section B6. Pneumonia in pregnancy

Clinical findings

Pneumonia and bacterial tracheitis are usually associated with a high fever. In the absence of stridor and wheeze, breathing difficulties in association with a significant fever are likely to be due to pneumonia. Examination of the chest may show reduced air entry, bronchial breathing and crepitations. Pleuritic chest pain, neck stiffness and abdominal pain may be present if there is pleural inflammation. Pleural effusions and empyema are complications. *Always consider HIV infection and TB.*

Emergency treatment of pneumonia

1. Ensure the airway is open and clear
2. Give oxygen through nasal cannula or mask depending on flow rate required to maintain saturation as below.
3. Attach a pulse oximeter (if available) and maintain SaO_2 > 94 %, with nasal cannula at a flow rate usually up to 5 litres/minute or, if necessary, by face mask with higher flow rates.
4. Give antibiotics for 7 days:
    a. ampicillin 2 grams IV/IM 6-hourly **plus** gentamicin 80 mg IV/IM 8-hourly or 5 mg/kg IV/IM every 24 hours for most cases of community-acquired pneumonia
    b. cefuroxime 500 mg IV/IM 8-hourly or flucloxacillin 500 mg IM or IV slowly every 6 hours for suspected or bacteriologically diagnosed Staphylococcus aureus
    c. erythromycin 500 mg every 6 hours orally for Chlamydia or Mycoplasma pneumoniae
    d. or whatever is available locally and appropriate.
5. Sit the patient upright.
6. Maintain hydration.
    a. Extra fluid may be needed to compensate for fluid loss from fever.
    b. Fluid restriction may be needed because of inappropriate ADH secretion, revealed by oliguria < 30 mL per hour or rising blood urea levels.
7. Chest X-ray is indicated if available.
8. Large pleural effusions/empyema should be diagnosed where possible by ultrasound, and pleural drainage undertaken under ultrasound cover (do not place a needle (see below) or chest drain into the heart, liver or an undiagnosed tumour or hydatid cyst) (see Section D1). *Remember that in advanced pregnancy the diaphragm is elevated.*

Tapping the chest for diagnostic tests in pleural effusions or empyema

Diagnostic procedure

1. Consider giving the patient oral analgesia
2. Wash your hands and put on sterile gloves.
3. Clean the skin over the chest with an antiseptic solution (e.g. 70% alcohol).
4. With the patient sitting up, elect a point in the mid-axillary line (at the side of the chest) just below the level of the nipple (4th intercostal space); see Section 58). Do not lie a pregnant patient supine to undertake a chest tap unless too ill to sit up in which case ensure lateral tilt after 20 weeks' gestation to prevent vena-caval obstruction.
5. Inject about 1 mL of 1% lignocaine into the skin and subcutaneous tissue at this point.
6. Insert a needle or needle-over-catheter through the skin and pleura, and aspirate to confirm the presence of pleural fluid. Withdraw a sample for microscopy and other tests and place it in a container.
7. If the fluid is clear (straw-coloured or brownish), pull out the needle or catheter after withdrawing enough fluid to relieve distress, and put a dressing over the puncture site. Consider a differential diagnosis of tuberculosis.
8. If the fluid is thin pus or cloudy (like milk), leave the catheter in place so that you can draw out more pus several times a day. Make sure that you seal the end of the catheter so that no air can get in.
9. If the fluid is thick pus which cannot pass easily through the needle or catheter, insert a chest drain as described in Section D1.

Pleural effusions/empyemas adjacent to the heart on the left side may cause pericarditis and cardiac arrhythmias. (Listen regularly for a pericardial rub, and ideally monitor an ECG if available until the patient is stable.)

Severe B7. Severe dehydration and gastroenteritis in pregnancy

The majority of patients can be treated with low-osmolarity oral rehydration solution (ORS) (by mouth or by nasogastric tube). **In patients with coincidental severe malnutrition, it is safer to use ORS with a lower sodium content, such as ReSoMal.**

Classification of dehydration

No dehydration (< 3% weight loss)

There are no clinical signs with this degree of dehydration, although there will be thirst in the fully conscious patient. The woman who is not fully conscious will not feel thirsty.

Some dehydration (3–9% weight loss)

The following clinical signs are seen:

- increased thirst
- dry mucous membranes
- loss of skin turgor, tenting when pinched
- sunken eyes
- restless or irritable behaviour.

Severe dehydration (≥ 10% weight loss)

The following clinical signs are seen:

- more pronounced effects of the signs seen in moderate dehydration
- lack of urine output
- hypovolaemic shock, including:
- rapid and feeble pulse (radial pulse may be undetectable)
- low or undetectable blood pressure
- cool and poorly perfused extremities
- decreased capillary refill time (> 3 seconds): test this on the sternum of patients with light skins and on the thumbnail of those with dark skins
- peripheral cyanosis
- rapid deep breathing (from acidosis)
- altered level of consciousness or coma.

Emergency treatment of severe dehydration (see Figure B7.1)

- Treat shock (see section C6) with an initial bolus of 500 to 1000 mL of Ringer- lactate/Hartmann's solution (R/L)
- Decide on the cause (e.g. acute gastroenteritis, diabetic ketoacidosis).
- Classify the extent of dehydration (see above).
- Calculate the fluid deficit (see below), add this to the maintenance and on-going losses and give over 24 hours.
- The major danger in rehydration (once shock has been treated) is causing the plasma sodium level to fall too rapidly. This may increase the transfer of water into the brain and result in cerebral oedema.
- Before the electrolyte results are known, or if such testing is not available, the safest fluid to give is R/L.

If the serum sodium level can be measured and is higher than 155 mmol/litre, aim to lower it slowly over 48 hours or longer.

Calculating fluid requirements

Deficit
If an accurate recent pre-illness weight is available, subtract the current weight to estimate lost fluid (1 kg = 1 litre of fluid).

For example, a patient who weighed 70 kg is seen with diarrhoea and a weight of 65 kg. In this case the estimated fluid loss is (70– 65) kg = 5 kg = 5000 mL deficit (i.e. 7% dehydrated).
If no recent weight is available, or the weight value given is considered to be unreliable:

- Decide the degree of dehydration.
- Weigh the patient.
- Use the formula: percentage dehydration × weight (kg) × 10 = deficit (in mL).

For example, a patient whose weight is estimated to be 70 kg is 8% dehydrated. In this case the estimated fluid loss is 8 × 70 × 10 = 5600 mL (233 mL/hour if replaced over 24 hours).

Maintenance
Estimated maintenance fluid requirements in pregnancy are 2400 mL/ day and 100 mL/hour.

On-going losses

- For each diarrhoeal stool: 500 mL of ORS after each stool.
- For each vomit: 200 mL of ORS after each vomit. Give small frequent volumes (e.g. 20 mL every minute) with a spoon or syringe or cup.

Add deficit to maintenance and on-going losses and aim to replace these over 24 hours.

For example, for a 70 kg patient who is 8% dehydrated, maintenance is 100 mL/hour, if there are no on-going losses. Total fluids needed per hour = 233 mL/hour (deficit) + 100 mL/hour (maintenance) = 333 mL/hour.

Severe acute gastroenteritis in pregnancy
Gastroenteritis is a common cause of dehydration and shock. Management starts with ABC, followed by assessment of the fluid deficit (extent of dehydration) and on-going losses of fluid. Weigh the patient and keep an accurate fluid balance chart.
It is important to give fluids that:

- correct the deficit
- provide maintenance
- replace on-going losses.

Differential diagnosis
Look for an abdominal mass or abdominal distension.
Consider the following:

1. HIV infections
2. surgical conditions, such as acute appendicitis, peritonitis or bowel obstruction (if suspected, resuscitate and call for surgical opinion)
3. typhoid (high-grade fever, rash, hepato-splenomegaly and toxicity
4. cholera
5. antibiotic-associated colitis
6. (rarely) inflammatory bowel disease

Treatment if not shocked

1. Start low-osmolarity oral rehydration solution (ORS) with 1–2 litres over 2–4 hours.
2. The carer should give small amounts of ORS (e.g. using a small cup) frequently.
3. Gradually increase the amount as tolerated, using a tablespoon, cup or glass.
4. After 12–24 hours, review progress with regard to rehydration and progress to the maintenance phase or continue rehydration.

Severe dehydration (≥ 10% fluid deficit with or without clinical signs of shock)

1. If the patient is shocked, assess and manage ABC, give oxygen if available, and start IV fluids immediately (use two intravenous lines if possible: use long saphenous vein cut-down or the external jugular vein if venous access is difficult).
2. Give a 500 mL or 1-litre bolus of Ringer-Lactate (R/L) or Hartmann's solution IV as rapidly as possible.
3. Reassess pulse, perfusion (capillary refill time) and mental status, and repeat the bolus if these are still abnormal.
4. **Do not use low-sodium-containing IV fluids such as 0.18% saline with 4% glucose, which can be dangerous (they can cause hyponatraemia and cerebral oedema).** Instead use R/L, ideally also containing 10% glucose (obtained by adding 100 mL of 50% glucose to each 500 mL).
5. Hypokalaemia is a major complication which needs urgent attention. Ideally measure serum K+ levels frequently. Provided that the patient is passing urine, IV potassium can safely be given, it should be added to the IV fluids given AFTER the boluses given to treat shock. Ideally and if tolerated, potassium should be corrected by giving low osmolarity ORS enterally as soon as possible.

If it is necessary to add potassium to IV fluids given to correct dehydration, particularly if diarrhea is continuing and if measured serum K+ is < 2.0 mmol/litre or there are ECG signs of hypokalaemia, namely ST depression, T-wave reduction and prominent U waves, and only if safe to do so, great care must be taken.

In acute depletion, an infusion at the rate of 0.1 to 0.5 mmol/kg/hour (6 to12 mmol/hour for a woman weighing 60 kg) of IV potassium can be used and the serum K+ level checked after 3 hours. The potassium for injection must be diluted before use and thoroughly mixed before being given. The maximum concentration of potassium that can be given through a peripheral vein is 40 mmol/litre. **The maximum infusion rate of potassium is 0.5 mmol/kg/hour.** Remember that R/L already contains 5 mmol/litre of potassium.

Note: The injectable form of KCl usually contains 1.5 grams (i.e. 20 mmol of potassium in 10 mL) and can be given orally. The daily potassium requirement is 1–2.5 mmol/kg (60-150 mmol for a patient weighing 60Kg).

When shock has resolved, and the patient's level of consciousness has returned to normal, the remaining estimated deficit must be taken by mouth or by gastric tube, especially if severe malnutrition and/or anaemia is present (giving large fluid volumes IV can precipitate heart failure).

Assess the patient's hydration status frequently.

Oral fluids

Recommendations for oral replacement therapy in gastro- enteritis are as follows:

1. Give low-osmolarity ORS (containing 75 mmol/litre of sodium) or, if the latter is unavailable, ORS containing 90 mmol/litre of sodium with an additional source of low-sodium fluid (e.g. water).
2. The amount given should be in the range 300–500 mL/ hour.
3. Giving high-osmolarity fluids may contribute to hypernatraemia. **Never give water alone, or low-salt drinks; these may cause hyponatraemia.**
4. Oral glucose within ORS enhances electrolyte and water uptake in the bowel.
5. 'Home-made' ORS (if WHO ORS is not available) can be prepared by adding a pinch of salt (1 mL) and a handful of sugar (5 mL) to a glass of clean potable water (250 mL).

Intravenous fluids

1. Even in patients who are drinking poorly, try to give enteral fluids by mouth or by gastric tube until the IV infusion is running.
2. Use R/L, which contains Na+ 131 mmol/litre, K+ 5 mmol/litre, HCO3– 29 mmol/litre and Ca2+ 2 mmol/litre.
3. R/L solution has no glucose to prevent hypoglycaemia. This can be corrected by adding 100 mL of 50% glucose to 400 mL of R/L giving approximately a 10% glucose solution (adding 50 mL to 450 mL of R/L gives a 5% solution).
4. R/L solution with 5% dextrose added has the advantage of providing glucose to help to prevent hypoglycaemia.
5. See above regarding potassium supplementation.
6. **It is dangerous to use plain 5% glucose solutions, or 0.18% saline plus 4% glucose. They do not contain adequate electrolytes, do not correct the acidosis or hypovolaemia, and can cause dangerous hyponatraemia.**
7. All patients should start to receive some ORS (at the rate of about 300 mL/hour) when they can drink without difficulty, which is usually within 1–2 hours. This provides additional base and potassium, which may not be adequately supplied by the IV fluid. Alternatively, give as soon as possible by gastric tube.

Over-hydration

Signs of over-hydration include the following:

- oedematous eyelids and generalised oedema, particularly ankle, facial and sacral oedema
- cardiac failure, especially in severe malnutrition or when also suffering severe anaemia
- respiratory distress (raised rate and some chest wall recession)
- tachycardia out of proportion to respiratory difficulty
- raised jugular venous pressure
- gallop rhythm/murmur
- enlarged liver
- basal lung crepitations.
- A chest X-ray, if available, may be helpful for showing pulmonary plethora or oedema.

Management of over-hydration

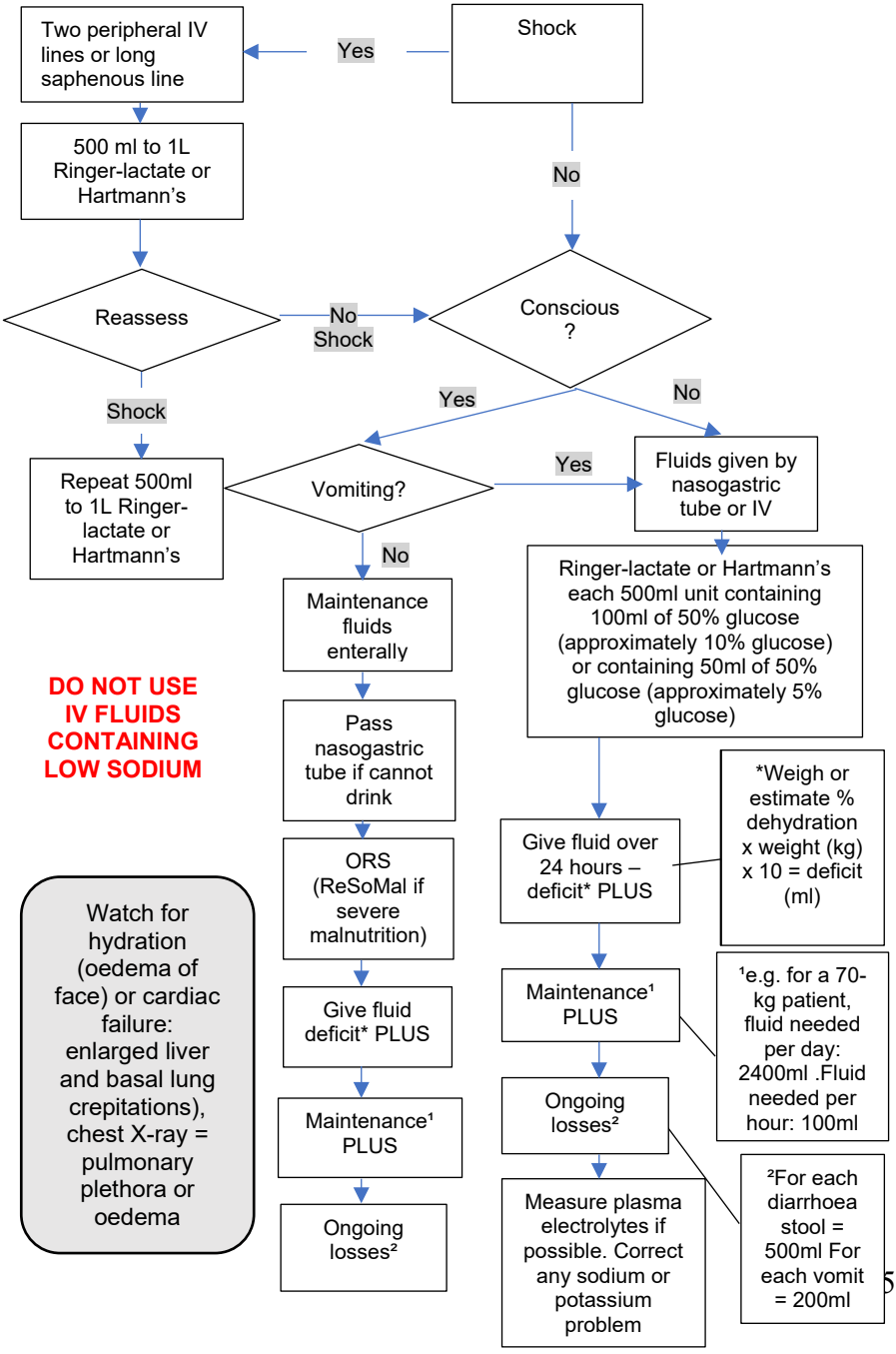
1. Stop giving ORS but give light food.
2. Do not give a diuretic unless the patient is in cardiac failure.

When the oedema has resolved, resume giving ORS.

Reassess the following:

1. ABC
2. circulatory and hydration status
3. plasma electrolytes if possible
4. urine output
5. give fluid according to plan; do not forget ongoing losses
6. reassess regularly (including biochemistry if possible)
7. do not forget glucose.

Figure B7.1 *Pathway of care for gastroenteritis with severe dehydration (10% or more)*



Section B8. Severe malaria in pregnancy

Symptoms and signs

1. impaired consciousness (including coma)
2. prostration, that is generalised weakness so that the patient is unable to sit, stand or walk without assistance
3. multiple convulsions: more than two episodes within 24 hours
4. deep breathing and respiratory distress (acidotic breathing)
5. acute pulmonary oedema and acute respiratory distress syndrome
6. circulatory collapse or shock, systolic blood pressure < 80 mmHg
7. acute kidney injury
8. clinical jaundice plus evidence of other vital organ dysfunction
9. abnormal bleeding.

Immediate measures (in hospital)

- Vital signs: temperature, pulse, blood pressure, and rate and depth of respiration.
- State of hydration.
- Estimation or measurement of body weight.
- Level of consciousness (AVPU or Glasgow Coma Scale scores).

— The depth of coma may be assessed rapidly by observing the response to standard vocal or painful stimuli (rub your knuckles on the woman's sternum; if there is no response, apply firm pressure on the thumbnail bed).

- RDT and malaria smear (thick and thin film) for diagnosis and for continued monitoring of the progress of the disease. Do not wait for a malaria smear result before initiating treatment, as it can take up to an hour. If the RDT is positive, commence treatment immediately.
- If the patient is unconscious and has a fever meningitis may be the diagnosis in addition to malaria consider giving IV antibiotics without prior diagnostic lumbar puncture.
- Measurement of glucose (finger prick test), haemoglobin, haematocrit and packed cell volume (PCV).
- Group and crossmatch blood and search for a suitable donor if there are no blood banking facilities.

Severe malaria drug treatment in pregnancy

Treat malaria in pregnancy urgently and early.

Calculate the dose in mg/kg. If you cannot weigh the patient, an average pregnant woman weighs about 60 kg, a small woman weighs around 50 kg and a large woman in resource limited settings around 80 kg.

Where available, artesunate IV/IM or artemether IM are the drugs of choice in the second and third trimesters. Their use in the first trimester must balance their advantages over quinine (artesunate and artemether are better tolerated and produce less hypoglycaemia) against the limited documentation of pregnancy outcomes. Artesunate may be given rectally.

IV/IM artesunate

Artesunate IV/IM: 2.4 mg/kg by direct IV injection (over 5 minutes) or IM injection at 0, 12 and 24 hours, then once daily until oral therapy is possible.

A solution for parenteral use should be prepared for either IV (10 mg/mL) or IM (20 mg/mL) use, following the manufacturer's instructions, using the sodium bicarbonate and saline solution supplied to dilute the concentrated artesunate.

For a small pregnant woman (estimated body weight 50 kg), each dose would be 12 mL IV (10 mg/mL) or 6 mL IM (20 mg/mL).

Artesunate IM should be administered in the antero- lateral thigh, drawing back before injection to ensure that the needle is not in a vein.

IM artemether

Artemether IM: loading dose is 3.2 mg/kg on day 0, followed by 1.6 mg/kg daily for at least two more doses; then continue until oral therapy is possible. A full course of oral therapy should be taken once IM therapy is discontinued.

An 80 mg/mL presentation is preferred to reduce the volume of the injection.
For a small pregnant woman (estimated body weight 50 kg) each dose would be 2 mL IM (80 mg/mL).

Artemether IM should be administered in the antero- lateral thigh, drawing back before injection to ensure that the needle is not in a vein.

Artemether is not well absorbed in shock, and in this situation an alternative treatment (IV or rectal artesunate, or IV quinine) should be chosen.

Rectal artesunate

- It is recommended that this should be available in all rural settings, including those with trained village healthcare workers.
- It can be given at 12-hourly intervals.
- The minimum dose is 10 mg/kg. Larger doses are not harmful but are not more effective.

- It can also be given to vomiting patients, or those unable to tolerate oral drugs.
- Rectal artesunate must always be followed by a full course of ACT when the patient is able to take oral drugs.

At present the WHO only recommends rectal artesunate as a pre-referral treatment. Where referral is not possible, ensure that a full course of ACT is given as soon as the patient is able to take oral treatment.

Artesunate is available as a rectal capsule: Rectocaps (Mepha), 50 mg and 200 mg. A WHO-approved rectal capsule is to be available soon, as 100 mg and 400 mg presentation.

The dose is 10 mg/kg, and therefore an average-sized mother needs 600 mg per dose. Give three 200 mg rectal suppositories at 0, 12, 24, 36, 48 and 60 hours.

Quinine dihydrochloride

Always give quinine with IV glucose.

Do not confuse doses of salt and base. Quinine is usually prescribed as the salt (10 mg of quinine dihydrochloride = 8.3 mg of base).

Loading dose

- Infuse quinine dihydrochloride 20 mg/kg body weight (usually 1.2 grams for the average 60 kg pregnant woman) in 500 mL of IV fluids (Ringer-lactate/Hartmann's solution (R/L) plus 5% or 10% glucose) over 4 to 8 hours. Do not let it go in too quickly. Quinine is usually available in 2-mL ampoules of 150 mg/mL, where 1.2 g thus corresponds to 8 mL
- Do not give quinine in 5% dextrose solutions without sodium, as there is a danger of hyponatraemia. Add 50 mL of 50% glucose to 500 mL of Ringer-lactate/Hartmann's solution (R/L). Add 100 mL of 50% glucose to 500 mL of R/L solution to give 10% glucose solutions.
- **Note that IV normal (0.9%) saline can be harmful in severe malaria, when there is frequently acidosis. 0.9% saline is an acid solution and worsens acidosis.** Use R/L instead
- Never give an IV bolus injection of quinine, as it is likely to cause cardiac arrest.
- Monitor blood glucose levels for hypoglycaemia every hour while the patient is receiving quinine IV.
- If it is definitely known that the mother has taken an adequate dose of quinine (1.2 grams) within the preceding 12 hours, do not give the loading dose. Proceed with the maintenance dose (see below).
- If the history of treatment is not known or is unclear, give the loading dose of quinine. Alternatively, omit the loading dose if the patient has received three or more doses of oral quinine in the last 48 hours, or mefloquine or halofantrine within the last 3 days.

- Wait 8 hours after a loading dose before giving the maintenance dose.

Maintenance dose

Infuse quinine dihydrochloride 10 mg/kg body weight (usually 600 mg for the average pregnant woman) in 500 mL of fluids (as above) IV over 4 hours. Repeat every 8 hours (i.e. quinine infusion for 4 hours, no quinine for 4 hours, quinine infusion for 4 hours, etc.) for 24 hours and then change to oral medication if the woman is conscious and able to swallow safely.

For follow-on oral treatment, give a 3-day course of oral ACT or 7 days of oral quinine. If the combination AS + MQ is used as ACT, wait 12 hours after the last dose of quinine before giving MQ. Do not use AS + MQ if the patient developed neurological signs during the acute phase.

The dose of oral quinine dihydrochloride or quinine sulphate is 10 mg/kg body weight (usually 600 mg for the average size of pregnant woman) by mouth every 8 hours to complete 7 days of treatment. Ask the patient to swallow the tablets quickly with milk.

Quinine may cause haemolysis in patients with glucose-6- phosphate dehydrogenase (G6PD) deficiency, which may result in the passage of haemoglobin in the urine (this is called Blackwater fever).

Make sure that plenty of fluids are given so that the urine output is adequate. Keep a strict fluid balance chart. Monitor the volume of fluid that you give, and the urine output. Do not overload with fluid.

If the haemoglobin level falls below 6 g/dl, give a blood transfusion but observe closely for fluid overload. When the patient is improving, give iron and folate tablets.

Intramuscular quinine

If you cannot place an IV line, you can give quinine IM, at strength of not more than 60 mg/mL. Some ampoules are 60 mg/mL (usually 10-mL ampoules). Some ampoules are 300 mg/mL or 600 mg/mL. Dilute these in 0.9% saline or Ringer-lactate/Hartmann's to a concentration of 60 mg/mL (e.g. 600 mg of quinine in 10 mL of saline). If you do not dilute quinine, the mother may develop an injection abscess. Use the same dose as you would give IV. Give half the dose into each anterior thigh.

When giving quinine by IM injection, regularly draw back to ensure that the needle is not in a vein, as an IV injection of quinine is likely to cause cardiac arrest.

Follow-on treatment for severe malaria

When the patient has received at least three IV or IM doses of artesunate or artemether, and is able to tolerate oral intake, give a full course (3 days) of **Artemisinin-based combination therapies (ACTs).** ACTs are, in many cases, the first line treatment for malaria that is not categorised as severe. There are several different types of ACTs. Examples include artemether-lumefantrine (Coartem) and artesunate-amodiaquine. Each ACT is a combination of two or more drugs that work against the malaria parasite in different ways.

Additional measures where needed

- Insert a nasogastric tube to minimise the risk of aspiration pneumonia if the patient's level of consciousness is low. This can also be used to give food to prevent hypoglycaemia if the patient is unconscious for a long period and is unable to eat.
- Monitor for hypoglycaemia by laboratory or bedside testing if available (see below for more detailed advice).
- Insert an IV cannula. IV fluids should be given with caution and the need for them assessed on an individual basis after ascertaining the nutritional status and degree of dehydration present (see below for more details).
- In general, patients with metabolic acidosis who have not previously received parenteral fluids are dehydrated and should be managed accordingly (see below for more details).
- Give oxygen, especially if metabolic acidosis is suspected or shock is present.
- Treat severe anaemia with a safe blood transfusion if the patient is showing signs of decompensation.
- Convulsions are common before or after the onset of coma. They are significantly associated with morbidity and sequelae. They may present in a very subtle way. Important signs include intermittent nystagmus, salivation, minor twitching of a single digit or a corner of the mouth, and an irregular breathing pattern.

Give anticonvulsants after also giving glucose IV (1 ml/kg of 50% glucose by **slow** IV injection) over 3 to 5 minutes in case hypoglycaemia is the cause. Give diazepam or phenobarbital if the patient is fitting, to prevent long-term neurological damage. Always have a bag and mask available incase the anticonvulsant produces respiratory depression and there must be someone who knows how to use it safely (usually a nurse anaesthetist) especially before IV diazepam is given. The dose of diazepam is 10 mg rectally or by slow IV injection. The dose of phenobarbital is 10 mg/Kg of phenobarbital in a bag of 100 ml of 0.9% sodium chloride given over 20 minutes.

- Prophylactic anticonvulsants have been recommended in the past, but recent evidence suggests that phenobarbital may be harmful and should only be given as treatment once convulsions have occurred.
- IV broad-spectrum antibiotics should be given routinely in an unconscious patient in case of additional meningitis.

Intensive nursing
The patient will need intensive nursing care at least until they regain consciousness. They may urgently need glucose or a blood transfusion if hypoglycaemia or haemolysis is severe.
Fluid replacement
If the patient is unable to drink, maintain daily fluid requirements using the nasogastric (preferred) or IV (greater risk of fluid overload) route. For IV use Ringer-lactate/ Hartmann's solution. Measure urine output (a Foley catheter should be used in unconscious patients).

	Daily fluid requirement	Hourly fluid requirement
In pregnancy	40 mL/kg	2.0 mL/kg

IV fluids
A Ringer-lactate or Hartmann's solution plus glucose mix is commonly recommended. Use a 10% glucose mix with Ringer-lactate or Hartmann's solution if hypoglycaemia is identified. Monitor carefully for fluid overload, especially when the IV route is used. Switch to the oral route as soon as possible. Fluids given should be included in the daily fluid requirement totals to avoid over-hydration.
Antibiotics
All patients who are in shock or who remain severely ill following resuscitation should receive a presumptive treatment with broad-spectrum IV antibiotics. Unconscious patients should have a lumbar puncture to exclude meningitis. Where this is not possible a presumptive treatment with a suitable antibiotic should be given.

Continuing hospital care of pregnant women with severe malaria

This should include the following:

- Nurse in the lateral tilt position if the woman is more than 20 weeks' pregnant, to avoid aorto-caval compression.
- If the patient is unconscious, nurse her in the recovery position, alternating sides frequently.
- Observe hourly pulse, blood pressure, respiratory rate and level of consciousness (using the AVPU scale).

- Frequently measure blood glucose levels (every hour if the patient has a reduced conscious level, especially when they are receiving quinine and/or where the level of consciousness does not improve).
- If the patient is conscious, regularly (4-hourly) determine blood glucose levels to exclude hypoglycaemia particularly if the patient is not eating well. This is especially important in pregnant women, particularly those receiving quinine therapy.
- A daily microscopic blood slide to determine the level of parasitaemia and to follow treatment efficacy.
- Regular haemoglobin measurement. The frequency will depend on the rate of red blood cell breakdown. This may be very rapid in cases of high parasite density.
- Blood transfusion where necessary with careful monitoring to prevent fluid overload. Packed cells should be used where possible. If overload is suspected, give a single dose of 20 mg of Furosemide IV.
- If the patient is unconscious or in shock, administer IV broad-spectrum antibiotics to manage septicaemia, pneumonia or meningitis, which are often associated with cerebral malaria.
- Oxygen is needed for patients in respiratory distress.
- Blood urea and electrolytes should be measured where possible.
- Fluid balance charts: unconscious patients should be catheterised to measure urine output, facilitate correct fluid balance and detect possible renal failure.

Management of life-threatening complications of severe malaria

Severe anaemia (due to haemolysis)

Monitor haemoglobin levels daily.

Severe haemolytic anaemia: haemoglobin < 5 g/dL or haematocrit < 15%.

Severe anaemia may be the presenting feature in malaria. Patients with severe anaemia, especially pregnant women, should be tested for malaria.

- Establish safe transfusion as soon as possible.
- Transfuse with screened blood only if the patient is severely symptomatic.

For patients with haemoglobin < 5 g/dL or haematocrit < 15%, recheck haemoglobin levels at least every 4 hours. Transfuse if haemoglobin levels start to fall or symptoms develop.

  - Packed cells are preferred for transfusion in pregnancy. Allow red blood cells to settle at the bottom of the bag and stop the infusion when all of the cells have been used.
  - Perform microscopy following transfusion and repeat or extend antimalarial treatment if parasitaemia is increasing.

- Transfusion rates may depend on the status of the patient. Exercise caution with malnourished patients.
- Suggested rates: two 500-mL units each over 4–6 hours giving IV 20 mg of furosemide with each 500 mL
- If the patient shows signs of fluid overload, give additional furosemide 20 mg IV, and repeat after 1–2 hours if indicated.

Give ferrous sulphate or ferrous fumarate 60 mg by mouth plus folic acid 5 mg by mouth once daily upon discharge from hospital.

Hypoglycaemia
This is defined as glucose levels of less than 2.5 mmol/litre (< 45 mg/dL).

Check for hypoglycaemia in patients who are unconscious, in shock or deteriorating, especially if they are malnourished, and in all patients receiving quinine. Often hypoglycaemia causes no symptoms until it results in coma and death. Watch for abnormal behaviour, sweating and sudden coma. Always give glucose with quinine. If the mother is drowsy, delirious or unconscious, do not assume that she has cerebral malaria; she could be hypoglycaemic.
Treat with an IV glucose infusion over 15 minutes.

- If you give 50% glucose it irritates the veins, so dilute 50 mL of 50% glucose with 50 mL of Ringer-lactate or Hartmann's solution to make a 25% solution and give 100 mL over 15 minutes.
- Then give 500 mL of 5% dextrose in Ringer-lactate/Hartmann's or 0.9% saline over 8 hours (see above for details of how to prepare this).

Retest 15 minutes after completion of infusion and repeat the infusion if blood glucose levels remain low. Repeat until blood glucose levels recover, and then infuse with 5–10% glucose in Ringer-lactate/Hartmann's solution or 0.9% saline (according to hypoglycaemia risk) to prevent recurrence. Ensure regular feeding when oral intake can be sustained. Fluids used to treat hypoglycaemia must be included in the daily fluid requirements.

If you do not have IV glucose, give sugar water by mouth or by nasogastric tube. Dissolve 4 level teaspoons (20 grams) in a 200 mL cup of clean water.

Hypoglycaemia is a major cause of death in patients with severe malaria, especially those who are pregnant. Remember that quinine will potentiate hypoglycaemia. Patients should receive regular feeding, including by nasogastric tube, when they are unable to take oral foods.

Fluid balance problems

Maintain a strict fluid balance chart and monitor the amount of fluids administered and urine output to ensure that there is no fluid overload. Assess the patient's clinical status regularly.

Note: Pregnant women with severe malaria are prone to fluid overload.

Acute renal failure (ARF)

This is defined as an abrupt decline in the renal regulation of water, electrolytes and acid–base balance, and continues to be an important factor contributing to the morbidity and mortality of malaria patients.

Oliguria or anuria is often associated with jaundice, anaemia and bleeding disorders.

Note: **Dehydration is a common cause of low urine output.**

- The basic principles of management are avoidance of life-threatening complications, maintenance of fluid and electrolyte balance, and nutritional support.
- The patient must be catheterised so that urine output can be accurately measured.
- Acute renal failure is suspected when the hourly urine output is < 30 mL/hour (measured over 4 hours). Blood concentrations of urea and creatinine (if they can be measured) are usually raised (creatinine >90 micromol/L)
- Make sure that the patient is adequately hydrated but avoid overload.
- If possible, monitor plasma electrolytes, especially serum potassium levels.

If urine output continues to be low despite adequate hydration, peripheral perfusion and normal blood pressure, give Furosemide 40 mg IV.

If renal failure is established, restrict fluid to insensible loss (30 mL/hour) plus urine output. If possible, refer the mother to a tertiary care centre for management of renal failure. Consider peritoneal dialysis (if available).

Convulsions

If there are convulsions, ALWAYS consider whether the mother has eclampsia. Test the urine for protein and measure the blood pressure.

If the mother has eclampsia, treat this with **magnesium sulphate (Section A+13)**. If she does not have eclampsia, treat convulsions with anticonvulsants, usually diazepam, phenobarbital or phenytoin (see below for doses).

Note: seizure activity in cerebral malaria needs to be looked for carefully, as it may just appear as a twitching of the thumb or mouth.

Diazepam

The loading dose of diazepam is 10 mg rectally or by slow IV injection over 2 minutes.

If seizures do not stop and hypoglycaemia has been excluded, repeat dose of IV diazepam once only after 30 minutes. Do not exceed 10 mg per dose. Always have a bag- valve-mask of a suitable size available in case the mother stops breathing. If two doses of IV diazepam do not stop seizures give either phenobarbital or phenytoin (see below).

Phenobarbital

The loading dose of phenobarbital is 10 mg/Kg of phenobarbital in a bag of 100 ml of 0.9% sodium chloride given over 20 minutes.

Danger: Phenobarbital is long acting and additional doses need to be given only once every 24 hours starting at 2mg/kg and building up to 6 mg/kg if needed.

Phenytoin

Loading dose

Infuse phenytoin 1 gram (approximately 18 mg/kg body weight) in 50–100 mL of 0.9% saline over 30 minutes (the final concentration should not exceed 10 mg/mL).

Note: Only 0.9% saline can be used to infuse phenytoin. All other IV fluids will damage the drug. Flush the IV line with 0.9% saline before and after infusing phenytoin.

Do not infuse phenytoin at a rate exceeding 50 mg/ minute, due to the risk of cardiac arrythmia, hypotension and respiratory depression. Complete administration within 1 hour of preparation.

Maintenance dose

Give phenytoin 100 mg IV slowly over 2 minutes or by mouth every 8 hours beginning at least 12 hours after the loading dose.

Respiratory distress

Rapid laboured breathing*:* check for and treat secondary pneumonia (give antibiotics and oxygen) or anaemia (transfuse), or pulmonary oedema, which may occur with or without fluid overload. Check the fluid balance (reduce IV fluids), supply oxygen, nurse the patient in a semi-sitting position, and do a trial of Furosemide, 40 mg IV, repeating this after 1–2 hours if indicated.

Slower laboured breathing (acidotic-Kussmaul breathing): ensure appropriate fluid replacement (plus transfusion if indicated) and treat associated conditions and infections.

Metabolic acidosis

Deep breathing with a clear chest is a sensitive and specific sign for the presence of metabolic acidosis. It is the single most important determinant of survival, and can lead to adult respiratory distress syndrome. Metabolic (lactic) acidosis has been identified as an important cause of death in severe malaria.

Metabolic acidosis in severe malaria has been attributed to the combined effects of several factors that reduce oxygen delivery to tissues:

Management

- Maintain airway patency and oxygen delivery; intubate if safe and if the patient is unconscious, in severe shock, or otherwise unstable.
- Establish an IV line; replace an adequate intravascular fluid volume if the patient has tachycardia, hypotension or other signs of poor tissue perfusion, such as poor capillary refill time. **IV normal (0.9%) saline can be harmful in severe malaria, when there is frequently acidosis. 0.9% saline is a strongly acidotic solution and can make the acidosis much worse.** Therefore, always use Ringer-lactate or Hartmann's solution for IV fluid replacement or in shock.
- Monitor for cardiac arrhythmias.
- The use of sodium bicarbonate is controversial and generally should be avoided.

Pulmonary oedema is very dangerous. The mother may have it on admission, or it may develop after several days. Fast difficult breathing is the first sign. Frothy (bubbly) fluid may be coming from the mouth. Pulmonary oedema causes hypoxia, fits, coma and death. In addition to malaria itself, pulmonary oedema can also be caused by too much fluid. Sometimes it is caused by malaria plus too much IV fluid, so watch the jugular venous pressure regularly and ideally, if skilled, measure central venous pressure.

Treatment of heart failure with pulmonary oedema (see Section B1)

1. Keep the patient upright; prop them up with pillows and lower the foot of the bed.
2. Give high concentrations of oxygen using a facemask and reservoir.
3. Give furosemide 40 mg IV. If there is no response (i.e. no increase in urine output), increase the dose progressively, every 4 hours, up to a maximum total dose of 200 mg.
4. If the woman might be receiving too much IV fluid, stop all IV infusions.
5. Provided the patient is not hypotensive (systolic blood pressure not below 90 mmHg) and has no serious obstructive heart valvular disease give Glyceryl Trinitrate (G.T.N.) by sublingual spray (400micrograms/puff) at a dose of 2 puffs every 5 minutes.
6. If GTN spray is not available give a glyceryl trinitrate (GTN) tablet 500 micrograms sublingually and repeat one tablet every 15 minutes up to a total of 3 tablets
7. I.V. morphine 5 mg over 5 minutes can be given as a dilator of veins and anxiolytic.
8. If still pregnant, ensure delivery as soon as patient is stabilised.

Shock

Although severe malaria alone may cause shock (algid malaria), it is uncommon and bacterial sepsis often coexists, which is more likely and must be treated. Management includes initial assessment for severe anaemia, which can also be the cause of shock due to lack of oxygen-carrying capacity. The management of severe anaemia, if this is responsible, is described above and in Section A+1.

If the patient is not severely anaemic, and particularly if they are dehydrated, give rapid fluid replacement provided that there are no signs of pulmonary oedema: Ringer-lactate or Hartmann's solution IV, 500 mL over 30 minutes, then reassess. If there is no improvement in capillary refill or tachycardia, repeat the infusion once or twice more, as required.

Give IV broad-spectrum antibiotics to treat septicaemia and any associated infections.

Abnormal bleeding

- Transfuse with fresh blood.
- Give vitamin K 10 mg IV or orally.
- Avoid IM injections

DO NOT GIVE non-steroidal anti-inflammatory drugs (NSAIDs)

Section B9 Acute appendicitis

Introduction

Appendicitis should be suspected in any woman with abdominal pain, whether she is pregnant or not. The diagnosis of appendicitis can be more difficult in pregnancy, due to the possibility of pregnancy-related conditions, including ectopic pregnancy, abruptio placentae, torsion of an ovarian cyst and pyelonephritis.

As pregnancy advances, the enlarging uterus displaces the appendix from its usual position, shifting the site of maximal tenderness towards the right upper quadrant (*see* Figure B9.1). In the third trimester, it may consequently mimic cholecystitis.

The site of an incision for appendicectomy should be over the point of maximum tenderness.

Clinical management

If appendicitis is suspected clinically, give a combination of antibiotics before surgery, and continue post-operatively until the woman is and fever-free for 48 hours:

- ampicillin 2 grams IV every 6 hours
- *plus* gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours
- *plus* metronidazole 500 mg IV every 8 hours.

Morphine 10 mg IV or IM may be administered as analgesia (see Section C7).

Immediate surgical exploration provided there is an experienced surgeon and nurse anaesthetist, and it is safe, is the best way forward, regardless of the stage of gestation. Appendicectomy should be performed even if the appendix does not look infected.

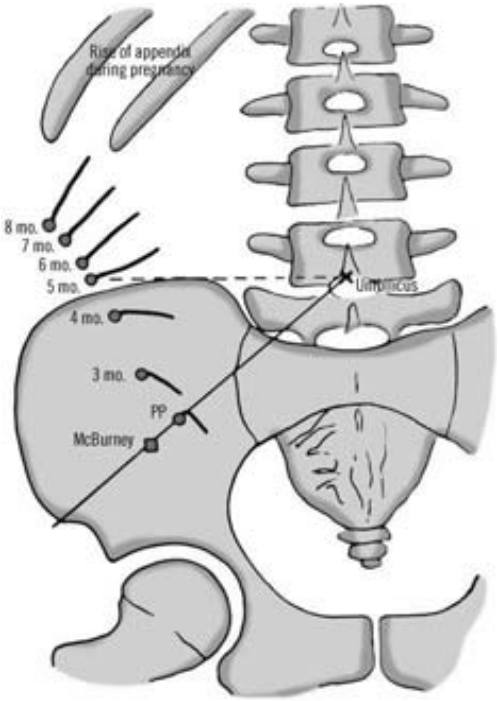
Delaying diagnosis and treatment can result in rupture of the appendix, which may lead to generalised peritonitis. This has a high maternal mortality in pregnancy, as well as a significant risk of miscarriage or preterm labour.

Peritonitis

If there are signs of **peritonitis** (fever, rebound tenderness, guarding and ileus), give antibiotics above as for peritonitis but continue until the infection has fully resolved (usually following surgery) and there has been no fever for 48 hours.

If appendicitis occurs in late pregnancy, the infection may be walled off by the gravid uterus. As the uterus rapidly decreases in size (involutes) after delivery, the infection may spill into the peritoneal cavity. In these cases, appendicitis then presents as generalised peritonitis.

Figure B9.1 The changes in position of the appendix as pregnancy advances. Adapted from McGraw-Hill Companies, Inc. Reproduced with the permission of Chris Paschalidis



Section B10. Tuberculosis in pregnancy

Introduction

Tuberculosis (TB) is generally becoming less common during pregnancy and in the fetus, even in high endemic countries, but remains a leading infectious cause of death during pregnancy and delivery, especially among women living with HIV. It is estimated that more than half a million women of child-bearing age die from TB (including HIV-related TB) each year, but the current epidemiology of TB in pregnancy is a reflection of the general incidence of disease. The infection has been associated with an increased risk of spontaneous abortion, perinatal mortality, small-for-gestational age and low birth weight in some studies. Poor outcome is attributable to delays in diagnosis or treatment, increasing the frequency of severe forms of extra-pulmonary disease.

Clinical findings

Signs and symptoms of TB are usually the same in both pregnant and non-pregnant woman. They include prolonged fever (especially at night), cough, weight loss, fatigue and breathing difficulty. Extra-pulmonary disease will present with organ-specific signs and symptoms such as lymphadenopathy, abdominal pain or mass, back pain, vaginal bleeding, pelvic inflammatory disease symptoms or infertility.

Diagnosis

Any woman who presents to an antenatal clinic with chronic respiratory symptoms or has had close contact with a TB index case, or unexplained illness, should be screened for TB. This includes a tuberculin skin test, sputum for acid-fast bacilli (AFB) stain and culture for mycobacterium TB. A chest X-ray may have harmful effects on the fetus in the first trimester of pregnancy but may be done with an abdominal lead shield. If clinically indicated a Chest X-ray is recommended as the risk to the fetus is very small and the mother's health a priority.

Extra-pulmonary TB is much more difficult to diagnose during pregnancy. After delivery, the placenta should be sent for histopathology, AFB stain and AFB culture to contribute to a diagnosis. The neonate should be evaluated thoroughly and treated accordingly.

Anti-tuberculous treatment during pregnancy

During pregnancy, tuberculosis represents a greater hazard to the pregnant woman and her fetus than does its treatment. Therefore, treatment should be commenced as soon as possible after a diagnosis has been made. Treatment for new patients with pulmonary TB is the same in pregnancy as it is for all other adults.

Please consult our textbook and a country specialist for the latest advice on drug treatment.

Drugs that are contraindicated during pregnancy

- streptomycin (which interferes with development of the ear and may cause congenital deafness)
- kanamycin, amikacin and capreomycin
- fluoroquinolones (ciprofloxacin, levofloxacin, ofloxacin and sparfloxacin)
- other second-line drugs (cycloserine, ethionamide and clofazimine).

TB treatment during pregnancy is the same for pregnant women as it is for non-pregnant women. Prompt initiation of therapy is mandatory to protect the mother and the fetus.

Vitamin K should be administered at birth to the infant of a mother taking rifampicin because of the risk of postnatal haemorrhage.

Pyridoxine (vitamin B_6) 10 mg daily is recommended for pregnant or breastfeeding women who are taking isoniazid- containing regimens.

Extra-pulmonary TB in pregnant women requires the same regimens as uncomplicated pulmonary TB. Some forms (e.g. meningitis, bone, joint) require a longer duration (9–12 months) of TB drugs.

If a woman has suspected resistant TB, attempts must be made to confirm drug resistance by appropriate cultures and therapy based on susceptibility results. Regimens are complicated and depend on susceptibilities, previous drug therapy, local susceptibility data, availability of second-line drugs and tolerability. An expert in infectious disease must be consulted in such cases. Pregnant women with resistant TB have a less favourable prognosis. They may sometimes require treatment with second-line drugs the safety of which is not well established in pregnancy.

Breastfeeding and TB

The low concentrations of anti-TB drugs in breast milk do not produce toxicity in the nursing newborn. Therefore breast- feeding should not be discouraged for an HIV-seronegative woman who is planning to take or is taking anti-TB drugs. Anti-TB treatment is the best way to prevent transmission of tubercle bacilli to the baby. Mother and baby should stay together and the baby should continue to breastfeed. After active TB in the baby is ruled out, the baby should be given 6 months of isoniazid preventive therapy, followed by BCG vaccination (for advice on breastfeeding and HIV, *see* Textbook). Breastfed infants do not require pyridoxine supplementation unless they are receiving isoniazid.

Treatment of latent TB infection

In most pregnant women, treatment of latent TB infection (LTBI) – that is, treatment of asymptomatic pregnant women with a positive tuberculin test or IGRA result and normal chest X-ray – should be delayed until 2 or 3 months after delivery, even though no harmful effects of isoniazid (INH, the standard treatment regimen for LTBI) on the fetus have been documented.
However, in the following situations where there is a high risk of progressing to active disease, treatment for LTBI with isoniazid (INH), 300 mg daily should begin during pregnancy. Treatment of LTBI should be started during the first trimester of pregnancy for:

- pregnant women who have HIV infection or behavioral risk factors for HIV infection, but who refuse HIV testing
- pregnant women who have been in recent close contact with an individual with smear-positive pulmonary TB.

Treatment of LTBI should be started after the first trimester of pregnancy for pregnant women who have had a documented tuberculin skin test conversion in the past 2 years. Treatment of LTBI, if indicated, should be started 2 to 3 months after delivery for all other pregnant women, including those with radiographic evidence of old healed TB. The recommended duration of LTBI therapy is 9 months. If a woman who is taking isoniazid and/or rifampin for treatment of LTBI becomes pregnant, treatment should be interrupted and started again 2 or 3 months after delivery, unless one or more of the above risk factors are present.

Perinatal TB

Women who have only pulmonary TB are not likely to infect the fetus but can infect their infant after delivery. Although protection of the infant from exposure and infection is of paramount importance, continuous close contact between infant and mother should be encouraged. Congenital TB is rare, but *in-utero* infections can occur after maternal bacteremia. If a newborn infant has suspected congenital TB, a full evaluation should be done and treatment initiated based on individual circumstances and specific recommendations. Management of the newborn infant is based on categorization of the maternal (or household contact) infection as follows:

- If the mother has completed TB chemotherapy during pregnancy, or has inactive disease, her infant should be given BCG at birth.
- If the mother has active disease or still requires treatment, the infant should be given isoniazid 10 mg/kg once daily for 3 to 6 months.

- Once the mother and infant are on appropriate treatment, the infant may breastfeed unless the mother has multidrug-resistant TB. A tuberculin test and chest X-ray are then performed on the neonate. If these are negative, BCG is given. If they are positive, full investigations for TB are undertaken. If no evidence of disease is detected, isoniazid is continued for another 3 to 4 months. If TB is suspected, full treatment is given at standard doses.

Directly observed treatment

Directly observed treatment: (DOTS) remains an important WHO strategy for reducing the TB burden worldwide. In DOTS, healthcare workers observe patients as they take their medicine. DOTS is practiced for patients with multi-drug-resistant (MDR) TB or those with complicated TB, and has been shown to be successful.

Section B11. Cystitis and acute pyelonephritis

Acute cystitis

Cystitis is a common complication of pregnancy, and is characterised by dysuria, frequency, urgency and, if severe, by haematuria. Severe cystitis can progress to pyelonephritis if not treated. The presence of loin pain and tenderness, along with fever, suggests a diagnosis of pyelonephritis.

Asymptomatic cystitis is more common in pregnancy, carries a risk of progression to pyelonephritis, and is associated with an increased risk of premature delivery.

Diagnosis

Use a dipstick leucocyte esterase test to detect white blood cells, and a nitrate reductase test to detect nitrites.

Microscopy of a urine specimen may show white blood cells in clumps, bacteria and some- times red blood cells. Urine examination requires a clean-catch midstream specimen of urine to minimise the possibility of contamination. The results of bacterial culture, although not necessary before starting treatment, are helpful if there is treatment failure, and also for monitoring bacterial sensitivity in the population.

Treatment with antibiotics for uncomplicated cystitis

Amoxicillin 500 mg by mouth three times a day for 5 days or cephalexin (or alternative available cephalosporin) 500 mg three times a day for 5 days.

Trimethoprim/sulfamethoxazole 1 tablet 160/800 mg by mouth twice a day for 3 days. This drug is best avoided in pregnancy unless there is no alternative. It must be completely avoided in the first trimester. This antibiotic is a folate antagonist and therefore promotes congenital abnormalities, and in the third trimester it may cause haemolysis in the neonate.

If treatment fails, check urine culture and sensitivity (if available), and treat with an antibiotic appropriate for the organism.

Acute pyelonephritis

Acute pyelonephritis is an acute infection of the upper urinary tract, mainly of the renal pelvis, which may also involve the renal parenchyma. It can precipitate premature labour. If shock is present or suspected, initiate immediate ABC treatment.

Check urine culture and sensitivity (if available) and treat with an antibiotic appropriate for the organism.

If urine culture is unavailable, treat with antibiotics until the woman has been fever-free for 48 hours:
Ampicillin 2 grams IV every 6 hours
plus Gentamicin 80 mg IM/IV every 8 hours or 5 mg/ kg body weight IV/IM once every 24 hours.

Once the woman has been fever-free for 48 hours, give amoxicillin/ampicillin 500 mg by mouth three times a day to complete 14 days of treatment.

If there is no clinical response within 72 hours, review the results and antibiotic coverage.

Alternative and/or second line treatment is with IV cephalosporins, e.g. cefuroxime 750 mg to 1.5 g 8-hourly.

Perform a renal ultrasound scan. If any significant malformation of the kidneys or renal tract is noted, refer the patient for specialist advice.

Section B12. Varicella zoster (chickenpox) in pregnancy and the neonate

Introduction

- Pregnant women and newborn infants are at risk of severe disease from varicella, involving serious effects on organs such as the lungs.
- Varicella is transmitted from respiratory aerosols and skin lesions in chickenpox itself, and from the skin lesions but not aerosols in shingles (which is not infectious until the skin lesions appear).
- In chickenpox, patients are infectious for 48 hours prior to emergence of the rash and until all of the skin lesions are crusted over.
- The incubation period is 10–21 days.
- Non-immune patients are those without a history of chickenpox or shingles or a completed vaccination profile. Immune status can be checked with blood varicella IgG measurement (if available).

Clinical features in pregnancy

Congenital varicella syndrome (CVS)

In the first or early second trimester infection may result in stillbirth, or the neonate may be born with a group of physical abnormalities known as congenital varicella syndrome (CVS). This is rare, occurring in 1–3% of women infected with chickenpox in the first 20 weeks of gestation (the period of maximum risk is between 12- and 20-weeks' gestation). There may be dermatomal scarring, limb hypoplasia, ocular abnormalities, low birth weight and early death. Survivors may have long-term developmental problems. An infant with CVS has a 30% risk of mortality in the first few months of life, and a 15% risk of developing herpes zoster between 2 months and 3 years of life.

Varicella pneumonia

Pregnant women with chickenpox may be more likely than non-pregnant women to develop severe pneumonitis. The risk is greatest in the third trimester, especially if lung disease is already present, or if the patient is a smoker or is immunocompromised (e.g. due to HIV infection).

Symptoms start as a non-productive cough, which can rapidly progress to respiratory failure within 36–48 hours. The cough becomes increasingly productive, with tachypnoea, dyspnoea, cyanosis and chest pain.

Perinatal infection

If a neonate is exposed (mother has a rash) around the time of birth (from 5 days before to 2 days after delivery), there is a 17–30% risk of dangerous perinatal infection. This is characterised by skin lesions, disseminated intravascular coagulation, pneumonitis and hepatitis, and it has a mortality of up to 30%.

Management
Maternal contact with varicella during pregnancy If the patient is immune (see above for definition), no treatment or isolation is required.

If the mother is non-immune and an IgG test is not available and affordable, and if she has had a significant contact with chicken pox or shingles, then give varicella zoster immunoglobulin (VZIG) (see below for details) within 4 days of contact if possible (maximum of 10 days after contact). Avoid contact with other pregnant women. The patient should be counselled regarding the signs of infection so that she can be treated early if it occurs.

Significant exposure to chicken pox occurs after very limited contact with an infected person (any face to face contact and as little as 15 minutes in the same room as an infectious patient). The risk of contracting chicken pox from exposure to shingles is very low if the infection is not in an exposed area.

Chickenpox during pregnancy
If this is mild, give oral aciclovir (see below for dose regimen) for 7 days, starting within 24 hours of the appearance of vesicles, and avoid contact with other pregnant women. In mild cases, Aciclovir leads to little improvement. It is most important in women at risk of severe disease (immuno- compromised, HIV infected, history of respiratory disease or smoking).

If it is severe, give IV aciclovir for 7 days. High- dependency care should be provided if available, as appropriate.

Prevention of neonatal chickenpox if the mother is infected from 7 days before to 7 days after birth
Give VZIG to the neonate as soon as possible after delivery. Isolate the mother and infant. This is crucial as chicken pox is very contagious (see above).
In addition, give IV aciclovir to the neonate if the onset of maternal symptoms was between 5 days before, and 2 days after the birth, as this is the period of highest risk of severe neonatal disease.

Infant in contact with chickenpox other than from mother, or from mother who develops chickenpox more than 7 days after the birth
If the mother is immune and the infant is full term at birth, no prophylaxis is needed. Mild illness may occur.

If the mother is not immune and the infant is less than 4 weeks of age, and full term at birth, give varicella zoster immunoglobulin (VZIG) (if available).

If the infant is preterm, and regardless of maternal immunity, give VZIG.

If VZIG is not available, IV aciclovir should be given to other infants exposed in hospital, as prophylactic use has been reported to reduce disease severity.

Regardless of whether VZIG is given, monitor the baby for signs of infection to enable early treatment should infection occur. VZIG may extend the incubation period to 28 days.

Shingles is very rare in infants and, if present, suspect HIV infection.

Doses of VZIG and aciclovir

In pregnancy

Aciclovir is of no benefit if commenced more than 24 hours after the appearance of chickenpox vesicles.

- Oral route: 800 mg five times daily for 7 days (mildly ill cases only).
- IV route: 10 mg/kg/dose every 8 hours for 7 days.

Side effects include nausea, vomiting, diarrhoea, headache and nephrotoxicity. Reduce the dose or dosage interval in patients with impaired renal function.

Varicella zoster immunoglobulin (VZIG): 1gram IM. Anaphylaxis is rare but ensure that adrenaline is available.

In the neonate

Aciclovir 10–20 mg/kg IV every 8 hours for at least 7 days. Side effects are as described above.

Varicella zoster immunoglobulin (VZIG): 250 mg by deep IM injection.

Section B13. Congenital syphilis

Introduction

Syphilis is a dangerous bacterial infection caused by *Treponema pallidum* which, when it occurs in pregnancy, can cause early fetal death, stillbirth, preterm birth, neonatal death or congenital infection. Mother-to-child transmission is a major problem, especially in resource-limited countries.

Congenital syphilis may be acquired from an infected mother via trans-placental transmission of *Treponema pallidum* at any time during pregnancy. If the mother receives adequate treatment, ideally before the second trimester, the risk of adverse outcome to the fetus is minimal.

Clinical signs in infants may include any of the following:

- low birth weight with a heavy placenta
- palms and soles showing a red rash, grey patches, blisters or skin peeling
- abdominal distension due to large liver and spleen
- jaundice
- anaemia
- some low-birth-weight infants with syphilis show signs of severe sepsis, with lethargy, respiratory distress, skin petechiae or other signs of bleeding.

Investigation

No newborn infant should be discharged from hospital without determination of the mother's serologic status for syphilis at least once during pregnancy, and also at delivery in communities and populations in which the risk of infection with congenital syphilis is high.

If you suspect syphilis, perform a venereal disease research laboratory (VDRL), rapid plasmin reagent (RPR) or rapid syphilis test on the infant's serum (not cord blood). Interpretation of the serological results in the neonate can be difficult, as maternal IgG antibodies are transferred across the placenta. A non-treponemal serological titre that is fourfold higher than the mother's titre is definitely significant, although a lower titre does not exclude congenital syphilis. As well as a careful examination of the infant, an x-ray of long bones (if available) may help with the diagnosis. Periostitis, metaphysitis and erosions of long bones are the commonest findings.

Because of the diagnostic difficulty, and the fact that infants may be asymptomatic, assessing the adequacy of maternal treatment is very important.

Treatment

All newborn infants of mothers with syphilis should be investigated and treated.

Adequate treatment for the mother is 3 doses of benzathine penicillin, given at least 4 weeks before delivery.

Infants should be treated for congenital syphilis if they have proven or probable disease demonstrated by one or more of the following:

- physical, laboratory or X-ray evidence of active disease
- a reactive result on maternal or infant VDRL testing where the mother has had no treatment, or inadequate treatment, or has had a non-penicillin antibiotic, even if the infant is asymptomatic.

Parenteral benzyl penicillin remains the preferred drug for treatment of an infant with any signs of congenital syphilis. The dose is 100,000-150,000U/kg/day given intravenously as 50,000 U/dose (37.5 mg) 12 hourly for the first 7 days and then 8 hourly for 3 days (total 10 days).

An alternative is procaine penicillin 50 000 units/kg or 50 mg/kg as a single dose by deep IM injection daily for 10 days. Ensure that this is not injected into a vein.

Asymptomatic neonates born to VDRL-positive or RPR-positive women, who have been adequately treated, should receive 37.5 mg/kg (50 000 units/kg) of benzathine benzyl penicillin as a single IM dose into the anterolateral thigh whether or not their mothers were treated during pregnancy. Routine CSF examination is not required. Ensure that the needle is not in a vein when this drug is given, by drawing back and ensuring that no blood is in the needle, as it can cause cardiac arrest and severe CNS damage if given IV.

Early congenital syphilis generally responds well to penicillin. Recovery may be slow in seriously ill infants with extensive skin, mucous membrane, bone or visceral involvement.

If the patient is allergic to penicillin (this is unusual), give ceftriaxone IM/IV once daily for 10 days. The dose for a neonate aged up to 15 days is 50mg/kg once daily; 15-28days 75-100mg/kg once daily, or give erythromycin, 7.5–12.5 mg/kg orally, four times a day for 14 days but erythromycin is less effective.

Where congenital syphilis was treated or suspected, the baby should be followed up. Non-treponemal test titres should decline over 6 months. If titres remain high at 6-12 months, the infant should be re-evaluated. Always treat both the mother and partner for syphilis, and check for other sexually transmitted infectio

Section B14. Viral haemorrhagic fever (VHF): Lassa and Ebola

Introduction

Viral haemorrhagic fevers (VHFs) are a group of severe infections caused by viruses that normally affect animals. Human infection is characterised by high fever and, in a proportion of cases, haemorrhage. Animal hosts such as rodents are usually asymptomatic and are often infected with virus from birth, excreting it in urine or faeces throughout life.

In primary cases, transmission to humans occurs by a variety of routes, such as food contaminated with urine (e.g. Lassa). The hosts for Ebola are not yet known. Humans with disease are usually highly infectious. Most VHFs cause severe disease with a high mortality, especially following human-to-human spread (secondary cases).

Some (e.g. Lassa fever) may also cause asymptomatic or mild illness.

Symptomatic disease is commonly mistaken for other febrile illnesses, typically malaria, typhoid fever or *Shigella* dysentery, which fail to respond to treatment.

Lassa fever

Distribution: West Africa (Nigeria, Sierra Leone, Liberia and Guinea).
Host: Mastomy's rat (habitat is rural).
Transmission:

- Primary: mainly from contact with host (rat) urine or faeces. Food may be contaminated.
- Secondary: transmission from patient to carer, or to hospital and laboratory staff is common, particularly from haemorrhagic cases. Maternal illness is particularly severe, with a high risk of vertical transmission to the baby (which is invariably fatal).

Prevalence

This disease is relatively common. Most primary human infections are not severe, and many are subclinical. Because the clinical course of the disease is so variable, detection of the disease in affected patients has been difficult. When presence of the disease is confirmed in a community, however, prompt isolation of affected patients, good infection prevention and control practices, and rigorous contact tracing can stop outbreaks.

About 80% of people who become infected with Lassa virus have no symptoms. 1 in 5 infections result in severe disease, where the virus affects several organs such as the liver, spleen and kidneys. The overall case-fatality rate is 1%. Observed case-fatality rate among patients hospitalized with severe cases of Lassa fever is 15%.

The disease is especially severe late in pregnancy, with maternal death and/or fetal loss occurring in more than 80% of cases during the third trimester.

Clinical features

- The incubation period of Lassa fever ranges from 6–21 days. The duration of illness is 2 to 21 days.
- High fever (>39°C) with cough and vomiting is present in 65% of hospital cases.
- Abdominal pain and diarrhoea are common (around 35% of cases).
- Sore throat and pharyngeal ulcers are highly suggestive of Lassa fever.
- In pregnancy the presentation can be heavy vaginal bleeding
- The onset of the disease, when it is symptomatic, is usually gradual, starting with fever, general weakness, and malaise. After a few days, headache, sore throat, muscle pain, chest pain, nausea, vomiting, diarrhoea, cough, and abdominal pain may follow. In severe cases facial swelling, pleural effusion, bleeding from the mouth, nose, vagina or gastrointestinal tract and low blood pressure may develop.
- Protein may be noted in the urine.
- Shock, seizures, tremor, disorientation, and coma may be seen in the later stages.
- Deafness occurs in 25% of patients who survive the disease. In half of these cases, hearing returns partially after 1–3 months.
- Transient hair loss and gait disturbance may occur during recovery.
- Death usually occurs within 14 days of onset in fatal cases.

Diagnosis of Lassa fever

Because the symptoms of Lassa fever are so varied and non-specific, clinical diagnosis is often difficult, especially early in the course of the disease. Lassa fever is difficult to distinguish from other viral haemorrhagic fevers such as Ebola as well as other diseases that cause fever, including malaria, shigellosis, typhoid fever and yellow fever.

Definitive diagnosis requires testing that is available only in reference laboratories. Laboratory specimens may be hazardous and must be handled with extreme care.

Note that malaria parasitaemia in an area of endemic malaria transmission is not sufficient to exclude other causes of fever (e.g. VHF) as the cause of a febrile illness, as many adults and older children may have coincidental asymptomatic malaria parasitaemia as the cause of a febrile illness.

Confirmation of diagnosis

- **Positive specific IgM serology** (on admission only 50% of cases are positive).
- **Rising IgG titres** to Lassa on acute and convalescent serum.
- Isolation of virus: this is rarely appropriate and, due to the high risks of laboratory infection, samples should not be taken without senior expert advice.
- Samples must be marked as high infection risk, ideally with standard yellow hazard tape, and sent in two
- sealed plastic bags. Samples should only be taken if laboratory staff are aware of the potential risks, and are
- able to take the necessary precautions to handle such specimens safely. The laboratory should be informed
- that the specimen has been sent.

Management

Appropriate symptomatic management is for fever, distress and pain. Treat pain with oral or IV paracetamol and morphine **but do not give aspirin like drugs or NSAIDS.**

ABC including oxygen and treatment of shock.

Blood transfusion may be required for a falling PCV or haemorrhage. Fresh-frozen plasma (FFP) may not be of benefit, as inhibitors of clotting factors may cause bleeding. Therefore, **fresh donor blood is ideal.**

The antiviral drug **ribavirin** seems to be an effective treatment for Lassa fever if given early in the course of clinical illness. Although it is expensive, it should be available in all rural hospitals. There is, however, no evidence to support the role of ribavirin as postexposure prophylactic treatment for Lassa fever.
There is currently no vaccine that protects against Lassa fever.

Prevention and control

Prevention of Lassa fever relies on promoting good “community hygiene” to discourage rodents from entering homes. Effective measures include storing grain and other foodstuffs in rodent-proof containers, disposing of garbage far from the home, maintaining clean households and keeping cats. Because Mastomy rats are so abundant in endemic areas, it is not possible to completely eliminate them from the environment.

Family members should always be careful to avoid contact with blood and body fluids while caring for sick persons.

In health-care settings, staff should always apply standard infection prevention and control precautions when caring for patients, regardless of their presumed diagnosis. These include basic hand hygiene, respiratory hygiene, use of personal protective equipment (to block splashes or other contact with infected materials), safe injection practices and safe burial practices.

Health-care workers caring for patients with suspected or confirmed Lassa fever should apply extra infection control measures to prevent contact with the patient's blood and body fluids and contaminated surfaces or materials such as clothing and bedding. When in close contact (within 1 metre) of patients with Lassa fever, health-care workers should wear face protection (a face shield or a medical mask and goggles), a clean, non-sterile long-sleeved gown, and gloves (sterile gloves for some procedures).

Laboratory workers are also at risk. Samples taken from humans and animals for investigation of Lassa virus infection should be handled by trained staff and processed in suitably equipped laboratories under maximum biological containment conditions.

Health-care workers seeing a patient suspected to have Lassa fever should immediately contact local and national experts for advice and to arrange for laboratory testing.

Ebola Virus Disease (EVD)

Distribution: Central Africa (Sudan, Democratic Republic of the Congo, Gabon, Cote d'Ivoire, Uganda) and West Africa (Guinea, Liberia and Sierra Leone).
Host: the main animal reservoir is unknown.

Transmission:

- Primary: infection occurs mainly in adults trekking in tropical Central African forests. Transmission from primates to humans has been recorded.
- Secondary: patients with advanced disease are viraemic and highly infectious. Once in a human host, transmission to carers, hospital and laboratory staff is frequent (30% of doctors developed Ebola during an outbreak in the DRC). However, once effective infection control measures have been implemented, secondary cases are rare.

The disease has a high death rate. Post-mortem transmission does occur, possibly through skin contact.

Clinical features

- A high fever is invariably present, and diarrhoea occurs in 85% of cases. This is bloody in 20% of cases and can be confused with *Shigella* dysentery.
- Vomiting and abdominal pain are common (75% of cases).
- Headaches, myalgia or arthralgias are reported in 50% of cases.
- Sore throat occurs in 50% of cases, and is a distinguishing feature, as is conjunctival injection (45%).
- A maculopapular rash, although poorly visible on black African skin, is common.
- Cough occurs in 10% of cases.
- Bleeding is seen in 40% of cases, and is usually either gastrointestinal, oral, vaginal, at injection sites or as skin petechiae.
- There is frequently signs of shock due to blood and fluid loss.
- Hospital mortality is around 80%.

Pregnant women are at increased risk of severe illness and death when infected. Pregnant women with EVD also appear to be at an increased risk of fetal loss and pregnancy-associated haemorrhage. The virus can cross the placenta and is likely to be transmitted to the fetus. Analysis of amniotic fluid, meconium, vaginal secretions, umbilical cord, and buccal swab samples from neonates have revealed the virus. Importantly the virus has been shown to persist in amniotic fluid for an unknown duration of time after negative RT-PCR tests for virus in maternal blood. Therefore, proper infection control precautions should be taken when managing convalescent pregnant women. Women who become pregnant after recovery from EVD pose little risk for transmission of the virus to the fetus.

Diagnosis

Clinical diagnosis

- Suspected clinical case (during epidemic): any febrile illness associated with haemorrhage. No contact history is required.
- Probable case (during epidemic): a febrile illness occurring within 3 weeks of contact with a case of Ebola

or

a febrile illness in which three or more of the above clinical features are present.

- Possible clinical case (non-epidemic): an unexplained severe febrile illness, particularly with haemorrhage, in an area of Ebola transmission, with no response to an antimalarial drug plus a broad-spectrum antibiotic.

Indirect laboratory tests supportive of diagnosis

- Raised liver transaminases (AST/SGOT).
- Low or normal initial white blood cell count.

Confirmation of diagnosis

Early serological tests were difficult to interpret, but newer specific IgM ELISAs allow diagnosis of acute cases on a single positive test. However, IgM is not always positive at presentation.

Samples need to be marked as high infection risk, ideally with standard yellow hazard tape, and sent in two sealed plastic bags. Samples should only be taken where laboratory staff are aware of the potential risks and can take the necessary precautions to handle such specimens safely. The laboratory should be informed that the specimen has been sent.

Notification

Consider formal identification of a possible outbreak of Ebola if there is a new illness of high mortality in adults in a recognised area of transmission, particularly if hospital- acquired secondary cases have occurred.

Management

- Full PPE for all health workers caring for patients and full details of isolation and prevention of cross infection are contained within WHO guidelines.
- ABC management including oxygen, treatment for shock with fresh donor blood, if available, for haemorrhage
- Antimalarial and antibiotic therapy should be given routinely, directed at treating possible alternative diagnoses (e.g. shigellosis, typhoid).
- Obstetric management should focus on the monitoring and early treatment of haemorrhagic complications. Healthcare providers should be aware that spontaneous abortion and intrapartum haemorrhage appear to be common among women with EVD, and high perinatal mortality rates among infants of women infected with the Ebola virus have been reported.
- Pregnant health workers should not care for patients with EVD.
- For management of diarrhoea and dehydration see Section B7
- For vomiting one of the best drugs is ondansetron orally 4 to 8 mg twice daily or by slow IV injection 8 mg given over 5 minutes. This can be followed by 8 mg by slow IV injection every 12 hours.

Section B15. Prevention of mother-to-child transmission (PMTCT) of HIV infection and Anti-Retroviral Treatment (ART) in pregnancy

Introduction

Consolidated ART guidelines published by the WHO in 2016 recommend that all pregnant and breastfeeding women infected with HIV should be commenced on ART (one simplified triple regimen), as lifelong treatment. This means that ART should be present throughout the duration of MTCT risk (i.e. throughout breastfeeding).

As most women should continue ART following delivery, an effective link with HIV treatment programmes is essential.

Prophylactic treatment for the baby depends on risk factors for transmission. See table B15.1, and risk factors below.

TABLE B15.1 WHO guidelines for ART in pregnancy for HIV infected women, and infant prophylaxis.

For pregnant women being given lifelong ART	For infants of mothers at high risk of acquiring HIV **	Breastfed infants of mothers with HIV, at high risk of acquiring HIV **	Infants of mothers who are on ART and not high risk,
Preferred regimens: TDF/3TC /DTG* TDF + 3TC + EFV (as fixed-dose combination) Alternative regimens: AZT + 3TC + EFV or AZT + 3TC + NVP	Daily nevirapine (NVP) for 6 weeks AND zidovudine (AZT) twice daily for 6 weeks.	Daily nevirapine (NVP) for 12 weeks AND zidovudine (AZT) twice daily for 12 weeks.	Daily nevirapine (NVP) for 6 weeks.

*This is the preferred regime where Dolutegravir (DTG) is available. Women who are not taking folate fortified foods, or who want to become pregnant, should be counselled on risks. www.who.int/hiv/pub/arv/arv-update-2019-policy/en

** High- risk infants are defined as those:

1. born to women with established HIV infection who have received less than 4 weeks of ART at the time of delivery; OR
2. born to women with established HIV infection with a viral load >1000 copies/ml in the four weeks before delivery, if viral load measurement is available; OR

3. born to women with incident HIV infection during pregnancy or breastfeeding; OR
4. identified for the first time during the postpartum period, with or without a negative HIV test prenatally

Women first diagnosed with HIV during labour or immediately postpartum:
The infants of these women are at high-risk, see table B15.1.

Co -trimoxazole prophylaxis to prevent Pneumocystis Jiroveci (formerly Carinii) pneumonia. (PCP)
HIV-exposed infants (children born to women with HIV) should be given co-trimoxazole prophylaxis from 4–6 weeks of age, and this should be continued until HIV infection has been excluded and the infant is no longer at risk of acquiring HIV through breastfeeding. (*WHO 2016 Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection).*

Co-trimoxazole prophylaxis has been shown to be very effective in HIV infected infants and children, in reducing mortality, and the likelihood of PCP as a cause of severe pneumonia. PCP is now unusual in countries where prophylaxis is routine. Co-trimoxazole also protects against common bacterial infections, toxoplasmosis and malaria.

When Co-trimoxazole should be discontinued:
If severe cutaneous reactions, such as Stevens-Johnson syndrome occur, or if there is renal and/or hepatic insufficiency, or severe haematological toxicity (severe anaemia or pancytopaenia). It is contraindicated in infants with glucose-6-phosphate dehydrogenase (G6PD) deficiency.

In an HIV exposed infant, only after HIV infection has confidently been excluded:
- For a non-breastfeeding child under the age of 18 months, this is by negative DNA or RNA virological HIV testing.
- For a breastfed HIV exposed child under the age of 18 months, negative virological testing is only reliable if performed 6 weeks after cessation of breastfeeding.
- For a breastfed HIV exposed child over 18months of age, negative HIV antibody testing 6 weeks after stopping breastfeeding.

Cotrimoxazole is a combination of trimethoprim/sulfamethoxazole (TMP/SMX) Recommended doses of 6-8mg/kg of TMP once daily should be used.

For infants under 6 months of age, give 2.5ml of suspension (40mg TMP/200mg SMX in 5 ml), or 1 paediatric tablet, or ¼ adult tablet (contains 20mg TMP/100mg SMX). Tablets can be crushed.

Use weight band dosages rather than body surface area doses. See table B15.2

Table B15.2. Simplified dosing for neonates

https://www.who.int/hiv/pub/guidelines/arv2013/arvs2013upplement_dec2014/en

https://www.who.int/hiv/pub/guidelines/ARV2018update/en/

Number of tablets or ml by weight band once/day

Drug	Strength of tablet or oral liquid (mg or mg/5ml)	3.0 – 5.9kg	6.0-9.9kg
Co-trimoxazole	Suspension 200/40 mg/5ml Tablets (dispersible) 100/20 mg Tablets (scored) 400/80 mg	2.5ml once/day 1 once/day -	5.0ml once/day 2 once/day 0.5 once/day
Zidovudine	10mg/ml	6ml twice/day	9ml twice/day
Nevirapine	10mg/ml	5ml twice/day	8ml twice/day

HIV-2 infection
HIV-2 is much less transmissible than HIV-1 (the MTCT risk is 0−4%). Non-nucleoside reverse transcriptase inhibitors (NNRTIs) such as NVP and EFV are not effective against HIV-2, and a triple nucleoside reverse transcriptase inhibitor (NRTI) combination is recommended.

Table B15.3 Treatment of HIV-2 infection

Mother requires treatment with AZT + abacavir (ABC) + 3TC Infant of mother with HIV-2 requires treatment with AZT twice a day until 4–6 weeks

Management of the delivery:
Labour can be a worrying time for the HIV-positive woman, particularly because of possible underlying fears about her own HIV infection and the risk of infecting her baby. She will need reassurance and support, and it is important to ensure she

knows that with all of the interventions that are given, her baby is more likely to be HIV-negative than infected.

Get close to the mother, greet her and be seen to shake hands with her, to help to reduce the stigma around touching those infected with HIV. Support her relatives and encourage her to tell her partner so that he can be tested for HIV. Promote safer sex and advise her to use condoms to prevent transmission of HIV.
Standard precautions should be used when caring for women in labour, whether or not they have HIV infection. Always wear gloves when touching body fluids and dispose of single-use syringes and needles safely.

During delivery, to reduce MTCT:

- avoid artificial rupture of membranes
- avoid prolonged rupture of membranes
- avoid unnecessary episiotomy, but also avoid a tear.

Both blood and placenta will contain HIV, so wear gloves, an apron and eye protection. Avoid direct contact of blood on your skin. Blood on intact skin should be washed off immediately. HIV-positive blood on an open wound or splashed into the eye can transmit HIV and should be washed immediately (use soap and water for a wound, and water for an eye) and managed in the same way as a needlestick injury (with post-exposure prophylaxis with ART).

Essential postnatal care for HIV-exposed infants

1. Completion of ART prophylaxis regimen.
2. Routine newborn and infant care, including routine immunisation and growth monitoring.
3. Co-trimoxazole prophylaxis.
4. Early HIV diagnostic testing and diagnosis of HIV-related conditions.
5. Continued infant feeding counselling and support, especially after early HIV testing.
6. Nutritional support throughout the first year of life, including support for optimal infant feeding practices, and provision of nutritional supplements and replacement foods if indicated.
7. ART for HIV-infected children when indicated.
8. Treatment monitoring for all children receiving ART.
9. INH prophylaxis when indicated.
10. Adherence support counselling for caregivers.
11. Malaria prevention and treatment where indicated.
12. Diagnosis and management of common childhood infections and conditions, and integrated management of childhood illness (IMCI).
13. Diagnosis and management of TB and other opportunistic infections.

Abbreviations: 3TC – Lamivudine
AZT – Zidovudine
DTG – Dolutegravir
EFV – Efavirens
NVP – Nevirapine
TDF – Tenofovir

Section B 16 Sickle-cell anaemia in pregnancy

See Handbook 2 Paediatric emergency care chapter for more information

Sickle-cell anaemia is a disease in which the patient's red cells form sharp points when they lack sufficient oxygen. These pointed red cells are destroyed by the body, and as a result the patient becomes anaemic. Sickle-cell anaemia is harmful to pregnant mothers. It causes miscarriage and perinatal deaths. It also causes painful crises, which may be life-threatening. Infections, especially urinary and chest infections, are also more common.

Before pregnancy

Ideally, women with sickle-cell disease (SCD) should be seen before pregnancy so that they can be told about how pregnancy and SCD can interact, and how to achieve the best outcomes. This is also an opportunity to screen for end-organ damage or manage existing problems, and perhaps to discuss contraception. These activities could be undertaken in the context of a regular specialist sickle-cell review.

Women should be encouraged to have their partner tested for haemoglobinopathy before becoming pregnant, so that the risk of having a child with SCD can be assessed. Prenatal diagnosis and possible termination of pregnancy may need to be discussed with the couple.

A history of previous Caesarean section and uterine curettage should be obtained because of the **increased risk of placenta praevia**

An adequate nutritional assessment should be under-taken. The patient's pre-pregnant weight, height, and optimal weight gain in pregnancy should be recorded.

Women who are planning to conceive should be told about:

- the danger of dehydration (from nausea and vomiting), cold, hypoxia, overexertion and stress in the genesis of sickle-cell crises
- the increased risk of worsened anaemia, crises, acute chest syndrome (ACS) and infection (especially urinary tract infection) during pregnancy
- potential effects on the baby, such as prematurity, growth restriction and fetal distress. The rate of complications may depend on the type of SCD that is present
- the increased risk of induction of labour and Caesarean section
- the chance of their baby being affected by SCD
- the outcome of pregnancy in SCD is usually favourable.

Investigations in low resource settings

- blood pressure and urinalysis: identifies women with hypertension and/or proteinuria
- full blood count
- haemoglobin electrophoresis
- serum iron, total iron binding capacity (TIBC) and ferritin levels
- renal and liver function tests
- red cell antibodies: may detect an increased risk of haemolytic disease of the newborn
- measurement of antibodies to hepatitis A, B and C, and HIV
- tuberculin skin test
- retinal screening (if an ophthalmologist is available); proliferative retinopathy is common in patients with SCD

Medication and vaccination

1. Folic acid (5 mg daily) is useful both before and throughout pregnancy.
2. Hydroxycarbamide (hydroxyurea) is helpful in severe SCD but should use contraception and stop hydroxy- carbamide 3 months before attempting to conceive.
3. Angiotensin-converting enzyme inhibitors or angiotensin- receptor blockers are not safe in pregnancy and should be discontinued prior to conception.
4. Chelation therapy (e.g. desferrioxamine) should be stopped prior to conception.
5. Vaccination against the following is recommended before pregnancy (if not previously given): *Haemophilus influenzae* type b, conjugated meningococcal C, and pneumococcus, hepatitis B and influenza.

Antenatal care

Antenatal care ideally by a multidisciplinary team that includes an obstetrician/obstetric clinician and a midwife with experience of high-risk antenatal care, and a doctor with an interest in SCD.

Discussion about pregnancy, SCD and vaccination should cover the points listed under 'Before pregnancy' above. Providing information and education about SCD, improving the mother's nutritional status, malaria prevention and early detection of bacterial infection have a positive impact on SCD-related morbidity and mortality in Africa.

SCD may increase the risk of pre-eclampsia, so it is advisable to give low-dose aspirin (75 mg daily) from 12 weeks' gestation (unless there is an allergy).

Because of the effects on fetal development, non-steroidal anti- inflammatory drugs (NSAIDs) should not be given before 12 or after 28 weeks' gestation.

Iron supplements should only be given if there is laboratory evidence of deficiency (haemoglobin level less than 11 g/dL). Live attenuated vaccines should not be given until after delivery.

The woman's partner should be offered testing for haemoglobinopathy. If the partner is a sickle-carrier or has SCD, the risks of delivering an infant with SCD should be discussed. This should ideally occur within 10 weeks of conception, so that prenatal diagnosis and discussion about termination can be offered. Factors to be considered include coping skills for caring for a child with a serious illness, personal and cultural values with regard to childbearing, religious beliefs, the need and desire to have children, feelings and attitudes about abortion, and beliefs about self-determination versus fate as determinants of adverse events.

There is increased risk of venous thromboembolism. Graduated compression stockings are an option. For hospital admissions, low-molecular-weight heparin is recommended (*see* Section A+15).

Blood pressure and proteinuria assessment should occur at each visit because of the increased risk of pregnancy-induced hypertension in SCD. Any pre-existing proteinuria or renal impairment should be monitored more frequently. Women should be observed closely if their blood pressure rises above 125/75 mmHg, if their systolic blood pressure increases by 30 mmHg, or if their diastolic blood pressure increases by 15 mmHg, in association with oedema and proteinuria in the second trimester.

Urinalysis for protein should be performed at each antenatal visit, and midstream urine sent for culture and sensitivity if symptoms of urinary tract infection are present and routinely if resources allow microscopy.

Ultrasound scanning should ideally occur as follows:

1. An early viability scan at 7–9 weeks' gestation.
2. The routine first-trimester scan (at 11–14 weeks' gestation)
3. Serial fetal biometry scans (growth scans) every 4 weeks from 24 weeks' gestation.
4. Screen for placenta praevia after 28 weeks

Transfusion in women with SCD who are pregnant

1. Routine transfusions are not required.
2. Decisions about transfusion should be made by an experienced haematologist (if available) and an
3. Obstetrician/obstetric clinician. One approach is to consider initiation of transfusions for women who have complications such as pre- eclampsia, severe anaemia, or increasing frequency of pain episodes.
4. Each woman should have an care plan that takes into account her previous sickle-cell and pregnancy history.
5. Treatment of acute painful crisis is the same as that for non-pregnant patients, with hydration, oxygen and analgesics, although doses of the latter may be higher. Reassurance should be given that morphine use during pregnancy does not harm the baby's health. However, if large doses of morphine are needed in late pregnancy, the newborn may require opioid weaning.

Intrapartum care

If there is a normally growing fetus, offer elective birth through induction of labour, or by elective Caesarean section if indicated for other reasons, between 38 and 40 weeks' gestation.

In low resource settings the risks of induction and the uncertainty about due date must be balanced against the potential increased risk of late pregnancy complications such as abruption and pre-eclampsia in SCD. SCD is not a contraindication to attempting vaginal delivery, or vaginal birth after previous Caesarean section. A 'group and save' for possible transfusion is acceptable for delivery unless there are atypical antibodies, when a cross-match should be requested (to reduce delays).

Inform the multidisciplinary team (the senior midwife in charge, senior obstetrician/obstetric clinician, anaesthetist and haematologist if available) when labour is confirmed.

Maintain warmth and hydration.

There is an increased risk of fetal distress which may necessitate operative delivery. There is also an increased rate of stillbirth, placental abruption and compromised placental reserve. If possible, involve the mother in fetal monitoring with ultrasound doppler probe immediately after every contraction during labour.

Insert a reliable IV cannula and give intravenous fluids if oral hydration is inadequate. A fluid balance chart should be kept in addition to the partograph.

Changes during the intrapartum period:

- There is an increased frequency of sickle-cell crises and ACS.
- Cardiac function can be compromised because of chronic hypoxaemia and anaemia.
- There is an increased risk of painful crises with protracted labour (more than 12 hours). If the woman is well hydrated and labour is progressing, the labour should be carefully supervised. Caesarean section should be considered if labour is not progressing well and delivery is not imminent.
- There is an increased oxygen demand. Use of pulse oximetry to detect hypoxia is appropriate. If the oxygen saturation is 94% or less, oxygen should be given by nasal cannula.
- Routine antibiotic prophylaxis in labour is not supported by evidence, but hourly observations of vital signs should be performed. A raised temperature (37.5°C or more) requires investigation and a low threshold for commencing broad-spectrum antibiotics.
- Women should be offered anaesthetic assessment in the third trimester of pregnancy, as general anaesthesia should be avoided where possible. Regional analgesia (spinal) is recommended for Caesarean section. **Do not give pethidine because of the risk of seizures**. IV paracetamol is helpful but if available Morphine is the most appropriate drug for pain control.

Postpartum care

- If the baby is at high risk of SCD (based on parental haemoglobinopathy results), early testing for SCD should be offered.
- Maintain maternal oxygen saturation above 94% and adequate hydration based on fluid balance until discharge.
- Low-molecular-weight heparin (or unfractionated heparin if the former is not available) should be administered while the woman is in hospital and for 7 days post-discharge following vaginal delivery, or for a period of 6 weeks following Caesarean section to prevent DVT and pulmonary embolus.
- Anti-thrombotic stockings are recommended in the puerperium.
- The risk of sickle-cell crisis is increased. Hydration and oxygenation should be maintained and early mobilisation encouraged. Crises should be managed as for non-pregnant women. NSAIDs can be given in the post-partum period and during breastfeeding. Breastfeeding should be encouraged.
- Postpartum contraceptive advice should be given. Progestogen-containing contraceptives, injectable contraceptives and the levonorgestrel intrauterine system are safe and effective in SCD. Oestrogen-containing contraceptives should be used as second-line agents. Barrier methods are as safe and effective in women with SCD as in the general population.

Section C1. Basic and Comprehensive Emergency Obstetric & Neonatal Care in resource-limited settings

The availability of Emergency Obstetric & Neonatal Care (EmONC) indicates how well any healthcare system can respond to the obstetric and newborn complications that are the main causes of maternal and newborn deaths. The Averting Maternal Death and Disability Program (AMDD) and the United Nations have defined nine essential EmONC services that directly treat these complications. These are termed signal functions.

The functional status of an EmONC facility depends on the 24-hour availability of these life-saving signal functions and whether they have been performed recently. To qualify as a Basic EmONC (or BEmONC) facility, health centres and hospitals must have performed the following seven signal functions within the past 3 months:

1. administered IM or IV antibiotics
2. administered IM or IV anticonvulsants
3. administered IM or IV uterotonic drugs
4. performed manual removal of the placenta
5. performed removal of retained products of conception (manual vacuum aspiration)
6. performed assisted vaginal delivery (with vacuum extractor or forceps)
7. performed neonatal resuscitation with a bag and mask.

To qualify as a Comprehensive EmONC (or CEmONC) facility, health centres and hospitals must have performed all seven basic services listed above, plus the following two additional signal functions, within the past 3 months:

1. blood transfusion
2. Caesarean section.

In order for these EmONC systems to work adequately, there must be effective coordination of the supplies of essential emergency drugs, medical and surgical supplies and equipment to every facility providing this care.

Essential drugs must include oxytocin, magnesium sulphate, misoprostol, antibiotics, antihypertensive drugs and tranexamic acid.
Essential supplies include sutures, intravenous cannulae, IV giving sets and urinary catheters.
Essential anaesthetic supplies include spinal needles, ephedrine and long-acting bupivacaine.
Essential equipment includes a portable ultrasound scanner, Caesarean section and laparotomy surgical kits, manual vacuum aspirators, vacuum delivery kits, forceps, self-inflating bag-and-mask ventilators for newborn resuscitation, and surgical head torches.

Section C2 Normal values for vital signs and information regarding safe treatment of pregnant patients

Normal vital signs

TABLE C2.1 Normal vital signs by age in pregnancy

	Heart rate (beats/minute)	Systolic blood pressure (mmHg)	Respiratory rate (breaths/minute)
In pregnancy	70–110*	95–135	15–20

*Heart rate in pregnancy increases by 10–15 bpm over the rate when not pregnant. WHO defines tachycardia as if > 110 bpm in pregnancy. Consider shock may be developing or present.

TABLE C2. 2 Normal heart rates when awake and asleep

Age group	Heart rate when awake (beats/minute)	Heart rate when asleep (beats/minute)
Non pregnant	55–90	50–90

TABLE C2.3 Normal systolic and diastolic blood pressures

	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)
In pregnancy	95–135*	60–85

*In pregnancy if systolic BP is < 90 mmHg consider shock may be present and if < 95 mmHg investigate for possible indicators of developing shock.

Do not base decisions to treat hypertension on the results of electronic sphygmomanometers, as they can be inaccurate. Always check with a hand-pumped machine.

Capillary refill time
The normal capillary refill time (CRT) is up to 3 seconds. It is important to be aware that in colder environments peripheral CRT is not a reliable test of perfusion.

Urine output
WHO recommendations are as follows:
Pregnant women: > 30 mL/hour or > 100 mL every 4 hours.

Normal core body temperatures
36.0–37.2°C (96.8 – 98.6°F).
To convert °C to °F multiply by 9, then divide by 5 then add 32.
To convert °F to °C deduct 32, then multiply by 5, then divide by 9.

Circulating blood volume
In pregnancy: 100 mL/kg. (In non pregnant women 70 ml/kg)

Normal values for laboratory measurements

Haematology

TABLE C2.4 Normal laboratory values for haemoglobin concentration

	Haemoglobin concentration (grams/dL)
In pregnancy	12.0–16.0

TABLE C2.5 Normal laboratory values for platelet count

Age group	Platelet count (× 10^9/litre)
In pregnancy	150–400

TABLE C2.6 Normal laboratory values for erythrocyte sedimentation rate (ESR), white blood cell count (WBC) and lymphocyte count

	ESR (mm/hour)
In Pregnancy	0–10
	WBC (× 10^9/litre)
In Pregnancy	4.5–11.0
	Median lymphocyte count (× 10^9/litre)
In Pregnancy	4.1–6.0

Chemistry

TABLE C2.7 Chemistry: normal laboratory values in pregnancy

Substance	Age	Normal range
Albumin (grams/litre)	Adult	40–53
Amylase (units/litre)	All ages	30–100
Bilirubin (conjugated) (µmol/litre)		0–3.4
Calcium (mmol/litre)		2.15–2.70
Creatinine (µmol/litre)		27–88
Glucose (mmol/litre)		3.3–5.5
Magnesium (mmol/litre)		0.60–0.95
Osmolarity (mosmol/litre)		276–295 (serum)
Potassium (mmol/litre)		3.5–5.5
Sodium (mmol/litre)		135–145
Urea (mmol/litre)		2.5–6.6

Oxygen saturation (SaO_2) in pregnancy
The normal range is 95–100%, although oxygen saturation depends on altitude, and corrections will be needed for those living more than 1000 metres above sea level.

The textbook lists the oxygen saturation levels measured in studies conducted at a range of different geographical locations above sea level.

Blood gases (normal arterial range)

In pregnancy:
- pH: 7.40–7.46
- pCO2: 3.7–4.2 kPa (28–32 mmHg)
- Standard bicarbonate: 18–21 mmol/L

Equivalent values for certain drugs used in an emergency
1 mg of prednisone or prednisolone is equivalent to 4 mg of hydrocortisone and 150 micrograms of dexamethasone or betamethasone.

Adrenaline (epinephrine) 1 in 1,000 contains 1000 micrograms in 1 mL.
Adrenaline (epinephrine) 1 in 10, 000 contains 100 micrograms in 1 mL.

Measurements of medical supplies
French gauge Fr = circumference of tube in mm.

Urinary catheters: in pregnancy from 14–16 Fr.
Nasogastric tubes: in pregnancy 16–20 Fr.

Fluid and electrolyte management

Normal requirements for fluid
The circulating blood volume in pregnancy is 100 mL/kg. Thus, initial expansion of vascular volume in a state of shock can be achieved with relatively small volumes of fluid. However, this volume is only a fraction of that required to correct dehydration, as the fluid has been lost from all body compartments in this condition. Clinically, dehydration is not detectable until more than 3–5% of the total body fluid has been lost.

It is important to remember that although fluid must be given quickly to correct loss of circulating fluid from the blood compartment (i.e. in shock, except in malnutrition) must be given carefully in dehydration

Fluid requirement can be divided into four types:
1. for replacement of insensible losses (through sweating, respiration, gastrointestinal loss, etc.)
2. for replacement of essential urine output (the minimal urine output to allow excretion of the products of metabolism, etc.)
3. extra fluid to maintain a modest state of diuresis
4. fluid to replace abnormal losses (e.g. blood loss, severe diarrhoea, diabetic polyuria losses, etc.).

A useful formula for calculating normal fluid requirement is provided in Table C2.9. It is simple, can be applied to all age ranges and is easily subdivided. The formula gives total fluid requirements – that is, types (1), (2) and (3) listed above.

TABLE C2.9 Calculating normal fluid requirements depending on body weight

Body weight	Volume of fluid (mL/24 hours)	Volume of fluid (mL/hour)	Na+ (mmol/ 24 hours/kg)	K+ (mmol/ 24 hours/kg)	Energy (kcal/ 24 hours)	Protein (grams/ 24 hours)
First 10 kg	100	4	2.0–4.0	1.5–2.5	110	3
Second 10 kg	50	2	1.0–2.0	0.5–1.5	75	1
Subsequent kg	20	1	0.5–1.0	0.2–0.7	30	0.75

For example:
a pregnant woman weighing 60 kg would require 1000 + 500 + 800 = 2300 mL per day.

In practice, the healthy patient only drinks when they are thirsty, but it is useful to have an idea of how much fluid a patient should be expected to need. Of course, if there are excess losses, as in diarrhoea or fever, or if the ambient temperature is especially high, leading to high insensible losses, more fluid is required. Except in cardiac or renal disease, a good way to check whether a pregnant woman is taking in enough fluid is to see whether they have a satisfactory urine output of at least 30 mL/hour.

Average fluid requirements in pregnancy are 1500– 2500 mL/day. This depends on levels of activity, ambient temperature and whether or not the mother has a fever.

Rehydration

Fluid deficit + normal fluid requirements + ongoing losses (sweat, diarrhoea, vomit, etc.).
Fluid deficit (mL) = percentage dehydration × weight (kg) × 10.
Ongoing losses:
- After each loose stool: 100–500 mL
- After each vomit: 2 mL/kg body weight.

Some useful information about biochemical measurements
- 1 ounce = 28 mL
- Percentage solution = number of grams in 100 mL (e.g. 10% dextrose = 10 grams in 100 mL).
- One millimole = molecular weight in milligrams.

Useful calculations:
30% NaCl = 5 mmol/mL each of Na+ and Cl–

0.9% NaCl = 0.154 mmol/mL each of Na+ and Cl–

15% KCl (15 grams/100 mL) = 2 mmol/mL each of K+ and Cl– (also called concentrated or strong KCl)

10% calcium gluconate (10 grams/100 mL) = 0.225 mmol/mL (note that 1 mL of calcium chloride 10% is equivalent to 3 mL of calcium gluconate 10%)

8.4% $NaHCO_3$ = 1 mmol Na+ and 1 mmol HCO_3 /mL

1 mL/hour of normal 0.9% saline = 3.7 mmol Na+ in 24 hours.
Serum osmolarity = 2(Na+ + K+) + glucose + urea (normally 285–295 mosmol/litre).

Normal requirements for electrolytes (unless there are excessive losses)
There are obligatory losses of electrolytes in stools, urine and sweat, and these require replacement. Any excess is excreted in the urine.

TABLE C2.10 Electrolyte content of body fluids

Fluid	Na+ (mmol/litre)	K+ (mmol/litre)	Cl– (mmol/litre)	HCO_3 (mmol/litre)
Plasma	135–145	3.5–5.5	98–108	20–28
Gastric fluid	20–80	5–20	100–150	0
Intestinal fluid	100–140	5–15	90–130	13–65
Diarrhoea	7–96	34–150	17–164	0–75
Sweat	< 40	6–15	< 40	0–10

TABLE C2.11 Normal water and electrolyte requirements in pregnancy

Maintenance requirements/24 hours	Volume of fluid (mL/day)	Sodium requirement (mmol/ day)	Potassium requirement (mmol/day)
	1500–2500	150	100

Commonly available crystalloid and colloid fluids

TABLE C2.12 Commonly available crystalloid fluids

Fluid	Na+ (mmol/litre)	K+ (mmol/litre)	Cl– (mmol/litre)	Energy (kcal/ litre)
Isotonic crystalloid fluids				
Saline 0.9% (normal)	150	0	150	0
Glucose 5% (50 mg/mL)	0	0	0	200
Hartmann's solution or Ringer-lactate solution*	131	5	111	0
Hypertonic crystalloid fluids				
Saline 0.45%, glucose 5%	75	0	75	200
Glucose 10% (100 mg/mL)	0	0	0	400
Glucose 50%	0	0	0	2,000

*Hartmann's or Ringer-lactate solution also contains HCO3- as lactate 29 mmol/litre and calcium 2 mmol/litre.

To make **10% glucose/dextrose solution in Ringer-lactate/ Hartmann's or 0.9% saline,** remove 100 mL from a 500 mL bag and inject into it in a sterile manner 100 mL of 50% dextrose/glucose.

To make **5% glucose/dextrose solution in Ringer- lactate/Hartmann's or 0.9% saline,** remove 50 mL from a 500 mL bag and inject into it in a sterile manner 50 mL of 50% dextrose/glucose.

To make a 10% solution of glucose for injection in treating hypoglycaemia and if there is only 50% dextrose/ glucose solution available:

- either dilute 10 mL of the 50% solution in 40 mL of sterile water
- OR add 10 mL of 50% dextrose to 90 mL of 5% glucose which will give an approximate 10% glucose solution.

TABLE C2.13 Commonly available colloid fluids

Colloid	Na+ (mmol/litre)	K+ (mmol/litre)	Ca2+ (mmol/litre)	Duration of action (hours)	Comments
Albumin 4.5%	150	1	0	6	Protein buffers
Gelofusine	154	< 1	< 1	3	Gelatine
Haemaccel	145	5	12.5	3	Gelatine
Pentastarch	154	0	0	7	Hydroxyethyl starch

Drop factor for IV infusions

Fluids can be calculated in drops/minute as follows. First identify from the IV giving set what the 'drop factor' is (for standard giving sets this may be 10, 15 or 20 drops = 1 mL). For micro-drop systems, which often accompany giving sets with burettes, 1 mL = 60 drops. When setting the infusion rate with the flow controller on the giving set below the chamber where the drops occur, always set and count the rate over a full minute.

Calculating drip rates for a standard giving set with a drop factor of 20 drops/mL

- One mL = 20 drops in standard giving set.
- Number of drops/minute = mL/hour with a standard giving set divided by 3.

With a micro-dropper infusion giving set with a drop factor of 60 drops/mL, 1 mL = 60 micro-drops.

Measuring neurological state

A = ALERT
V = responds to VOICE
P = responds to PAIN = Glasgow Coma Scale score of ≤ 8.
U = UNRESPONSIVE

Hypoglycaemia: definition and blood glucose conversion

Hypoglycaemia is defined as a blood glucose concentration of < 2.5 mmol/litre or < 45 mg/dL.

1 mmol/litre = 19 mg/dL of glucose

Section C3. Prevention of hospital infection

Introduction

Nosocomial or hospital-acquired infection is a major problem not only in terms of cost but also, more importantly, because it increases morbidity and mortality in patients. Such infections may affect up to 10% of all patients. Nosocomial infection requires a source of microorganisms and a chain of transmission. It is essential that all healthcare staff examine their own practice to ensure that they are not part of this chain of transmission.

The combination of the use of powerful antibiotics and poor hygiene also predisposes to the development of antibiotic-resistant microorganisms, which are difficult both to eradicate from the environment and to treat.

Pregnant women are at high risk of infection. However, not all infections are related to their particular disease process, but rather they may be caused by failure of both hospital management and individual healthcare workers to introduce and adhere to strict infection control policies.

Requirements and procedures

The following measures are essential in order to minimise the risks of infection and cross-infection.

A clean and adequate water supply

Just as water and sanitation are of central importance in the prevention of cross-infection in emergency refugee camps, they are also of vital importance in hospitals, particularly where there are vulnerable patients. Running water (both hot and cold) is preferable. Hot water should be stored at 65°C, distributed at 60°C, and the temperature then reduced to 43°C to be used from the taps. This process helps to ensure that water-borne infections such as Legionnaire's disease are not passed on to staff or patients and reduces the risk of burns for staff.

Accessible sinks in all areas

These should preferably be equipped with elbow-operated taps, and there should be adequate washing and toilet facilities for staff and patients.

Effective cleaning policies

The whole of the hospital, including the grounds, should be kept clean. Entrances should screen visitors' shoes for dirt, and corridors need to be cleaned at least twice a day with a disinfectant (see below). Ward areas, floors, window-sills, light fittings and curtains need to be kept clean, but the priority is the

adequacy and cleanliness of the toilets and bathrooms. These should be kept hygienic by frequent cleaning and disinfection. Staff appointed as cleaners should be given adequate status and salaries to reflect the importance of the work they are doing, as well as training in how to keep the hospital clean and why this is so important.

Effective services for disposal of human and other waste

Human and other waste should be disposed of and collected separately. Foot-operated bins are preferable, and frequent rubbish collections are essential. Ideally the hospital should have its own incinerator.

Laundry service

All bedding, towels, flannels and curtains must be regularly washed with a detergent and disinfectant. Industrial washing machines are essential.

Strict hand-washing policies

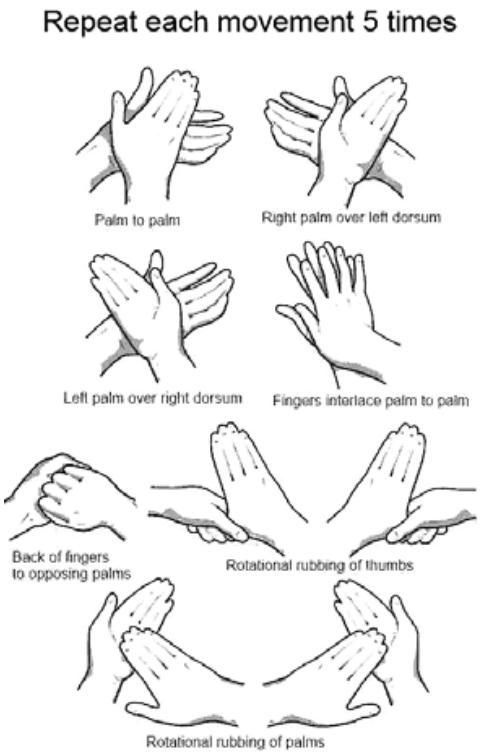
Viruses and bacteria can survive on the hands for 2 to 3 hours. **Correct hand-washing** technique for all staff, visitors and patients is the most important factor in the prevention **of cross-infection.** It is easily taught, and frequently an improvement in practice is demonstrated in the short term. However, when examined over a longer period of time, old habits and short cuts reappear.

Good hand-washing techniques are dependent on adequate supplies of clean water, ideally elbow-operated taps, a liquid soap supply and an effective method of hand drying (*see* Figure C3.1). Where it is impossible to provide liquid soap and paper towels, some ingenious solutions have been attempted. Bar soap suspended in a net bag over the sink area and individual cloth towels for each patient, changed every 24 hours or at the discharge of the patient and kept within their bed space, can be effective. Added emollient protects the hands. Antiseptics can be added to liquid soap to improve antimicrobial activity, and chlorhexidine is a cheap and effective antiseptic that is widely available throughout the world. However, there is no good evidence that this increases the effectiveness of hand washing substantially. Antiseptics should be used before invasive procedures and where there is heavy soiling with potentially contaminated body fluids or other human waste. Povidone iodine should be reserved for use as a surgical scrub.

When running water is not available or hand washing is difficult, a 70% alcohol gel is useful. This is a new but fairly expensive product that has a significant part to play in the prevention of introduction of cross-infection in high-risk areas. When rubbed on and allowed to dry, it is effective in disinfecting the hands. After initial conventional hand washing it can be used between each patient contact, but further hand washing is still recommended after every five to six rubs.

All of the above-mentioned items may be regarded as a considerable extra cost for a health service but are cost saving when balanced against an increased length of hospital stay due to infection, the additional medications required and sometimes unnecessary deaths caused.

All staff should have a personal responsibility for hygiene, but every ward should also identify an individual (ideally a nurse with the support of a microbiologist, if available) to be responsible for the education of all staff in techniques that will prevent the spread of infection, particularly effective hand washing and drying. This education programme will need to be ongoing, as even in the best centres these programmes are only effective for relatively short periods of time. The organisation needs to support the identified staff member in reinforcing that all grades and members of staff have responsibility for their practice (especially doctors and obstetric clinicians who should act as role models). In addition, it needs to become the norm for this identified staff member, no matter how junior they are, to be recognised as the expert in their unit, and anyone who is asked to carry out hand washing must immediately and without argument comply with this request.



FigureC 3.1 *Effective hand washing.*

Disposal of body fluids

Each ward or unit must have an area set aside for this purpose. It, and all the equipment that it contains, must be kept scrupulously clean and body fluids disposed of quickly, with any spillage removed immediately. If there is likely to be a risk of body fluids being contaminated with life-threatening organisms, additional precautions should be taken. After hand washing, disposable clean gloves should be used by all staff and family members who will be assisting with the toileting of patients.

Care must be taken with sharp objects such as hypodermic needles, in order to protect the patient, their family, other unit visitors and staff.

Cleaning, disinfection and sterilisation of equipment and furniture

The manufacturer's instructions for individual items of equipment must always be followed. These will usually clearly state which items need to be sterilised and where disinfection will be sufficient. They will also indicate appropriate dilutions for disinfectants. All equipment should be cleaned before being sterilised or disinfected.

Sterilisation

This is the complete elimination and destruction of all forms of microbial life. This is frequently achieved by steam under pressure, dry heat, gas or liquid chemicals. Such a sterilisation system must be available in every ward where invasive procedures are undertaken, and such systems are also required for instruments and towels used in the operating theatre.

Disinfection

This is a process that eliminates the majority of microorganisms, with the exception of the most resistant endospores. It is usually accomplished using liquid chemicals called disinfectants. Hypochlorites are inexpensive and effective disinfectants. They are active against most microorganisms, including HIV and hepatitis B. However, they do have a corrosive effect on metals, and if used on fabric or carpet can bleach out colours. Hypochlorites in a diluted form (usually 0.1% solution) for domestic use are contained in household cleaners available worldwide. These household cleaners can be used in the hospital environment for general cleaning, but stronger solutions (0.5% chlorine solution) must also be available, particularly for the disposal of body fluids, for initial cleaning of bloodstained instruments, and following outbreaks of notifiable infections. A 0.5–1% solution is recommended for the treatment of blood and body fluid spills, and 0.05–0.1% solution can be used for all surfaces. Hypochlorites are available as tablets, which makes the process of dilution easier.

How to prepare high-level disinfectant solutions

The best compound for the preparation of chlorine solutions for disinfection is household bleach (also known by other names such as Chlorox® and Eau de Javel). Household bleach is a solution of sodium hypochlorite which generally contains 5% (50 g/litre or 50 000 ppm) available chlorine.

Thick bleach solutions should never be used for disinfection purposes (other than in toilet bowls), as they contain potentially poisonous additives.

When preparing chlorine solutions for use, the following points should be noted:

1. Chlorine solutions gradually lose strength, and freshly diluted solutions must therefore be prepared daily.
2. Clear water should be used, because organic matter destroys chlorine.
3. A 1:10 bleach solution (0.5%) is caustic. Avoid direct contact with the skin and eyes.
4. Bleach solutions give off chlorine gas, so must be prepared in a well-ventilated area.
5. Use plastic containers for mixing and storing bleach solutions, as metal containers are corroded rapidly and also affect the bleach.

Two different dilutions of bleach are used for disinfection. 1:10 bleach solution (containing 0.5% chlorine) is a strong disinfectant, which is used to disinfect the following:

- excreta
- bodies
- spills of blood or body fluids
- medical equipment (e.g. delivery sets, kidney dishes, suture instruments, catheters, speculum).

To prepare a 1:10 bleach solution, add one volume (e.g. 1 litre) of household bleach to nine volumes (e.g. 9 litres) of clean water.

Always wear gloves.

Immediately after delivery or examination, clean the instruments below the level of solution in the plastic bucket using a brush. Leave for 10 minutes and then place them in soapy water, wash with a brush, and flush every catheter with a 10–20 mL syringe. Next rinse with clean water and air dry, and then sterilise or boil for 20–30 minutes. Store dry in a metal bowl.

Change the solution after 24 hours or when it becomes bloodstained.

Label buckets with tape indicating the date and time when the solution was prepared and when it needs to be changed.

The above 0.5% solution can also be used to prepare 1:100 bleach solution (containing 0.05% chlorine)
This is used for the following:

- disinfecting surfaces
- disinfecting bedding
- disinfecting reusable protective clothing before it is laundered
- rinsing gloves between contact with different patients (if new gloves are not available)
- rinsing gloves, aprons and boots before leaving a patient's room
- disinfecting contaminated waste before disposal.

To prepare 1:100 bleach solution, add one volume (e.g. 1 litre) of 1:10 (0.5%) bleach solution to nine volumes (e.g. 9 litres) of clean water.

Note that 1:100 bleach solution can also be prepared directly from household bleach by adding 1 volume of household bleach to 99 volumes of clean water (e.g. 100 mL of bleach to 9.9 litres of clean water) but making it up from 1:10 bleach solution is easier.

Cleaning

This is often the most neglected of the three processes, and it must precede sterilisation and disinfection. When undertaken using a disinfectant detergent, cleaning alone will effectively reduce the number of microorganisms and make safe those items that come into contact with the intact skin (e.g. blood pressure cuffs, bed rails, intravenous poles).

Isolation of patients with specific infections

For isolation procedures to be effective they need to be instituted early. Two or more patients with the same infection can be isolated together. Different isolation techniques will be needed, and the use of gowns, gloves and masks will be necessary if the infection is very contagious and/or very serious. In some cases, nursing the patient in a cubicle or single room until medical tests are complete is all that is necessary. When there is a need for Personal Protective Equipment (PPE); gowns, gloves, face shields, goggles and masks, these will require frequent changing or washing to ensure their efficacy and must be used by everyone who comes into contact with the patient, including medical staff and carers. Ideally, they should be used only once and then removed and discarded or sent for laundering on leaving the isolation area. An area will need to be set aside for changing, with supplies of gowns, gloves, aprons and masks. Gowns made of cotton material will need to be worn with plastic aprons.

Infection control measures following the death of a patient

When a patient dies, the amount of time that family members are able to spend with them will vary according to the facilities that are available. Rituals and beliefs concerning the death of an individual, and the management of the body, usually involve religious or cultural observance. There are many beliefs surrounding the distinction between physical and spiritual life, in particular the belief that something of the individual survives death, either to be reborn through reincarnation or to fulfil their spiritual destiny in the afterlife. It is important that the correct funerary procedures, if any, are followed in order to ensure that the bereaved are not distressed by any omission which they consider important.

All societies, whether religious or not, have to deal with the problem of the death of their patients and the bereavement of parents and other close family members. Like other transitions in an individual's life, death is usually marked by a rite of passage in which central values are restated and important social bonds re-emphasised. Precise customs vary in different religions and traditions, but common features include the washing and laying out of the corpse (which may be embalmed), and the wake, or watching over the dead body. These customs may need to be modified to prevent the spread of infection to other members of the community, or because of the need to perform post-mortem examinations to establish an exact cause of death. Effective hand-washing procedures remain of paramount importance.

In countries where the climate is characterised by extremes of temperature, refrigeration of dead bodies until they can be returned to the family is essential. Each hospital should have a mortuary building adjacent to, but separate from, the hospital. To prevent the spread of infection, staff working in the mortuary will need to be

provided with separate clothing for use in that department. The use of two pairs of gloves, or thick rubber gloves and protective clothing, will be necessary for the post-mortem examination if there is suspected infection of the body with life-threatening bacteria or viruses.

The mortuary department will need to have facilities for families to see and spend time with their dead relative, and a separate comfortable area where documentation can be completed and any necessary interviews with local government officials can be conducted. The mortuary department not only provides facilities for post-mortem examination, but also, in large centres, it can be part of the government facilities for forensic post-mortems, which may provide additional resources for the hospital. Having these centres within a hospital may improve services for families, but care needs to be taken that there is a culture of openness that involves families in the consent procedures for all examinations performed after the patient's death.

Conclusion

Each member of the hospital has a role to play in the prevention of hospital-acquired infections. The greatest responsibility lies with the healthcare professionals, particularly midwives, obstetric clinicians, nurses and doctors, who in the hospital setting are in contact with patients and their families 24 hours a day, and because of this are the main perpetrators of cross-infection. However, they can also demonstrate good practice by, for example, being the catalysts for change, and improving the education of other hospital staff and families.

Section C4 Triage for women who are or who may be pregnant: seeing the sickest first

Introduction

The word 'triage' comes from the French word 'trier' (meaning 'to sort'). It is the process by which patients presenting to a health facility with an illness or injury are assigned a clinical priority. It is an essential step in clinical risk management, as it means that, if done correctly, those patients who are most in need of care receive it first. Triage should have a robust mechanism to ensure that patients at imminent risk of death or who are seriously ill or injured, requiring immediate resuscitation or emergency management, are provided with treatment before patients with conditions that are less critical, who can wait for further assessment and treatment.

The models of decision making, of which there are many, require three steps:

1 rapid initial assessment
2 determination of the appropriate categories
3 selection of the most appropriate category.

Triage involves **determining the priority of a patient's treatment based on the severity of their condition, not on when they arrived or their place in a queue.** Triage divides patients into the following three categories:

1. those who are at imminent risk of death, and require immediate resuscitation
2. those who are seriously ill or injured, and who need timely emergency management
3. those who have conditions which can wait before further assessment and possible treatment.

Of course, it is not always immediately apparent which category a patient is in, so most methodologies are based on a rapid physiological assessment of vital functions (presence of uncontrolled bleeding (C), airway (A), breathing (B), circulatory status (C) and conscious level (D)).

Rapid initial assessment

When a woman is or might be pregnant presents to a health facility she is of immediate concern and should be given priority through triage without disadvantaging seriously affected other people This process requires the ability to recognise first, those patients who need resuscitation **(immediate management, group 1, 'red'**), and secondly, those who need **urgent treatment (group 2, 'orange')** (*see* Table C41). This process must take only a few seconds, as any delay can be fatal.

Table C4.1 A triage scale

Triage number	*Type of action*	*Colour*	*Maximum target time to action (minutes)*
Category 1	Immediate	**Red**	0
Category 2	Urgent	**Orange**	15
Category 3	Non-urgent	**Green**	60 (1 hour)

From the moment of arrival at the health facility (some information may be given before arrival, by contact between the ambulance crew and the facility), a decision on those who need resuscitation must be made. The decision making is based on the clinical signs listed in the second column of Table C4.2.

Once a triage category has been identified, the patient should have observations of respiration rate and characteristics (e.g. wheeze, stridor, recession), pulse rate/volume, blood pressure, temperature and a rapid measure of conscious level, such as AVPU score (Alert, responds to Voice, responds to Pain, Unconscious; *see* Section C9), measured and recorded.

Table C4.2 Clinical signs on simple observation or from history which indicate the need for immediate resuscitation in pregnancy (CABC)

Underlying mechanism	What does the healthcare worker undertaking triage see in the patient or hear from the relatives?
C Uncontrolled bleeding	Obvious heavy bleeding from the vagina or from other sites in the body
A problem that is obstructing, or might obstruct, the upper airway A: AIRWAY	The patient is unconscious The patient is fitting or has been fitting There is major trauma to the face or head, including burns There is severe stridor or gurgling in the throat

Underlying mechanism	What does the healthcare worker undertaking triage see in the patient or hear from the relatives?
Any problem producing apnoea, severe respiratory distress or cyanosis B: BREATHING	The patient is not breathing The patient is gasping The patient is cyanosed The patient is having so much difficulty breathing that they cannot speak
Any problem producing cardiac arrest, shock or heart failure C: CIRCULATION	The patient has heavy vaginal bleeding The patient has suffered major trauma The patient appears shocked (very pale/white, cannot sit up, has a reduced conscious level)

Table C4.3 Clinical signs on simple observation or from the history in pregnancy which indicate the need for urgent management but not resuscitation

Underlying mechanism	*What does the healthcare worker undertaking triage see or hear from the patient or the relatives?*
A problem that might obstruct the upper airway in the future A: AIRWAY	There is trauma to the face or head, or burns to this area, but the patient is conscious and able to speak Ingestion or accidental overdose of drugs that may alter the conscious level?
A problem producing respiratory difficulty B: BREATHING	The patient has difficulty breathing but can speak, and there is no cyanosis
Any problem that might, unless rapidly treated, lead to shock or heart failure C: CIRCULATION	The patient has vaginal bleeding which is heavy*, but is not yet shocked (they are able to stand or sit up and speak normally) The patient has suffered major trauma and is not yet shocked, but may have internal bleeding (they are able to stand or sit up and speak normally) Any burns covering more than 10% of the body The patient has fainted and has abdominal pain (this includes possible ruptured ectopic

Underlying mechanism	*What does the healthcare worker undertaking triage see or hear from the patient or the relatives?*
	pregnancy) but they are now able to stand or sit up and speak normally The patient has passed products of conception and is still bleeding, but is not shocked (they are able to stand or sit up and speak normally) The patient has severe abdominal pain, but is not shocked (they are able to stand or sit up and speak normally) The patient is extremely pale, but is not shocked (severe anaemia) (they are able to stand or sit up and speak normally)
Possible severe pre-eclampsia and impending eclampsia	The patient is complaining of a headache and/or visual disturbance
Severe dehydration	The patient is complaining of severe diarrhoea/vomiting and is feeling very weak, but is not shocked (they are able to stand or sit up and speak normally)
Possible complication of pregnancy	The patient has abdominal pain not due to the uterine contractions of normal labour
Possible premature labour	The patient is not yet due to deliver, but has had ruptured membranes (with or without contractions)
Infection that might become dangerous	The patient has a high fever > 38°C (they are hot to touch or shivering, but are able to stand or sit up and speak normally)
Possible intrauterine death	After 24 weeks of pregnancy the patient has not felt fetal movements for 24 hours or more
Prolapsed cord	The patient says that her membranes have ruptured and she can feel the umbilical cord

*Heavy bleeding is defined as a clean pad or cloth becoming soaked within less than 5 minutes.

***Note that a low blood pressure in pregnancy is a late and dangerous sign**.*

Helping to ensure that triage works well

The following actions will help to prevent life-threatening delays:

1. Train all staff (including clerks, guards, door keepers and switchboard operators) to recognise those who need resuscitation.
2. Practice triage and the structured approach to emergencies with all staff in the facility.
3. Ensure that access to care is never blocked. Emergency equipment must always be available (not locked away) and in working order. This requires daily checks and the keeping of logbooks. Essential emergency drugs must be constantly available.
4. Give proper training of appropriate staff in the use of the equipment and drugs required.
5. A special trolley containing equipment and drugs for emergencies must be available at all times.
6. Protocols on the structured approach to emergencies (see below) must be available. Pathways of emergency care should be prominently displayed on the walls in areas where emergencies are managed.
7. Implement systems by which patients with emergencies can be exempted from payment, at least temporarily. These include local insurance schemes and health committee emergency funds. This exemption must be made known to all gatekeepers and security staff.

Special priority signs

Haemorrhage

Category 1 patients (red) are those who are exsanguinating.

A haemorrhage that is not rapidly controlled by the application of sustained direct pressure, and which continues to bleed heavily or soak through large dressings quickly, should also be treated immediately (Category 1, red).

Conscious level

Category 1 or immediate priority (red) includes all unconscious patients (U or P on the AVPU scale).

In patients with a history of unconsciousness or fitting, further dangerous events are possible. Those who respond to voice are allocated to Category 2 urgent (orange).

Pain

Patients with severe pain should be allocated to Category 1 immediate (red), and those with any lesser degree of pain should be allocated to Category 2 urgent (orange).

For patients who have sustained **significant trauma or other surgical problems,** anaesthetic and surgical help is required **urgently.**

If there is an **urgent referral** from another healthcare facility or organisation, the patient must be seen **immediately** or **urgently**, depending on the circumstances.

Importance of regular reassessment

Triage categories may change as the patient deteriorates or gets better. To achieve this, all clinicians involved in the pathway of care should rapidly assess priority whenever they encounter the patient. Changes in priority must be noted, and the appropriate actions taken.

All patients with symptoms or signs in the **immediate (red)** or **urgent (orange)** categories represent emergencies or potential emergencies and need to undergo the structured approach to emergencies as outlined in Section C8.

Non-urgent cases

Proceed with assessment and further treatment according to the patient's needs once the immediate and urgent patients have been stabilised.

Section C5 Safe blood transfusion

Introduction

Blood or blood products should be transfused only when needed to save life or to prevent major morbidity.

- The risk of transmission of infection is a major concern in countries with limited resources and poorly organised blood transfusion services.
- Blood must be stored safely, or a bank of adequately screened donors must be available 24 hours a day, especially for obstetric emergencies or major trauma.
- In emergency situations, relatives accompanying patients are often asked to donate blood if compatible. Unlike stored blood it is warm and contains active clotting factors.
- When giving a blood transfusion, care must be taken to ensure that the blood is compatible with that of the recipient, is infection free and the transfusion is monitored by someone who is able to recognize any adverse reactions.

Clinical situations that require blood transfusion

The WHO defines anaemia as any Hb level below 110 g/L. However, in pregnancy, normal haemodilution means that a cut-off value of less than 10 g/dL is more appropriate. In a pregnant woman, transfusion may be considered at an Hb level of 60–70 g/L. However, Hb concentration should not be the only factor when deciding to transfuse. In addition to Hb level, the following factors must be taken into account:

1. Heart rate. If it is rapid, this will support the decision to transfuse.
2. Respiration rate. If it is rapid, this will support the decision to transfuse.
3. Is the patient already in circulatory collapse (shock) due to bleeding or is there visible massive haemorrhage? If so **the need for transfusion is very urgent**.

- Some patients will not show any of these features, and it might then be justifiable to use haematinics (i.e. iron and folic acid). Some patients may show the above features and have an Hb level higher than 50 g/L. It will also be necessary to transfuse patients if their symptoms are caused, or significantly worsened, by anaemia (e.g. heart failure).
- When possible, provide malaria prophylaxis, particularly in pregnant women. Early treatment of clinical malaria reduces the profound haemolysis that is a major reason for transfusion in endemic areas. Anaemia due to malaria responds to treatment with antimalarial drugs and folic acid.

- Blood transfusion is not required for sickle-cell disease in the steady state. It may be indicated in severe anaemia with incipient or established cardiac failure, acute splenic enlargement, sequestration crisis with rapidly falling haemoglobin levels, aplastic crisis, acute chest syndrome, stroke, and sometimes as exchange transfusion for severe priapism (*see* Section NN on sickle-cell disease).
- National programmes for thalassaemia and other congenital haemolytic disorders, such as glucose-6- phosphate dehydrogenase deficiency, help to reduce transfusion requirements.

In situations where blood transfusion is safe and available, recommendations for its use are as follows.

Red-cell-free components

- Fresh frozen plasma (FFP) is only recommended when a specific blood clotting defect has been identified. In the absence of specific testing, consider administering FFP to a patient with signs of disseminated intravascular coagulation who is acutely unwell, as it may be lifesaving.
- Freeze-dried plasma is available, and its advantages include a long shelf life and the lack of need for refrigeration.
- Platelets are prepared from fresh blood using a special, simple centrifugation method, and the remaining blood can be given back to the donor. Once extracted by this method, platelets can last for up to 5 days at room temperature (around 23°C). Platelets should not be stored in a refrigerator. Transfused platelets survive only briefly in the body, and repeated infusion may be required for active bleeding, or before essential procedures such as a lumbar puncture.

Blood donation and provision

Safe transfusion is enhanced by the following measures: collection of blood from repeat regular donors screened using a standard health-check questionnaire, and who are free from transfusion-transmissible infection.

Establish a routine procedure for collection, testing and processing which should cover routine and emergency transfusions.

Pre-transfusion testing

Minimum acceptable tests on blood prior to transfusion

1. ABO and Rhesus D grouping.
2. Screening for hepatitis B antigen, antibodies to HIV-1 and -2, hepatitis C virus antigen and syphilis.
3. Additional tests for locally prevalent infections, such as malaria and Chagas disease.

- 0.1–0.2 mL blood in an EDTA bottle is required for grouping, and 2 mL of clotted blood in a plain bottle for compatibility testing.

- The inclusion of control A, B, O, RhD-positive and RhD-negative cells in the procedure is part of good laboratory practice and should be part of the testing method.
- If possible, two methods should be used for grouping, to ensure reliability
- The most suitable method for compatibility is the anti-human globulin technique at 37°C for 1 hour. Agglutination should be read before and after the addition of the anti- human globulin reagent.

Blood groups

There are four major blood groups: A, B, AB and O. To avoid ABO incompatibility, the blood group of both the donor and the receiver must be known. Blood can only be donated in the direction of the arrows shown in Figure C5.1.

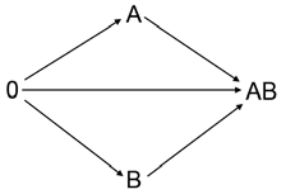


Figure C5.1 *Safe transfusion of ABO blood groups.*

For ABO typing:

- Donors with blood group O can donate to patients (receivers) with blood group A, B, AB or O.
- Donors with blood group A can donate to patients with blood group A or AB.
- Donors with blood group B can donate to patients with blood group B or AB.
- Donors with blood group AB can donate only to patients with blood group AB.
- Blood group O is known as the universal donor that is they can donate to people with any blood group
- Blood group AB is known as the universal recipient and can receive blood from people with any blood group

For Rhesus typing

Blood is also categorised according to its rhesus status. Therefore:

- Rhesus-negative donors can give to Rhesus-positive and Rhesus-negative women
- Rhesus-positive donors can only give to Rhesus-positive women

If the blood group is unknown and blood is required before a cross-match can be performed, give O-Rhesus-negative blood if this is available.

Bedside transfusion

- Venous access with a large cannula is needed in pregnant women.
- A pregnant mother's body contains 100ml of blood for every kg of body weight
- Blood is usually cleaned and filtered in the lab, so when transfusing it to a patient the only filter that needs to be used is the usual on-line filter in a standard giving set (170 – 200 microns).
- Blood should be given using an accurate measurement of rate and time. **Close observation of the patient is needed during transfusion, especially in the first 15-30 minutes in case of transfusion reactions.**

ALWAYS CHECK THE SUITABILITY OF THE IV GIVING SET FOR GIVING A BLOOD TRANSFUSION.

Blood transfusion for severe anaemia where there is heart failure

1. Give a high concentration of oxygen, bed rest and sit the patient upright (with lateral tilt as well if she is more than 20 weeks pregnant).
2. Consider transfusion with packed cells if the haemoglobin concentration is less than 5.0 g/dL (with IV furosemide of 40 mg for each unit of packed cells). If blood cannot be centrifuged, let the bag hang until the cells have settled. Infuse the cells slowly and dispose of the remaining serum (*see* Section 1.7 on blood transfusion).
3. Partial exchange transfusion may be helpful. Use a cannula in a large vein in the antecubital fossa, withdraw 20 mL of the patient's anaemic blood and infuse 40 mL of new blood (ideally packed red blood cells) over 5 minutes and repeat 5–10 times.

Blood transfusion reactions

Blood transfusion can be lifesaving and provides great clinical benefit to many patients, but, like any treatment potential benefit should outweigh risks, which include the following:

- immunological complications
- errors and 'wrong blood' episodes
- infections (bacterial and viral).

Causes of acute complications of transfusion

1. Acute haemolytic transfusion reaction

- Due to ABO incompatibility. The patient has anti-A or anti-B antibodies that destroy incompatible infused red blood cells This may lead to disseminated intra- vascular coagulation (DIC) and acute renal failure.

- Infusion of ABO-incompatible blood is almost always a result of errors in labelling sample tubes and/or request forms, or inadequate checks at the time of transfusion. When red cells are mistakenly administered, there is about a 1 in 3 risk of ABO incompatibility and a 10% risk of mortality, with the most severe reaction seen in a group O individual receiving group A red cells.
- Non-ABO red cell antibody haemolytic reactions tend to be less severe.

Management

1. Stop blood, replace giving set, and keep IV open with 0.9% saline
2. Insert bladder catheter and monitor urine output
3. Give fluids to maintain urine output >30ml per hour
4. If urine output <30 ml per hour despite fluid challenges, give frusemide
5. If no diuresis following frusemide, give mannitol 20% 100ml.
6. Check compatibility label of blood corresponds with patient ID
7. Inform lab staff of reaction
8. Take blood for blood cultures – alternative diagnosis may be an infected blood unit.

2. Infective shock

- Bacterial contamination of blood can be fatal.
- Rapid onset of sepsis tachycardia, low pulse pressure, hypotension, rigors and collapse follows the transfusion.
- Usually occurs during transfusion of first 100ml of blood

Management

- Stop transfusion and change giving set
- Treat sepsis. Give IV fluids and IV antibiotics – eg cephalosporin plus gentamicin

3. Transfusion-related acute lung injury (TRALI)

- TRALI is a form of acute respiratory distress due to donor plasma containing antibodies against the patient's leucocytes. The donor is usually a multiparous woman.
- During, or soon after infusion, a non-productive cough, breathlessness, hypoxia and frothy sputum develops. Fever and rigors may be present.
- Chest X-ray if available shows multiple perihilar nodules with infiltration of the lower lung fields.

Management

- High flow oxygen
- Diuretics worsen the situation

4. Fluid overload

- This occurs when too much fluid is transfused or it is transfused too quickly, leading to pulmonary oedema and acute respiratory failure.

- Patients at particularly high risk are those with severe or chronic anaemia, or severe malnutrition and who have symptoms of cardiac failure or normal blood volumes (i.e. who are not bleeding) prior to transfusion.

Patients at risk should receive packed cells rather than whole blood via slow transfusion, with diuretics if required.

Hypoxia, tachypnea are signs of pulmonary oedema

Management (see Section B1)

- Sit patient upright
- Do not give any more IV fluid until fluid overload has gone
- Give Furosemide
- Consider GTN and low dose morphine

5.Non-haemolytic febrile reactions to transfusion of platelets and red cells

- Fevers (more than 1.5°C above baseline) and rigors may develop during transfusion due to the patient's antibodies to transfused white cells.
- This type of reaction affects 1–2% of patients.
- Multiparous women and those who have received multiple previous transfusions are most at risk. Reactions are unpleasant but not life-threatening. Usually symptoms develop towards the end of a transfusion or in the subsequent 2 hours.

Management

- Most febrile reactions can be managed by slowing or stopping the transfusion and giving paracetamol.

6. Severe allergic reaction or anaphylaxis

Allergic reactions occur when patients have antibodies that react with proteins in transfused blood components. Anaphylaxis occurs when an individual has previously been sensitised to an allergen present in the blood, and subsequently, on re-exposure, releases immunoglobulin E (IgE) or IgG antibodies.

Anaphylaxis

Presentation

Symptoms or signs may occur after only 5–10 mL of transfusion of incompatible blood, so **patients should be observed very closely at the start of each blood unit transfused**.

Symptoms

These include chest pain, abdominal pain, nausea and shortness of breath

Signs

These include the following:

- fever (a rise in temperature of 1.5°C or more) and rigors
- urticaria
- hypotension or hypertension
- tachycardia
- flushing and swelling of the face
- respiratory distress including wheeze or stridor
- oozing from wounds or puncture sites
- haemoglobinaemia
- haemoglobinuria.

For treatment of anaphylaxis, *see* Section B3

7. Mild Allergic reactions

Allergic reactions occur when patients have antibodies that react with proteins in transfused blood components.

Investigations and management of an acute transfusion reaction

Management

1. Where the only feature is a rise in temperature of less than 1.5°C from baseline, or urticaria, recheck that the correct blood is being transfused, give paracetamol and antihistamine, reset the transfusion at a slower rate and observe the patient more frequently.
2. Although fever or rigors are not uncommon in response to a transfusion and may represent a non-haemolytic febrile reaction, they may also be the first sign of a severe adverse reaction.
3. Where the reaction is more severe:
   - Stop the transfusion and call a doctor urgently to review the patient.
   - Vital signs (temperature, blood pressure, pulse, respiratory rate and oxygen saturation levels) and respiratory status (dyspnoea, tachypnoea, wheeze and cyanosis) should be checked and recorded. Look for signs of heart failure (basal lung crepitations and enlarged liver).
   - Check the patient's identity and recheck against details on the blood unit and compatibility label or tag.
4. Initial management if ABO incompatibility is suspected is as follows:
   - Take down the blood bag and the giving set with blood in it.
   - Keep the IV line open with Ringer-lactate or Hartmann's solution.
   - Give oxygen and fluid support.
   - Monitor urine output, usually following catheterisation, and maintain it at more > 30 mL/hour in pregnancy, giving Furosemide if it falls below this.
   - Consider inotropic support if hypotension is prolonged.
   - Treat DIC by giving fresh new blood fully matched to the recipient.

- Inform the hospital transfusion department immediately.

5. If another haemolytic reaction or bacterial infection of blood unit is suspected:
   - Send haematological and microbiological samples for investigations outlined above.
   - General supportive management is as for ABO incompatibility.
   - Start broad-spectrum IV antibiotics if bacterial infection is considered likely.
6. If anaphylaxis or severe allergic reaction is suspected:
   Follow the anaphylaxis protocols for pregnant women see Section B3
7. If TRALI is suspected:
   - Give high-concentration oxygen, IV fluids and inotropes (as for acute respiratory distress syndrome).
   - Assisted ventilation may be urgently required; discuss this with an anaesthetist.

TRALI improves within 2–4 days in over 80% of cases if there is adequate management and respiratory support.

8. If fluid overload is suspected:
   - Give IV furosemide and a high concentration of oxygen.

Delayed complications of transfusion

Delayed haemolysis of transfused red cells

In those who have previously been immunised to a red cell antigen during pregnancy or by transfusion, the level of antibody to the blood group antigen may be so low as to be undetectable in the pre-transfusion sample.

However, after transfusion of red cells bearing that antigen, a rapid secondary immune response raises the antibody level dramatically, leading to the rapid destruction of transfused cells.

At 5–10 days post-transfusion, patients present with fever, falling haemoglobin levels (or an unexpectedly poor rise in haemoglobin levels), jaundice and haemoglobinuria. A rise in bilirubin levels and positive direct antiglobulin test (DAT) will also be present.

Development of antibodies to red cells in the patient's plasma (allo-immunisation)

- Transfusion of red cells of a different phenotype to that of the patient will cause allo-immunisation (for example the development of anti-RhD in RhD-negative patients who have received RhD-positive cells).
- This is dangerous if a pregnant patient later receives a red cell transfusion and can cause haemolytic disease of the newborn (HDN).

Iron overload

- Each unit of blood contains 250 mg of iron, and those receiving red cells over a long period of time may develop iron accumulation in cardiac and liver tissues.
- Chelation therapy (with desferrioxamine) is used to minimise iron accumulation in those most at risk.

Infection

The risk of becoming infected with HIV, hepatitis B or hepatitis C from transfusion is now small in situation where there are safe and reliable blood transfusion systems. However, since there is always the potential for unrecognised or unknown infection to be spread via transfusion, **all** non-essential transfusions should be avoided.

Blood must be stored at the correct temperature at all times (at 2–6°C for up to 35 days if using citrate- phosphate-dextrose adenine anticoagulant *or* up to 21 days if using citrate-phosphate-double dextrose). This means that electrical power for the blood transfusion storage fridge must not stop and if it does an alarm must indicate to laboratory staff that blood can rapidly become infected if temperature exceeds 6 degrees C for more than a very short time period. Ideally each blood bag should be labelled with a temperature-sensitive strip that changes colour when the correct temperature for storage has been exceeded for a clinically significant period of time.

Improving safety

Reducing transfusion errors

- Introduce robust hospital transfusion protocols.
- Provide training for all staff involved in blood administration/taking samples for cross-matching.
- An understanding of transfusion medicine should be a core curricular component for all doctors in training.
- Improved information technology, such as use of a unique barcode on the patient's wristband/blood sample and prepared blood, is important.
- Appoint specialist transfusion practitioners where possible.

Reducing unnecessary transfusion

- Transfusion risks related to the use of allogeneic blood can be eliminated by the use of autologous blood (whereby patients collect and store their own blood for use in planned surgery). However, this practice is not risk-free.
- Ensure that blood products are only used when the patient is judged more likely to benefit from than be harmed by a transfusion.

- Ensure that electrical power to blood storage refrigerators is constant and have measures to detect failures in power supply.
- Always record in the patient's notes the indication for giving blood.
- Adopt procedures such as checking for and correcting anaemia prior to planned surgery, stopping anticoagulants and antiplatelet drugs before surgery, minimising the amount of blood taken for laboratory samples, and using a simple protocol to guide when haemoglobin should be checked and when red cells should be transfused.
- Accept a lower haemoglobin concentration as a trigger for transfusion.
- Accept a lower post-transfusion target haemoglobin level.

Section C6 Shock during pregnancy and after birth

Shock results from an acute failure of circulatory function. The most common causes in pregnancy are obstetric haemorrhage, severe sepsis, anaphylaxis, pulmonary embolus, major trauma (including burns) and severe anaemia.

Diagnostic pointers

During assessment and resuscitation, a focused history of the previous 24 hours and previous illnesses should be obtained.

- A history of possible obstetric bleeding. This may be vaginal bleeding, or 'silent' bleeding into the abdominal cavity (as in ruptured ectopic pregnancy, placental abruption or ruptured uterus).
- A high fever points to septicaemia or malaria.
- Urticaria, angioneurotic oedema or a history of allergen exposure points to anaphylaxis.
- Heart failure points to severe anaemia (usually with severe pallor), valve disease or cardiomyopathy.
- A history of vomiting and/or diarrhoea points to fluid loss, either externally (e.g. gastroenteritis) or into the abdomen (e.g. appendicitis and peritonitis).
- A history of major trauma points to blood loss, and, more rarely, tension pneumothorax, haemothorax, cardiac tamponade or spinal cord transection.
- Severe tachycardia or signs of heart failure point to a cardiac arrhythmia or a cardiomyopathy.
- A history of polyuria, sighing respiration and a very high blood glucose level points to diabetes
- A history of drug or traditional medicine ingestion points to poisoning.

Primary assessment indicating shock in pregnancy

- Fast, weak pulse (≥ 100–110 beats/minute).
- Pallor (especially of the inner eyelids, palms or around the mouth).
- Sweatiness or cold clammy skin.
- Rapid breathing (> 30 breaths/minute).
- Anxiety, reduced conscious level, confusion or unconsciousness.
- Low blood pressure (systolic pressure less than 90 mmHg is a late sign).
- Reduced urine output (< 30 mL/hour).

Resuscitation: CABC (see Section C8)

Call for help including nurse anaesthetist, obstetric clinician, theatre staff.

Airway and haemorrhage control

If heavy bleeding is the suspected cause of shock, take immediate steps to stop the bleeding. For example in post-partum haemorrhage (PPH) external uterine massage uterotonic drugs such as oxytocin or misoprostol, bimanual compression, aortic compression and condom catheter, and, if sufficient helpers are present, anti-shock garments with use of the leg segments only are urgently required. Urgent surgical intervention may also be needed (e.g. for ruptured ectopic pregnancy or post caesarean section where wound breakdown internally may be possible).

● Use an opening manoeuvre if the airway is not open or is partially obstructed. Keep the airway open. If there is improvement but the airway closes without active opening support, consider airway adjuncts to maintain the airway if the patient is unconscious (P or U on the AVPU scale).
● Suction if necessary.
● Maintain and protect the airway if needed by intubation undertaken by experienced help (if available).

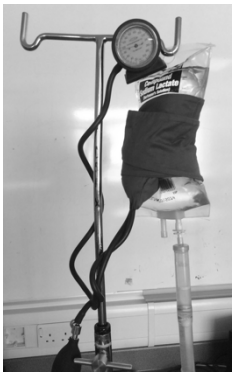
Breathing

● Provide a high concentration of oxygen through a facemask with a reservoir bag if there is adequate spontaneous respiration.
● For patients with inadequate ventilation, breathing should be supported with oxygen via a bag-mask, and experienced help should be summoned (if available).

Circulation

1. Gain IV access. Use a short, wide-bore (16- to 18-gauge) IV cannula.
2. Access via the internal or external jugular veins is a good option if peripheral access is impossible. Long saphenous vein cut-down may also be considered, and the new intraosseous drill can be used if all else fails (see Section E13).
3. Applying pressure on the site of the bleeding can be valuable in many circumstances, including the uterus in PPH (see Section A+11) and external haemorrhage from major trauma (Section D1).
4. If sufficient help is available try to obtain two vascular access sites to give large volumes quickly, and in case one line is lost.
5. A blood pressure cuff can be used to speed up infusions in emergency situations. Wrap the cuff around the blood/fluid bag and place it inside a non- compressible bag. (see Figure C6.1).

Figure C6.1 *BP cuff around IV fluid bag*



1. Use the left lateral tilt position (or recovery position if unconscious) to minimise aortic and vena caval compression, and to reduce the risk of aspiration in patients after 20 weeks' gestation.
2. Elevate the legs by raising the foot of the bed.
3. If there are sufficient helpers available, consider placing the leg segments (1,2, and 3) only of an anti-shock garment to gain time whilst awaiting blood transfusion and laparotomy. **Do not apply the pelvic or abdominal segments (4 and 5) of the garment and do not stop other vital activities to arrest bleeding whilst placing the leg segments of the garment in place.**
4. Give an initial rapid bolus of crystalloid IV fluid 500 mL to 1 L of Ringer- lactate/ Hartmann's solution or 0.9% saline **or blood if the patient is bleeding**. A colloid at the same dose can also be given, if available. It is essential that the bolus is given as rapidly as possible.
5. Further boluses of 500–1000 mL will usually be required in the first hour. Once more than 2 litres have been given IV, complications such as pulmonary or cerebral oedema may occur.
6. Keep the patient warm but do not overheat.

Choice of fluid for volume replacement

Blood (especially fresh donor blood) crystalloid or colloid fluids are appropriate for volume replacement in shock.

Hypotonic dextrose/glucose infusions (such as 5% glucose or 0.18% saline in 5% glucose) do not constitute appropriate fluid resuscitation and must not be given in shock. They are dangerous because they lower serum sodium levels, which can result in seizures and brain swelling.

Compared with colloids, crystalloid fluids:

- Do not remain in the circulation for long diffusing more readily into the interstitial space producing more peripheral oedema especially where capillary leak is part of the shock
- where capillary leak exists, allow more water to enter the interstitial space, because of its lower osmotic pressure
- needs two to three times more volume than colloids to expand the vascular space

Nevertheless, the use of both crystalloids and colloids is appropriate, although crystalloids (e.g. Ringer-lactate/Hartmann's solution or 0.9% saline) are more likely to be available in low resource settings.

Choice of crystalloid

The fluid that was traditionally infused into the circulation for the management of shock was 0.9% saline. This fluid may, however, have dangers. An infusion of 0.9% saline causes a hyperchloraemic acidosis (a high chloride concentration leading to an acidosis) which, in the shocked patient, who is already acidotic, may cause a deterioration in vital organ function (especially cardiac function), even though perfusion of the cells has been improved by the increased circulating volume.
There are sodium-containing alternatives to 0.9% saline that are safer as they approximate more closely to human serum/plasma in content, although they are more expensive. We recommend in low resource settings the use of Ringer-lactate/Hartmann's solutions, which are widely available.

Blood transfusion

If there is significant blood loss or pre-existing severe anaemia in the face of any blood loss, blood transfusion will be needed. Full cross-matching takes about 1 hour to perform. For urgent need, type-specific non-cross-matched blood (which is ABO- and rhesus-compatible but has a higher incidence of transfusion reactions) takes about 15 minutes to prepare. In dire emergencies, O-negative blood must be available to be given.

Fluids should be warmed, especially if they are given in large volumes. In the absence of heaters, bags of fluid or blood can be warmed by placing them under the clothes next to the skin of a staff member or relative.

The concept of *'targeted crystalloid fluid-resuscitation'* requires urgent research into shock due to obstetric haemorrhage. Here the initial boluses of IV crystalloids required to treat shock would only be given to keep the vital organs (especially the brain, heart and kidneys) perfused before blood becomes available and, of most importance, surgery and specific medical treatments to stop the bleeding have started to take effect. The administration of too large a volume of IV crystalloids

fluids may increase the blood pressure, damage clotting and disrupt early clot formation.

If this approach is used when giving boluses of crystalloid in shock due to bleeding (before blood is available and before procedures undertaken to stop haemorrhage are effective), only the amount necessary to keep the blood pressure at a level sufficient to perfuse the vital organs is given. There is no clear evidence to indicate the precise blood pressure that should be achieved in a woman in shock due to haemorrhage. However, adequate perfusion of vital organs may best be indicated by a radial pulse which can be palpated and an alert conscious level. During pregnancy, the adequacy of the fetal heart rate may also be helpful.

Especially in low resource settings, it may be best to start with IV boluses of 500 mL of crystalloid and reassess after each bolus, always aiming to stop haemorrhage and obtain blood for transfusion as soon as possible. In situations where there is brisk active blood loss and delay in obtaining blood or effective intervention to halt the bleeding, several boluses of crystalloids may be required. **The importance of urgently undertaking measures to halt the bleeding and obtaining blood for transfusion rapidly cannot be overstated.**

Tranexamic acid

This should be started as soon as possible after the onset of major haemorrhage. The loading dose is 1 gram over 10 minutes followed by an IV infusion of a further 1 gram over a period of 8 hours. The slow IV bolus dose is given by injecting 1 gram of tranexamic acid into a 100-mL bag of 0.9% saline and letting it run through over a period of about 10–20 minutes (the exact timing is not crucial). The 8-hour infusion is given by injecting 1 gram of tranexamic acid into a 500-mL bag of 0.9% saline and giving it over a period of 8 hours (approximately 60 mL/hour).

Determine the cause of bleeding

- If bleeding occurs before 24–28 weeks of pregnancy, suspect miscarriage, induced abortion, ruptured ectopic pregnancy or molar pregnancy.
- If bleeding occurs after 24–28 weeks or during labour, but before delivery, suspect placenta praevia, abruptio placentae or ruptured uterus.
- If bleeding occurs soon after childbirth, suspect atonic uterus, retained placental fragments, ruptured uterus, tears of the genital tract or occasionally an inverted uterus.
- In all cases consider the possibility of a primary or secondary blood clotting disorder (see Table C6 1).

Table C6 1
Whole blood clotting time
If laboratory clotting tests are not available:
Transfer 2 mL of venous blood into a small dry clean plain glass test tube (approximately 10 mm × 75 mm).

Hold the tube in your closed fist to keep it warm (+ 37°C).

After 4 minutes, tip the tube slowly to see if a clot is forming. Then tip it again every minute until the blood clots and the tube can be turned upside down.

Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down easily, suggests a blood clotting disorder.

Cases where infection is the suspected cause of shock (septicaemia)

● Collect appropriate samples (blood cultures, urine, pus, swabs) for microbial culture before starting antibiotics, if facilities are available, but do not delay giving antibiotics because of specimen collection.

● Give a combination of antibiotics to cover aerobic and anaerobic infections, and continue until the patient has been fever-free for 48 hours:

- benzyl penicillin 2.4 grams initially, then 1.2 grams IV 6-hourly or ampicillin 2 grams initially, then 1 g IV/IM every 6 hours
- **plus** gentamicin 80 mg IV/IM 8-hourly or 5 mg/kg body weight IV/IM once every 24 hours
- **plus** metronidazole 500 mg IV every 8 hours
- or ceftriaxone 2–4 grams IV once daily or cefotaxime 2 grams 12-hourly IV **plus** metronidazole 500 mg IV every 8 hours.
- if peritonitis is possible, always include metronidazole IV.

● If the patient is in shock, do not give antibiotics by mouth or IM, as they will not be absorbed.

● Reassess the patient's condition for signs of improvement.

Cases where haemorrhage due to trauma is the cause of shock (Section D1)

● Try and stop haemorrhage and if appropriate prepare for surgical intervention.

● Give 500 mL IV crystalloid fluid resuscitation boluses and reassess circulation after each bolus until blood is available (see above).

General issues

Never give IV boluses of 5% dextrose or dextrose saline (4%/0.18%), as they cause hyponatraemia, and may result in cerebral oedema and death.

An antibiotic such as cefotaxime or ceftriaxone should always be given IV when a diagnosis of septicaemia with a purpuric rash is present (suspect meningococcal infection).

Take blood for the following investigations (if available): full blood count (FBC), renal and liver function tests, blood culture, cross-matching, blood clotting, glucose stick test and glucose laboratory test.

Insert a urethral catheter and monitor urine output.

Cases where a blood clotting disorder is present and fractionated blood products are not available

● Use fresh whole blood (straight from the donor if possible).
● If volume overload is a concern, allow the unit of fresh whole blood to stand for 30 minutes. The red blood cells will drop to the bottom, and the fluid/plasma above them containing clotting factors can be drawn off with a syringe and needle, and plasma alone can be given.

Reassess ABC on a regular basis.

Reassess the response to fluids to determine whether the patient's condition is improving. Signs of improvement include the following:
● decreasing pulse rate (a rate of ≤ 100–110 beats/minute)
● increasing blood pressure (systolic pressure ≥ 90–100 mmHg)
● improving mental status (less confusion or anxiety)
● increasing urine output (≥ 30 mL/hour).

Continue monitoring to ensure that the pulse rate and blood pressure do not deteriorate after improvement, indicating the return of shock.

If the mother's condition improves adjust IV fluids to a maintenance level of 1200 ml over 12 hours and continue management for the underlying cause of shock.
Always test for and treat any hypoglycaemia.

Inotropes

An IV infusion of dobutamine and/or dopamine at 5–20 micrograms/kg/minute should be considered, especially if a third bolus of fluid is required.
Sometimes adrenaline by IV infusion at 0.05–2 micrograms/kg/minute may be required.
These infusions can initially be given carefully through a peripheral vein until central venous access is obtained by an expert such as a nurse anaesthetist.

Section C7. Pain control in pregnancy and in labour

Pain control in pregnancy

Local anaesthetic drugs by infiltration (the most widely used method)
Lidocaine 0.5–2%

- Used for rapid and intense sensory nerve block.
- Onset of action is within 2 minutes; the procedure must not be started until an anaesthetic effect is evident.
- Effective for up to 2 hours.

Doses:
A maximum of 200 mg (500 mg if used with adrenaline) not more than 4-hourly
Preparation of lidocaine 0.5% solution. Combine:

- lidocaine 1%, 1 part
- Ringer-lactate, Hartmann's solution, 0.9% saline or sterile distilled water, 1 part

Advantages of adding adrenaline include:

- less blood loss
- longer effect of anaesthetic (usually 1–2 hours)
- lower risk of toxicity because of slower absorption into the general circulation.

The concentration of adrenaline to use is 1:200 000 (5 micrograms/mL). *Note*: It is critical to measure adrenaline carefully and accurately using a 1-mL or, at the most, 2-mL syringe. Observe strict infection prevention practices.

Table C7.1 Formula for preparing 0.5% lidocaine solutions containing 1:200 000 adrenaline

Desired amount of local anaesthetic needed (mL)	*Ringer-lactate or Hartmann's solution (mL)*	*Lidocaine 1% (mL)*	*Adrenaline 1:1000 (mL)*
20	10	10	0.1
40	20	20	0.2
100	50	50	0.5
200	100	100	1.0

Local infiltration into an abscess is not recommended, because local anaesthetics are ineffective in inflamed tissues.

Complications of local anaesthesia

- If more than 40 mL of 0.5% lidocaine are to be used, add adrenaline as described above. Procedures that may require more than 40 mL of 0.5% lidocaine are Caesarean section and repair of extensive perineal tears.
- Use the lowest effective dose.
- Inject slowly.
- Avoid accidental injection into a vessel. There are three ways of doing this:

1. the moving needle technique (preferred for tissue infiltration): the needle is constantly in motion while injecting, which makes it impossible for a substantial amount of solution to enter a vessel
2. the plunger withdrawal technique (preferred when considerable amounts are injected into one site): the syringe plunger is withdrawn before injecting, and if blood appears the needle is repositioned, and another attempt is made
3. the syringe withdrawal technique: the needle is inserted and the anaesthetic is injected as the syringe is being withdrawn.

Symptoms and signs of lidocaine allergy

Redness of skin, skin rash/hives, bronchospasm, vomiting, serum sickness and rarely shock.

Symptoms and signs of lidocaine toxicity

Note: lidocaine can be absorbed through mucous membranes in a large enough dose to be toxic.

Table C7.2 Lidocaine toxicity

Mild toxicity	*Severe toxicity*	*Life-threatening toxicity (rare)*
Numbness of lips and tongue Metallic taste in mouth Dizziness/light headedness Ringing in ears Difficulty in focusing eyes	Sleepiness Disorientation Muscle twitching and shivering Slurred speech	Tonic–clonic convulsions Respiratory depression or arrest Cardiac depression or arrest

- Direct intra-arterial or IV injection of even a small amount may result in cardiac arrhythmias and convulsions (see above).
- Resuscitative facilities and healthcare professionals with resuscitative skills should be present.

If symptoms and signs of mild toxicity are observed wait a few minutes to see if the symptoms subside. Check vital signs and talk to the patient. Delay the procedure for at least 4 hours if possible.

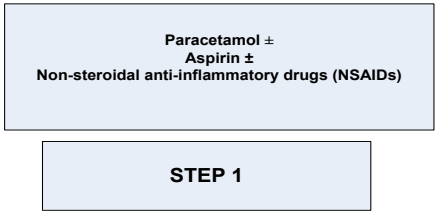
Adrenaline toxicity

This is caused by excessive amounts or inadvertent IV administration, and results in:

- restlessness
- sweating
- hypertension
- cerebral haemorrhage
- rapid heart rate
- cardiac arrest.

Systemic drug treatment for pain

Figure C7.1 *WHO two step ladder for pain control*



**An adjuvant is another drug (e.g. steroid or anxiolytic) or type of treatment (e.g. TENS or radiotherapy) that can prevent and relieve pain.*

A. Non-opiate analgesics

Paracetamol

- This is the most widely used analgesic (and is anti-pyretic).
- It does not cause respiratory depression.
- It is dangerous in overdose but a safe and effective drug in pregnancy in recommended doses.
- It is given by mouth, rectally or intravenously.
- The maximum daily dose should not be given for more than 3 days.

- Caution is needed in patients with liver impairment.
- There are no anti-inflammatory effects.
- Paracetamol can be combined with NSAIDs and both have a morphine-sparing effect, lowering the dose, and therefore severity of side effects of morphine.

Non-steroidal anti-inflammatory drugs (NSAIDs) (e.g. ibuprofen, diclofenac)
Do not give NSAIDs in the third trimester of pregnancy, as they may close the ductus arteriosus and predispose to pulmonary hypertension of the newborn. They may also delay the onset and progress of labour.

- Anti-inflammatory, anti-pyretic drugs with moderate analgesic properties.
- Less well tolerated than paracetamol, causing gastric irritation, platelet disorders and bronchospasm. **Do not give in patients with gastric ulceration, platelet abnormalities or significant asthma.**
- Useful for post-traumatic and bone pain because of their anti-inflammatory effect. They are given by the oral or rectal route (e.g. diclofenac). There is a risk of gastric haemorrhage through whichever route the NSAIDs are given.

Table C7.3 Orally administered drugs for mild or moderate pain

Medicine	***Maximum daily dose***	***In pregnancy***	***After birth of the baby***
Paracetamol	4 doses in 24 hours	500 mg to 1 g 6-hourly	500 mg to 1 g 6-hourly
Ibuprofen		Do not use in pregnancy	400 mg orally 6 to 8 hourly Do not use in pre-eclampsia
Diclofenac		Do not use in pregnancy	100mg rectally 12 hourly Do not use in pre-eclampsia

Preparations:
Paracetamol: oral suspension, 120 mg/5 mL, 250 mg/5 mL; tablets, 500 mg.
Ibuprofen: oral suspension, 100 mg/5 mL; tablets, 200 mg, 400 mg.
Diclofenac: tablets, 25 mg, 50 mg; dispersible tablets, 10 mg.

Notes on ibuprofen and diclofenac

- **Do not use during pregnancy.** Can be used post-delivery or post Caesarean section unless the patient has pre-eclampsia
- Caution is needed in patients with asthma, liver or renal failure.
- Contraindications include dehydration, shock, bleeding disorders and hypersensitivity to aspirin.
- NSAIDs and paracetamol can be used in combination.
  If rectal drugs are available, the doses are similar to oral doses.

Table C7.4 Intravenous paracetamol for mild or moderate pain

Age/weight	*Dose*	*Maximum dose in 24 hours*
Pregnant woman less than 50 kg body weight	15 mg/kg every 4–6 hours	60 mg/kg
Pregnant woman more than 50 kg body weight	1 g every 4–6 hours	4 g

Intravenous paracetamol (see later in this section)

- Paracetamol IV is formulated as a 10 mg/mL aqueous solution (in ready-to-use 50-mL and 100-mL vials for infusion over 15 minutes).
- It is useful, effective and safe.
- The peak analgesic effect occurs within 1 hour, lasting approximately 4–6 hours.
- Ensure correct dose is given, as serious liver toxicity can occur in overdose.
- Side effects are rare but include rashes, blood disorders and hypotension on infusion.
- Caution is needed in patients with severe renal impairment, severe malnutrition or dehydration.
- Paracetamol helps to reduce the amount of morphine required when used in combination.

B. Opiate analgesics: Morphine

- The most important drug in the world for pain control, and WHO recommends that it should be universally available.
- In resource-limited countries it is mostly administered orally, which is useful for chronic or anticipated pain but less effective for acute pain. The latter requires IV administration of morphine.
- At an appropriate dose, analgesia occurs without impaired consciousness.

- Nausea and vomiting are rare with oral treatment, but when morphine is given intravenously for the first time it may produce this side effect.

Intravenous use of morphine

- Minimal haemodynamic effects in a supine patient with normal circulating blood volume.
- In hypovolaemic patients it can contribute to hypotension. Therefore:
  - monitor the patient's cardiovascular status
  - have an IV fluid bolus of Ringer-lactate or Hartmann's solution ready (500 mL to 1 litre in pregnancy).
- In excessive dosage it can produce a dose-dependent depression of ventilation and decreased respiratory rate, leading to apnoea.
- Patients who are receiving morphine in hospital (where it is often administered IV) need observation and/or monitoring of respiratory rate and sedation level.
- Morphine is better controlled by the IV than the IM route. If using the IV route, give a small dose initially and repeat every 3–5 minutes until the patient is comfortable. Individuals vary widely with regard to the dose needed to provide pain relief. It is rarely appropriate to give morphine intramuscularly, and **for patients who are in shock, giving morphine IM is dangerous, as it can be initially poorly absorbed, and then quickly absorbed when perfusion improves, potentially leading to too high a blood level of the drug.**
- Intravenous morphine can be dangerous in situations of raised intracranial pressure without the means to provide respiratory support.
- During late pregnancy or delivery, morphine can cause respiratory depression in the neonate.

Table C7.5 WHO advice: oral and rectal morphine for severe pain in hospital

Age	*Dose*	*Interval*
In pregnancy	5–10 mg	Every 4 hours

Note: We suggest starting with the lower dose (5mg) and give more frequently, e.g. every hour if needed, until the patient is comfortable, then increase the new individual dose 4 hourly of morphine.
Almost all patients with chronic pain can be managed with oral morphine when this is given in the doses shown in Tables 5.5 and 5.6 in combination with non-opioid analgesics. These are starting doses and can be increased as necessary on an individual patient basis if pain is not controlled.

Parenteral (IV or IM) morphine

IV morphine is only needed if oral or rectal preparations are not going to be absorbed (e.g. in shock) or where rapid emergency onset is needed. IV morphine is potentially less safe, especially if staff shortages mean that the correctly calculated dose is not given. **IM morphine is dangerous in shock.**

Table C7.6 Intermittent IV (bolus) morphine dosage.

Age	*Dose*	*Interval*
In pregnancy	10 mg	Every 4 hours

MCAI suggests that the total dose recommended is drawn up in 10mls 0.9% saline and that 2ml boluses of this solution are given every 3--5 minutes until the patient is comfortable. Also, if pain returns despite regular paracetamol/non-steroidal analgesia, further dose of oral/IV morphine can be given within 6 hours if the respiratory rate is normal and the patient is not sedated.

Monitoring during morphine administration:

Side effects occur only in overdose and should not be seen at the doses stated here. They include the following:

1. Respiratory depression. If the respiratory rate is < 12 breaths/minute in pregnancy
   - Alert medical staff and ensure that bag/valve/mask and naloxone are available.
   - Monitor SaO_2 as appropriate (it should be higher than 94% in air).
2. Constipation. Use prophylactic laxatives.
3. Monitor for urinary retention.
4. Patients with liver and renal impairment may need lower doses and longer time intervals between doses.
5. Caution in patients with head injuries

Naloxone

Naloxone is an opiate antagonist that reverses the sedative, respiratory-depressive and analgesic effects of morphine, and so should be given to treat morphine overdose. When treating overdose, always ventilate with bag/valve/mask first if patient is unresponsive before giving naloxone. This is because arrhythmias and pulmonary oedema can be caused if naloxone is given to a patient with high blood carbon dioxide concentrations.

Naloxone doses to reverse opioid induced respiratory depression

In pregnancy give 1.5 to 3 microgram/kg

If respiratory rate is low, but the patient's oxygen saturation is acceptable (>94%) with facemask oxygen, in order to avoid complete reversal of analgesia draw up 400 microgram naloxone into 20ml and give 1-2mls every 2 minutes until the patient is rousable and the respiratory rate increased to an appropriate rate.

Preparations: Ampoule 20 microgram/mL
Give IV or IM if IV is not possible. Repeat after 2–3 minutes if there is no response; the second dose may need to be much higher (up to 100 micrograms/kg). An IV infusion may be needed if protracted or recurrent depression of respiration occurs because naloxone is short acting compared with most opioids.

Starting dose for naloxone infusion: 5 to 20microgram/kg/hour
(For the newborn, to treat respiratory depression due to maternal opioid administration during labour or delivery 200 microgram as a single IM dose or 60 microgram/kg)

Safe use of morphine in hospital

Narcotic drugs, which may be controlled by law within the country concerned, should have a separate cupboard permanently fixed to the wall and locked. The keys to drug cupboards should be kept separately to all other keys and be carried by a qualified nurse for the period of each shift, and then handed over to the nurse taking over the next shift. A logbook is necessary for recording the ordering and use of narcotic drugs. It is completed to order stocks, using one page for each order. It also records the use of each ampoule, tablet or dose of liquid. The name of the patient, hospital identification, date and time when the drug was given, and whether or not any portion of the drug was discarded is entered in the register (*see* Figure C7.1). Then each entry is signed by two staff members. Ideally, both must hold a nursing, medical or pharmacology qualification, and one must be a member of the ward or unit staff. In addition, two members of unit staff must check the stock levels once in every 24-hour period and sign to confirm that the stocks are correct. Any discrepancy must be reported immediately to the senior nurse manager for the hospital.

Each hospital should have a policy for dealing with unauthorised use of narcotic drugs, and, in some countries, this will involve national law enforcement agencies.

When new drug stocks are required, the order book is sent to the central pharmacy, ideally in a container with a tamper-proof seal. Once the pharmacist has placed the order in the container, it is sealed and must not be opened until its arrival in the receiving ward or department.

When the stock arrives in the unit, the seal is broken in the presence of the messenger and the contents are checked against the order book, which is then signed by both. Drugs are then entered in the drug register, with two staff members checking and signing. The drugs are placed in the appropriate cupboard, which is then relocked.

In most hospital wards and units, these precautions will both ensure that adequate narcotic drugs are available when they are needed by patients and prevent provision of supplies to those who may abuse them.

Use of morphine

- Morphine is a safe drug if administered by doctors and nurses who know how to use it and how to monitor patients who have been given it. It is not addictive if used only in the short term for severe pain.
- It is not difficult to use, but because it is a controlled drug it requires special procedures to ensure its security.
- It is relatively inexpensive.
- It is a powerful and effective drug that is recommended by the WHO as the first-line medication for the treatment and prevention of severe pain.

NAME, FORM OF PREPERATION AND STRENGTH ……..									
AMOUNT(S) OBTAINED					AMOUNT(S) ADMINISTERED				
Amount	Date Received	Serial no. of requisition	DATE	TIME	Patients Name	Amount Given	Given by (signature)	Witnessed by (signature)	Stock Balance

FIGURE C7.1 *Page of a controlled drugs record book.*

Special procedures required to ensure the secure and appropriate use of morphine

1. Morphine must be stored in a secure locked box attached to the wall of each ward/area where it might be needed.
2. The box must always contain sufficient quantities for any anticipated clinical need.
3. The keys to the box must be readily available to staff who are caring for patients and held by the senior person on the ward 24 hours a day.
4. A logbook recording every individual dose given and the name of the patient to whom it was administered must be signed by two members of staff.
5. Any unused morphine must be safely disposed of.
6. Every vial must be accounted for and the vials counted to check that the number tallies with the logbook at the beginning of each shift.

Morphine is usually available in 1- or 2-mL ampoules at a concentration of 10 mg/mL. **Always check the strength.**

The dose is 10 mg IV for pregnant women (5 mg initially and then another 5 mg after 5 minutes if necessary).

Two people must check the calculation.

- The volume maybe small, so dilute with 0.9% saline or 5% dextrose up to 10 mL Check the dilution
- The prescription of morphine must be clearly written, dated and signed (do not use fractions for doses).
- The antidote, naloxone, must also be kept in the secure box.
- The patient's notes must record the prescription and use of morphine.
- All patients who are receiving morphine need regular monitoring and charting of ABC in particular:
    - respiratory rate
    - blood pressure
    - oxygen saturation
    - AVPU score.

Oxygen and a bag-valve-mask system of appropriate size must be available near to every patient who is receiving morphine.

Summary safe use of morphine in hospital

- Morphine is an essential drug that must be used when severe pain is present or likely to occur.
- To ensure its safe use, attention to the logistics of secure storage is of paramount importance.
- Close monitoring of ABC and D (disability) is essential, and naloxone must be available at all times.
- The prescribing and recording of doses of morphine and naloxone must be carefully undertaken.

Prevention and treatment of nausea and vomiting due to initial dose of morphine

1. *Cyclizine*. This covers the widest range of causes of nausea and vomiting with the least side effects. The IV dose in pregnancy 50mg 8 hourly
2. *Domperidone* - where gastric emptying is a problem, then as in Table C7.7 for doses

Table C7.7 Domperidone for prevention and treatment of nausea and vomiting

Domperidone	
Oral	*Rectal*
In pregnancy: 10–20 mg 3–4 times daily, up to a maximum of 80 mg daily Tablets, 10 mg; Suspension, 5 mg/5 mL	In pregnancy, 60 mg twice daily Suppositories, 30 mg

Both of the above anti-emetics can cause extrapyramidal side effects, including acute dystonia, which can be treated with diazepam IV in pregnancy, 5 to 10 mg.

Sedation Sedation is not recommended for use in pregnancy after the first trimester, because of the risks of regurgitation and aspiration. A health worker skilled in anaesthesia must be present when sedation is being used in pregnancy.

C. Pain control in labour

Until recently in low resource settings the only safe pharmacological treatment is nitrous oxide plus oxygen (in a 50/50 combination). Epidural anaesthesia is effective but requires careful monitoring (unlikely to be available), risks local infection, and can increase the need for Caesarean section. Opiate drugs, such as pethidine and morphine, have many potentially harmful effects on the woman and newborn infant.

Intravenous paracetamol in labour has now been introduced in Liberia (see below)

Nitrous oxide with oxygen
Our recommendation is that, where possible, nitrous oxide plus oxygen should be made available for all women who need pain control, particularly the primigravida.
It is recommended that a maximum concentration of 50% nitrous oxide and 50% oxygen should be used.
The labour ward must be adequately ventilated and the mask fit well to avoid contamination of others in the vicinity.
The drug is always self-administered to ensure its safety. (If drowsiness occurs, the woman will drop the mask).
It should not be used for more than 24 hours and can interfere with vitamin B12 metabolism if used continuously rather than intermittently (i.e. only during contractions).

The cylinder must not be mixed up with those containing 100% nitrogen. Nitrous oxide and oxygen mixture (Entonox) is supplied in a blue cylinder with white quadrants on the shoulder, whereas 100% nitrogen is supplied in a plain blue cylinder without white shoulders.

Treatment with nitrous oxide and oxygen
The woman should inhale the gas only during painful contractions. After starting an inhalation, it takes 30 seconds to 1 minute for the nitrous oxide and oxygen mixture to act, and ideally the onset of the contraction should be anticipated, and inhaling started 30 seconds before it begins. Between contractions, the mouthpiece or mask should be removed, and the woman should breathe normally from room air.

Between patients, the mouthpiece or mask must be cleaned and disinfected.
Side effects include drowsiness, dizziness, nausea and vomiting, and buzzing in the ears.
Nitrous oxide and oxygen is contraindicated in patients with impaired consciousness.

It does not modify uterine contractions or cause harm to the neonate.

Intravenous Paracetamol
Controlling the pain of labour in mothers attending CB Dunbar Hospital.
Statement to be readout and discussed with mothers during labour

Acting on feedback from women in labour who have told us that they are in pain and want us to do something to help them we are trying to reduce the severity of pain suffered by mothers during labour.
However, providing pain control in labour is not straightforward. We must be sure that it does not harm either you or your unborn baby. One drug which may be helpful is called Paracetamol. This is widely used as an oral medicine both within and outside pregnancy to control common causes of pain such as headaches or muscular aches following minor injuries. Provided the dose taken does not exceed 4 grams per 24 hours in an adult there are no significant side effects.

The pain resulting from the contractions that occur during labour can be extremely severe and most of the techniques and drugs used in well-resourced countries are not easy to control or even safe in situations where medical resources are limited, as in Liberia.

In the last few years, a form of Paracetamol has been developed that can reduce severe pain. It has to be given into a vein and, if an intravenous cannula is not already in place, a cannula will need to be placed in one of your veins in order for it to be administered. Previous studies in other countries, during labour, have shown that this intravenous preparation of Paracetamol can reduce severe pain. With permission of the Ministry of Health and yourself we would like to offer you this form of treatment during your labour.

Pain can be described in the following 5 ways

Level 1. Mild,
Level 2. Causing you significant discomfort,
Level 3. Causing you significant distress
Level 4. Is so severe that it can be described as horrible
Level 5. Is so very severe that it can be described as excruciating or the worst possible pain that you could imagine.

Intravenous paracetamol will only be offered if you describe your labour pain as causing major distress; that is level 4 or 5.

In any 6-hour period, only one intravenous injection of Paracetamol can be given. It is likely, and we hope, that the severity of pain will be reduced within the first 10 to 15 minutes and the benefit last for at least 5 more hours. You will be asked for your views on the level of pain you are suffering every 1 hour following the injection and this will be recorded onto a chart.

If labour is continuing for more than 6 hours after the injection of paracetamol and is causing severe pain a second dose could be given at this time, provided that you consider it is helping you. Again, measurements of labour pains every hour after this second injection will continue until your labour has ended or until another 6 hours have passed. If labour has not ended 12 hours after the first injection has been given and you remain in severe distress/pain an additional third dose could be given.

Very many thanks for reading/listening to this explanation.

I CONFIRM THAT I HAVE READ TO THE MOTHER THE ABOVE STATEMENT ON THE USE OF INTRAVENOUS PARACETAMOL IN THE CONTROL OF SEVERE PAIN DURING LABOUR AND, WHEN APPROPRIATE, THE MOTHER HAS ALSO READ THIS DOCUMENT.

NAME …….
SIGNATURE…….

Each 6 hourly dose given based on body weight:
Do not give more than 4 doses in a 24-hour period
Mother's weight 50 Kg or more give 1-gram (1000mg) doses (100ml by slow IV infusion over 15 minutes)
Mother's weight 44 to 49 Kg give 750 mg doses (75ml by slow IV infusion over 15 minutes)*
Mother's weight 33 to 43Kg give 500 mg doses (50ml by slow IV infusion over 15 minutes)*

*1. For the 500mg dose 'before starting the paracetamol infusion the midwife should withdraw and discard 50ml of the solution from the 100ml (1000mg) bottle of paracetamol'.

*2. For the 750mg dose 'before starting the paracetamol infusion the midwife should withdraw and discard 25ml of the solution from the 100ml (1000mg) bottle of paracetamol'.

3. For the 1000mg dose 'the midwife should infuse the whole bottle (100ml) of paracetamol'

Section C8. Structured approach to managing emergencies in pregnancy

Introduction to the Structured Approach

Both within the hospital setting, in basic health facilities and even in the home, patients of all ages may present as an emergency. We will not know what is wrong with them (the diagnosis) but, while waiting to find out, a seriously ill patient may die.

The structured approach to emergencies is aimed at supporting critical body functions until a clear diagnosis and treatment plan can be achieved. This section describes the structured approach to assessment and the simple early interventions that can maintain the lives of a pregnant woman and her fetus while waiting for definitive management. Interventions after primary assessment and resuscitation are mentioned in this chapter, but these are described in more detail in the relevant chapters.

Pregnant women most commonly become critically ill because of complications of pregnancy, massive haemorrhage, serious infection and seizures.

The structured approach outlined in this section allows the health worker to focus on stabilising the sick woman during the first hours of care. *Primary assessment and resuscitation* are concerned with the maintenance of vital functions and the administration of life-saving treatments. *Secondary assessment and emergency treatment follow*, allowing more specific therapies to be started. Secondary assessment and emergency care require a system-by-system approach in order to minimise the risk of significant conditions being missed.

Sequential primary assessment and any necessary resuscitation occur before any illness-specific diagnostic assessment or treatment takes place. Once the patient's vital functions are stabilised, ***secondary assessment and emergency treatment*** can begin.

After each intervention, its effects should be tested by reassessment. Regular reassessments are a key component of the structured approach.

Following cardiac and/or respiratory arrest, the outcome for a pregnant woman is poor. The reason for the structured approach is to recognise and treat critically ill women before they have respiratory and/or cardiac arrest, and so improving the chances of survival for her and her baby.

Training

Members of the clinical team must know their roles. They will ideally have trained together in:

- emergency situations and their immediate management
- drugs and their use, administration and side effects
- emergency equipment and how it functions.

The ability of a facility to deal with emergencies should be assessed and reinforced by the frequent practice of emergency drills involving the structured approach.

Primary assessment and resuscitation CABCD

The initial actions are:

1. Call for help. When appropriate summon specialist help early such as an anaesthetist, obstetrician capable of surgery, operating theatre staff.
2. Try and stay calm but do not waste time.
3. Do not leave the patient unattended.
4. A team leader to oversee management will avoid confusion.
5. Assess and resuscitate in a standard order using the structured approach – CABCD: Control life threatening haemorrhage, **Airway, Breathing, Circulation, Disability (Neurological Status)** (see below). This approach ensures that all patients with a life-threatening or potentially life-threatening problem are identified and managed in an efficient way **whatever their diagnosis or pathology**.

Reassess the patient after any intervention and if there is deterioration in the woman's condition.

C Control of life threatening haemorrhage
A Assessment and Resuscitation of the Airway
B Assessment and Resuscitation of Breathing
C Assessment and Resuscitation of the Circulation
D Assessment and Resuscitation of the neurology

This is conveniently remembered as an "CABCD approach" and the aim is to maintain an oxygenated blood supply to vital organs including the heart itself, the brain, kidneys etc.

The order of intervention is Control life threatening bleeding first, then Airway, then Breathing, then Circulation then neurology. The reason for this order is because continued loss of blood from the circulation takes time to replace, oxygen cannot be

carried around in the blood to vital organs if the blood is not oxygenated first, and the lungs cannot oxygenate the blood if there is an obstructed airway to prevent air containing oxygen to enter the lungs.

If you are alone with the patient, you have to start with Control Bleeding, then Airway, then move to Breathing and then to Circulation then to neurology. If assistance is available, one person can deal with Control of Haemorrhage, one with Airway, another with Breathing and a third with Circulation, all working simultaneously, but in this situation, there should be a 'team leader' to take overall control.

Central neurological failure (D for disability) is the fifth stage of the primary assessment and resuscitation and relates to impaired consciousness resulting in significant effects on vital organs (for example eclampsia). (more detail later in this section)

During primary assessment and resuscitation, interventions to treat immediately life-threatening problems are performed. These include procedures such as massaging the uterus when there is a post-partum haemorrhage, basic airway opening procedures, suction, oropharyngeal airway insertion, intubation, assisted ventilation, venous cannulation and fluid resuscitation (when safe and appropriate). At the same time, oxygen is provided to all patients with life-threatening CABCD problems. Vital signs are recorded, and essential monitoring is established.

Remember that in pregnancy there is also a fetus whose health and survival is dependent on the quality of resuscitation of the mother.

Primary assessment and resuscitation involve sequential assessment and resuscitation of vital functions CABCD– **Control haemorrhage**, **Airway, Breathing, Circulation and Neurology**.

If there are no life-threatening signs, the primary assessment can be completed within about 1 minute. If life-threatening signs are identified, resuscitation procedures are required.

This sequential primary assessment and any necessary resuscitation occur **before** any illness- specific diagnostic assessment or treatment takes place. Once the patient's vital functions are stabilised, secondary assessment and emergency treatment can begin.

After each intervention, its effects should be tested by reassessment. **Regular reassessments** are a key component of the structured approach.

During **secondary assessment**, illness-specific pathophysiology is sought and emergency treatments are instituted. Before secondary assessment, it is important that resuscitative measures are continuing. During the secondary assessment, vital signs should be checked frequently to detect any change in the patient's condition. If there is deterioration, primary assessment and resuscitation should be repeated in the "Haemorrhage control, Airway, Breathing, Circulation" sequence.

Details of Primary assessment and resuscitation

1.Call for help (general and specific)

2. Primary assessment and resuscitation to control life threatening haemorrhage

If the patient has massive obstetric haemorrhage or major trauma and is obviously bleeding rapidly, measures to stop any further blood loss or exsanguination must be instituted at the same time as Airway resuscitation. (see Sections A+6, A+9, A+11 and D1 for examples)

3. Primary assessment and resuscitation of airway

Primary Assessment

LOOK- for chest or abdominal movement
LISTEN – for breath sounds
FEEL – for breath

Talk to the patient. A patient who can speak has a clear airway.

Signs associated with airway obstruction may include any of the following:

- an absence of breathing
- stridor, snoring, or gurgling in the throat
- cyanosis
- chest wall recession or see-saw movement of chest and abdomen
- agitation, reduced consciousness, or coma.

Airway obstruction is most commonly due to obstruction by the tongue in an unconscious patient.

Resuscitation of the airway

Open the airway and keep it open

If there is no evidence of air movement, open the airway using the following:

a head tilt, chin lift or jaw thrust manoeuvre (*see* Section C9 on life support). If this opens the airway and breathing starts, keep the airway open manually until it can be secured.
suction/removal of blood, vomit or a foreign body under direct vision.

If there is no improvement after adjusting the airway manually and trying different techniques, place **an oropharyngeal airway (Section C9),** which may be helpful **if the patient is unconscious and has no gag reflex.** Avoid using a nasopharyngeal airway if there is any suspicion of base of skull injury.

Place in the recovery position if unconscious.
If the airway is still obstructed, a definitive airway by intubation or surgical airway may be needed.
Give oxygen to all patients.

Reassess the airway after any airway-opening manoeuvres. If there continues to be no evidence of air movement, then airway patency can be assessed by performing an airway-opening manoeuvre while giving rescue breaths.

Advanced airway management
Advanced airway management techniques for securing the airway by **intubation** may be required in patients with any of the following:

- persistent airway obstruction
- altered level of consciousness, with failure to protect the airway, especially from vomiting and aspiration
- facial trauma, including burns, penetrating neck trauma with expanding haematoma, and severe head injury.

This should be performed by a skilled intubator such as a nurse anaesthetist.

If it is not possible to provide an airway using intubation, a **surgical airway** may be required (Section D1).

Specific resuscitation measures when there is an airway problem.
For upper airway obstruction due to **anaphylaxis,** IM adrenaline (1 mg IM in pregnancy) and nebulised adrenaline (5 mL of 1 in 1000) can be lifesaving.

If major trauma is present, protect the cervical spine with a collar, sandbags and tape if the patient is likely to have an unstable cervical spine and if subsequent surgical stabilisation is possible.

4. Primary assessment and resuscitation of breathing

An open airway does not guarantee adequate ventilation. The latter requires an intact respiratory centre and adequate pulmonary function with coordinated movement of the diaphragm and chest wall.

Primary assessment

Assess whether breathing is adequate by:

1. assessing effort:
   - recession
   - rate
   - added noises
   - accessory muscles
   - alar flaring
   -

2. assessing **efficacy**:
   - listening for reduced or absent **breath sounds**, or any wheezing, with a stethoscope or ear on chest wall
   - **chest and/or abdominal expansion** (symmetrical or asymmetrical)
   - pulse oximetry SaO_2

3. assessing effects on **heart rate**

4. assessing effects on **colour of nails and mucous membranes** (check the possibility of cyanosis)

5. assessing effects on **mental status.**

Evidence of life-threatening respiratory difficulty which can progress if not treated

This includes the following:

1. Absence of breathing (apnoea)
2. Very high or very low respiratory rates
3. Gasping, which is a sign of severe hypoxaemia, and may indicate impending respiratory arrest and death
4. Inspiratory stridor
5. Expiratory wheezing
6. Reduced or absent breath sounds on auscultation
7. Lack of chest wall expansion
8. severe chest wall recession, usually with increased respiratory rate, but pre-terminally with a fall in rate

9. severe hypoxaemia (cyanosis) and pulse oximetry showing oxygen saturation (SaO_2) of less than 95%.
10. signs of tension pneumothorax (respiratory distress with hyper-resonant percussion) (*see* Section NN)
11. major trauma to the chest (e.g. tension pneumothorax, haemothorax, flail chest) (*see* Section NN)
12. signs of severe asthma (severe respiratory distress with wheezing, but a silent chest in severe asthma can be a near-fatal situation) (*see* Section NN).

Table C8.1Respiratory rates 'at rest' in pregnancy

	Respiratory rate (breaths/minute)
In pregnancy	15-20*

** In pregnancy, respiratory rate does not change over that in adult women although tidal volume increases resulting in approximately a 50% increase in minute ventilation.*

Fast breathing
The WHO states that a breathing rate of 30 per minute or more in pregnancy as dangerous.

Care should be taken when interpreting single measurements. It is more useful to use trends in measurements as an indicator of improvement or deterioration.

Slow breathing rates may result from fatigue or raised intracranial pressure or may immediately precede a respiratory arrest due to severe hypoxaemia.

Chest wall recession
- Intercostal, subcostal or sternal recession reflects increased effort of breathing.
- The degree of recession indicates the severity of respiratory difficulty.
- In the patient with exhaustion, chest movement and recession will decrease.

Inspiratory or expiratory noises
- Stridor, usually inspiratory, indicates laryngeal or tracheal obstruction.
- Wheeze, predominantly expiratory, indicates lower airway obstruction.
- Volume of noise is not an indicator of severity.

Grunting

- This is observed in patients with stiff lungs in an attempt to prevent airway collapse (it represents the noise made by closure of the larynx during expiration, which is the body's attempt to increase lung volume).
- It is a sign of severe respiratory distress.

Accessory muscle use

Exceptions

Increased effort of breathing **does not occur** in three circumstances:

1. exhaustion
2. central respiratory depression (e.g. from raised intracranial pressure, poisoning or encephalopathy)
3. neuromuscular disease (e.g. poliomyelitis).

Effects of breathing failure on other physiology

Heart rate: this is increased with hypoxia, but decreases when hypoxia is severe, when bradycardia is a sign of impending cardiorespiratory arrest.
Skin colour: hypoxia first causes vasoconstriction and pallor. Cyanosis is a late sign and may indicate impending cardiorespiratory arrest. In an anaemic patient it may not be seen, however hypoxic the patient is.
Mental status: hypoxia causes initial agitation, then drowsiness, followed by loss of consciousness.

Resuscitation of breathing

Give high-flow oxygen to all patients with respiratory difficulty. Give as much oxygen as possible through a mask with a reservoir bag to any patient who is breathing but has respiratory difficulty or the other signs of hypoxaemia (e.g. cyanosis).
In the patient with absent or inadequate breathing, it is essential to breathe for the patient using:

- bag–valve–mask ventilation: if using oxygen, add a reservoir to increase the oxygen concentration.

Intubate (if skilled professionals are available) and provide assisted ventilation through the tube if long-term ventilation is needed or bag–mask ventilation is ineffective.

However, never persist with intubation attempts without ventilating the patient intermittently with a bag and mask as necessary to prevent hypoxaemia during the intubation process.

Patients die from hypoxia, not from failure to intubate.

Specific resuscitation measures when there is a breathing problem

Perform **needle thoracocentesis** if the diagnosis is tension pneumothorax (*see* Section D1). This should be followed by a chest drain.

Give **nebulised salbutamol** if the patient has severe, life-threatening asthma (5 mg in pregnancy). If a nebuliser is not available, use a spacer and metered-dose inhaler (100 micrograms/puff; 10 puffs initially) (see Section B2)
Give **IM adrenaline** (1 mg in pregnancy) and **nebulised salbutamol** (see above) if wheezing is due to anaphylaxis. (see Section B3)
Give **anticoagulant** (Low Molecular Weight Heparin) if pulmonary embolus is diagnosed in pregnancy or post-delivery (*see* Section A+15)
Give **calcium gluconate** (10 mL 10% IV over 10 minutes) if respiratory arrest is due to magnesium toxicity in a patient treated for eclampsia with magnesium sulphate. (see Section A+13)

Primary assessment and resuscitation of circulation

If there is no palpable pulse, a very slow heart rate < 40 beats/minute in a pregnant woman) or no “signs of life” (e.g. movements, coughing, normal breathing), cardiac arrest or near-cardiac arrest is likely, and life support must be started (*see* Section C9).

Agonal gasps (irregular, infrequent breaths) do not provide adequate oxygenation and are not a “sign of life”.

In addition to cardiac arrest or near-arrest, **shock** and **heart failure** are additional life-threatening issues that it is important to identify.

Shock

The following clinical signs can help to identify shock (inadequate circulation) (*see* Section C6).

Heart rate

Heart rate increases in shock and heart failure.
Severe bradycardia due to hypoxaemia may be a sign of near cardiorespiratory arrest.

Table C8.2 Heart rates in pregnancy

	Normal range of heart rate (beats/minute)
Pregnancy	70–115*

* The heart rate in pregnancy increases by 10—15 beats per minute over that in anon-pregnant adult women. The WHO defines a heart rate in pregnancy of 110 per minute or more as dangerous and amongst other causes evidence of shock.

Pulse volume
Absent peripheral pulses or reduced strength of central pulses can signify shock.

Capillary refill time (CRT)

- Pressure on the centre of the sternum or fingernail for 5 seconds should be followed by return of the circulation to the skin within 3 seconds or less. CRT may be prolonged by shock, cold environment, or the vasoconstriction that occurs as a fever develops.
- Prolonged CRT is not a specific or sensitive sign of shock and should not be used alone as a guide to the need for or the response to treatment.

Blood pressure
The cuff should cover at least 80% of the length of the upper arm, and the bladder should be more than two-thirds of the arm's circumference. In pregnancy the largest possible cuff should be used to avoid missing a raised blood pressure.

Korotkoff phase 5 (K5, disappearance of sound) should be used to measure diastolic pressure. Korotkoff phase 4 (K4, muffling or softening of sound) should only be used if the sound does not disappear until near to zero cuff pressure.

In pregnancy the patient should ideally be sitting (in the lateral tilt positions > 20 weeks' gestation) when blood pressure is measured with the cuff level with the heart.

Hypotension is a late sign of circulatory failure in pregnancy and will be rapidly followed by cardiorespiratory arrest unless it is treated urgently.

WHO defines normal adult BP as 120/80 mm Hg. Blood pressure falls early in pregnancy due to a decrease in systemic vascular resistance. It is usually 10 mmHg below baseline and reaches a lowest mean value of 105/60 mmHg in the second trimester. During the third trimester it gradually returns to the pre-pregnancy level at term.

The normal systolic blood pressure in pregnancy is in the range 95–135 mmHg. The normal diastolic blood pressure is in the range 60– 85 mmHg.

The WHO suggests a systolic BP of < 90 mmHg in pregnancy as evidence of shock.

A systolic BP
< 95 mmHg should prompt a search for other possible indicators of developing shock. This is more significant if there is a tachycardia.

The cardiovascular system in pregnancy compensates well initially in shock. *Hypotension is a late and often sudden sign of decompensation and, if not reversed, will be rapidly followed by death. Serial measurements of blood pressure should be performed frequently.*

Effects of circulatory failure on other organs
***Respiratory system*:** tachypnoea and hyperventilation occur as a result of the acidosis caused by poor tissue perfusion.

Skin: pale or mottled skin indicates poor perfusion.

Mental status: circulatory failure causes initial agitation, then drowsiness, followed by unconsciousness.

***Urine output*:** a reduction in urine output to < 30 mL/hour in pregnancy indicates inadequate renal perfusion.

In pregnancy: *fetal compromise* can be the first sign of shock in the mother.

The **WHO definition of shock** is cold hands, *plus* CRT of > 3 seconds, *plus* a weak and rapid pulse.

Life-threatening shock is usually associated with:
- severe tachycardia
- a weak-volume pulse (ideally assess centrally: brachial, femoral or carotid)
- low blood pressure (this is a late sign)
- extreme central pallor (especially if there is severe anaemia)
- raised respiratory rate (due to acidosis)
- poor skin circulation, with a CRT of > 3 seconds
- reduced conscious level.
- Changes in the fetal heart rate (bradycardia or tachycardia)

Remember that anaphylaxis is one cause of shock, and typically there is a relevant history and other signs such as angio-oedema and urticaria.

Remember that if shock is associated with heart failure, fluid overload will be fatal (for information on how to recognise and manage heart failure, see Section B1).

Resuscitation of the circulation in pregnancy

For cardiac arrest or near arrest, **chest compressions** should be undertaken (Section C9). Ensure that there is an open and secure airway.

Give **high-flow oxygen** to any patient who has an inadequate circulation (whether due to shock or to heart failure). This should be administered via a face mask with a reservoir bag (or an endotracheal tube if intubation has been necessary).

Venous or intra-osseous access should be obtained and blood for essential tests taken (haemoglobin, cross-matching, blood clotting factors, and urea and electrolytes if possible).
After 20 weeks' gestation, place the patient in the left lateral tilt position to prevent uterine pressure on the abdominal and pelvic veins reducing venous return to the heart.

Treating shock in pregnancy (see Section C6)
In all patients with shock, elevate the legs and only if there are sufficient helpers available, consider placing the leg segments (1,2, and 3) only of an anti-shock garment to gain time whilst awaiting blood transfusion and laparotomy.

Do not apply the pelvic or abdominal segments (4 and 5) of the garment and do not stop other vital activities to arrest the bleeding whilst placing the leg segments of the garment in place.

Giving **tranexamic acid** 1g early in haemorrhage improves outcome. It can be repeated after 30 minutes if needed.

Fluids in shock
In most cases of shock, if obvious bleeding is the cause then the first priority must be to stop the bleeding. IV or IO fluids are then required as the immediate resuscitation treatment, once the airway has been opened and secured and oxygen is being given. However, different causes of shock require different approaches to treatment, as described below.

- If loss of fluid causing **hypovolaemia** is the cause of shock: give an immediate **IV/IO bolus of 500-1000 mL of crystalloid (usually Ringer-lactate/Hartmann's or 0.9% saline)** provided that heart failure is not present (*see* above).

- If the loss of fluid causing shock is due to **severe gastroenteritis**, there will usually be evidence of severe dehydration and a history of profound or long-standing diarrhoea. Give 500-1000 mL **of Ringer-lactate or Hartmann's solution as an initial IV or IO bolus** as rapidly as possible, reassess, and then repeat if necessary. In cases of cholera, up to 3 litres may be required in pregnant patients. Additional potassium will usually be required (*see* Section B7)

- If the loss of fluid causing shock is due to **bleeding**, which is **one of the commonest causes in pregnancy**, give crystalloid immediately and then try to obtain blood for transfusion as rapidly as possible, ideally fresh donor blood as it contains platelets and clotting factors. Give O-negative blood if this is available.

The concept of **targeted crystalloid fluid resuscitation** is important and requires urgent research into management if the cause of hypovolaemic shock is haemorrhage due to penetrating injury in trauma or to obstetric haemorrhage such as ruptured ectopic pregnancy. Here the initial boluses of IV crystalloids required to treat shock would **only** be given to keep the vital organs (especially the brain, heart and kidneys) perfused before surgery and/or specific medical treatments to stop the bleeding have started to take effect.

Fresh blood is particularly useful to combat the coagulopathy that occurs in major blood loss if specific coagulation components such as platelets are unavailable.

Giving too much IV crystalloid can increase the blood pressure and theoretically increase bleeding by disrupting early clot formation. IV crystalloid also dilutes the red cells (and coagulation factors) in the circulation.

We suggest that when giving boluses of crystalloid in **shock due to bleeding (before blood is available and before procedures undertaken to stop haemorrhage are effective)** in patients with obstetric haemorrhage or penetrating major trauma, only the amount needed to maintain the blood pressure at a level sufficient to perfuse the vital organs is given. There is no clear evidence to indicate the precise blood pressure that should be achieved in pregnant women who are in shock due to haemorrhage. **Adequate perfusion of vital organs may best be indicated by a radial pulse that can be palpated and a conscious level of A or V on the AVPU scale (i.e. the woman is either awake or will respond by opening their eyes when spoken to).**

During pregnancy, the adequacy of the fetal heart rate may also be helpful but do not take too long to identify this.

When shock is present in pregnancy, therefore, and to maintain a palpable radial pulse and adequate conscious level, start with IV boluses of 500 mL of crystalloid or ideally blood, and reassess after each bolus.

In situations where there is brisk active blood loss and delay in obtaining blood or effective intervention to halt the bleeding, several boluses of crystalloids may be required. **The importance of undertaking measures to halt the bleeding and obtaining blood for transfusion rapidly cannot be overstated.**

If shock is due to **septicaemia with purpura** (meningococcus or dengue), give IV or IO boluses of Ringer-lactate/Hartmann's or 0.9% saline as fast as possible, 1 litre in pregnant women, and then reassess. Usually at least 2–3 litres in pregnant women will be required to overcome septic shock (*see* Section A+14). In this situation, **inotropes** may be valuable if they are available and safe to use

If shock is due to **anaphylaxis,** give a**drenaline,** 1 mg (1 mL of 1 in 1000) IM in pregnant women, in addition to IV or IO fluid (see Section B3).

If shock is due to **severe anaemia** (see Section A+1), IV crystalloid boluses such as Ringer-lactate or Hartmann's solution must be given with extreme care (due to the risk of heart failure). As soon as possible, give blood carefully (50 mL in pregnant women, over 15 minutes) and then reassess and repeat if it is safe to do so.

Partial exchange transfusion may be helpful in this situation, especially if it is possible to access a large superficial vein in the antecubital fossa. Successively remove 20-mL aliquots of the patient's blood and replace each 20 mL with 40 mL of packed donor red blood cells until shock has resolved.

Treating Heart failure (see Section B1)

This life-threatening situation can be seen in severe anaemia, after IV fluid overload, in the presence of structural heart disease, and with severe hypertension in pregnancy. It is important to distinguish heart failure from shock, as the resuscitation required is different.

Some of the following signs will be present in heart failure:

- tachycardia out of proportion to respiratory difficulty
- severe palmar or oral pallor (if anaemia is the cause)
- raised jugular venous pressure
- gallop rhythm on auscultation of the heart
- some heart murmurs (if a structural heart defect is responsible)

- an enlarged, sometimes tender, liver
- crepitations on listening to the lung bases

In pregnancy, **severe hypertension** can cause heart failure (check the blood pressure; patients with values above 170/110 mmHg can present with heart failure and pulmonary oedema).

Resuscitation for heart failure in pregnancy

1. **Sit the patient up**.
2. Give high flow **oxygen.**
3. Give I.V. furosemide 40mg over 2 minutes. Repeat after 30 minutes if there is an inadequate diuretic response. (Max dose 120mg/hour)
4. Provided the patient is not hypotensive (systolic blood pressure NOT below 90 mmHg) and has no serious obstructive heart valvular disease give Glyceryl Trinitrate (G.T.N.) by sublingual spray (400micrograms/puff) at a dose of 2 puffs every 5 minutes.
5. If GTN spray is not available give a glyceryl trinitrate (GTN) tablet 500 micrograms sublingually and repeat one tablet every 15 minutes up to a total of 3 tablets
6. I.V. morphine 5 mg over 5 minutes can be given as a dilator of veins and anxiolytic. Morphine should be used with caution, especially in patients with altered mental status and impaired respiratory drive.
7. If the patient has severe anaemia, consider **partial exchange transfusion (see Section C5)**.
8. If still pregnant, ensure delivery as soon as patient is stabilised.

Primary assessment and resuscitation of neurology (disability)

Always assess and treat haemorrhage control, Airway, Breathing and Circulation problems before undertaking neurological assessment.

Primary assessment: Conscious level: AVPU

Alert is the normal state for an awake person. If the patient does not respond to **Voice** (i.e. being spoken to and asked 'Are you all right?'), it is important that assessment of the response to **Pain** is undertaken next. A painful central stimulus can be delivered by sternal pressure, by supra-orbital ridge pressure or by pulling frontal hair. A patient who is **Unresponsive or who only responds to Pain** has a significant degree of coma which can reduce airway reflexes and cause airway obstruction and impair breathing causing hypoxia.

A	**ALERT**
V	**RESPONDS TO VOICE**
P	**RESPONDS TO PAIN**
U	**UNRESPONSIVE**

Convulsions
Generalised convulsions, also known as 'fits' or 'seizures', can obstruct airway and cause abnormal breathing, both during the fit itself and immediately afterwards, when lowered levels of consciousness may be present. Hypoxia is likely, because of increased oxygen consumption because of the fit and because of decreased oxygen reserves in pregnancy

Posture
Many patients who have a serious illness in any system can be hypotonic.

Stiff posturing, such as that shown by decorticate (flexed arms, extended legs) or decerebrate (extended arms, extended legs) posturing, is a sign of serious brain dysfunction. These postures can be mistaken for the tonic phase of a convulsion. Alternatively, a painful stimulus may be necessary to elicit these postures.

Severe extension of the neck due to upper airway obstruction can mimic the opisthotonus that occurs with meningeal irritation.

Pupils
Many drugs and cerebral lesions have effects on pupil size and reactions. However, the most important pupillary signs to seek are dilatation, lack of reaction to light and inequality, which suggest possible serious brain disorders.

Always check blood glucose levels or suspect hypoglycaemia. Hypoglycaemia with a blood glucose level of less than 2.5 mmol/L (45 mg/dL) can cause impaired consciousness, coma or fits.

Respiratory effects of central neurological failure
The presence of any abnormal respiratory pattern in a patient with coma suggests mid- or hindbrain dysfunction.

Circulatory effects of central neurological failure
Systemic hypertension with sinus bradycardia (Cushing's response) indicates compression of the medulla oblongata caused by herniation of the cerebellar tonsils through the foramen magnum. **This is a late and pre-terminal sign.**

Raised intracranial pressure (ICP) may cause:
- *hyperventilation*
- slow sighing respirations
- apnoea

- hypertension
- bradycardia.

Resuscitation for major neurological problems: D Disability

1. If the patient is unconscious (P or U on the AVPU scale) but their airway and breathing are adequate, place them in the recovery position, so that if they vomit there is less likelihood of aspiration because when unconscious, the gag reflex may not be operative.
2. If the patient is unconscious or fitting, always give oxygen.
3. If hypoglycaemia is a cause of reduced consciousness (or a suspected cause, but immediate blood glucose measurements are not possible), treatment with glucose is urgently required. In pregnancy give 100 mL of 25% glucose IV or IO. (Make 100 mL of 25% glucose by adding 50 mL of 50% glucose to 50 mL of Ringer-lactate or Hartmann's solution). Recheck the blood glucose level after 20 minutes, and if the level is low (< 2.5 mmol/litre or < 45 mg/dL), repeat the IV/IO glucose.
4. If fitting occurs in pregnancy, treat as eclampsia and give magnesium sulphate (see SectionA+13).
5. To gain time in acutely raised intracranial pressure (ICP) in pregnancy (e.g. in cases of head injury), consider the use of IV mannitol. Give 20 grams of 20% mannitol over 15 minutes as soon as cerebral oedema is suspected. Repeat every 4–6 hours. This will draw fluid out of the brain for a short while, thereby temporarily reducing the ICP. Because the effect of mannitol is only short-lived (a matter of hours), it is used to gain time while definitive care is being set up (e.g. surgical intervention to drain an extradural or subdural haematoma; see Section D1).
6. In any case where meningitis or encephalitis is suspected, it is vital that suitable antibiotics and/or antiviral drugs are started IV or IO as soon as the condition is suspected.

Secondary assessment and emergency treatments

The secondary assessment takes place once vital functions have been assessed and the initial resuscitation of those vital functions has been started. Primary assessment and resuscitation can usually be undertaken in less than 1 minute if the patient does not have a life-threatening airway, breathing, circulation or neurological problem.

Secondary assessment includes a *focused medical history*, a *focused clinical examination* and *specific investigations* designed to establish which emergency treatments might benefit the patient.

At the end of secondary assessment, the practitioner should have a better understanding of the complication of pregnancy, the illness or injury likely to be affecting the patient and may have thought of possible diagnoses.

Emergency treatments will be undertaken at this stage in addition to those given as part of resuscitation/life-saving treatments, in order to manage specific components of serious illnesses or injuries (e.g. steroids for asthma, Caesarean section for antepartum haemorrhage due to placenta praevia).

The history often provides the vital clues. Do not forget to ask any health worker who has seen the patient about the initial condition and about treatments and the response to treatments that have already been given.

The secondary assessment is not intended to complete the diagnostic process, but rather it aims to identify any problems that require emergency treatment.

1. Secondary assessment following the control of life threatening haemorrhage: examples of emergency treatment that might be needed
Following abdominal uterine massage as *resuscitation treatment* to try and stop bleeding following post-partum uterine atony, emergency treatment with uterotonic drugs, bimanual compression, condom catheter tamponade may be required.

2. Secondary assessment following airway and breathing problems; examples of emergency treatment for airway and breathing failure
Stridor and shock following ingestion or injection of a known allergen suggests anaphylaxis (see Section B3). Patients in whom this is likely should have already received IM adrenaline (1 mg in pregnancy *as resuscitation treatment*). Nebulised salbutamol or adrenaline and IV or oral steroids and anti-histamines would then be part of emergency treatment.

Patients with a history of asthma or with wheeze, significant respiratory distress and/or hypoxia should receive *inhaled salbutamol and oxygen as resuscitation treatment*, but then need oral steroids and further inhaled bronchodilators as emergency treatment (see Section *B2*).

In acidotic breathing, measure blood glucose levels to confirm diabetic ketoacidosis. A bolus of IV Ringer-lactate or Hartmann's solution will already have been given as *resuscitation treatment* for any shock due to dehydration, and insulin can now be given as emergency treatment (see Section *B4*).

In clinically suspected pulmonary embolus in pregnancy, IV unfractionated heparin could be given as *resuscitation treatment,* and subcutaneous low-molecular-weight heparin should be given as emergency treatment (see Section *A+15*).

3. Secondary assessment following circulation problems; examples of emergency treatment for circulatory failure

After resuscitation treatment targeted secondary assessments and emergency treatments are often needed for obstetric emergencies that are known to cause shock. These include sepsis (for which antibiotics are needed), and antepartum or postpartum haemorrhage (for which specific treatment including medication such as uterotonic drugs and urgent surgery are needed) together with replacement of lost blood.

Further IV/IO boluses of fluid should be given as emergency treatment in shocked patients with hypovolaemia from gastroenteritis or with sepsis who have not shown a sustained improvement in response to the first IV fluid bolus given as *resuscitation treatment* (*see* Sections C6 and B7).

In trauma if there is uncontrolled internal bleeding, after an initial IV fluid bolus or O negative blood as *resuscitation treatment,* early surgical intervention has priority as emergency treatment, and too much IV fluid may be harmful. Continued blood transfusion may also represent an emergency treatment after the initial resuscitation (*see* Section D1).

Where shock due to sepsis is present and treated with IV fluid boluses as *resuscitation treatment*, IV broad-spectrum antibiotics would subsequently be given as emergency treatment.

Secondary assessment following neurological problems (disability): examples of emergency treatment for neurological failure

In a pregnant patient with convulsions, resuscitation treatment would include airway management, oxygen and the first doses of magnesium sulphate. Subsequent emergency treatment for presumed eclampsia would include urgent delivery and anti-hypertensive drugs as appropriate.

In a diabetic pregnant patient on regular insulin treatment, loss of consciousness without signs of acidosis would first receive ***resuscitation treatment*** for hypoglycaemia by a bolus of IV glucose. The prevention of further hypoglycaemia by subsequent IV and oral glucose and modification of the dose of insulin would represent emergency treatment. (Section B4

Section C9. Basic and Advanced Life support skills and cardio-respiratory resuscitation in pregnancy

Background

Respiratory arrest, cardiac arrest or both during pregnancy, during delivery or after birth are unusual but maternal survival rates are very low. The cause of the arrest is not often reversible, and the physiological changes present, especially in advanced pregnancy hinder effective Cardio-Pulmonary Resuscitation (CPR). Prevention is the key. Cardiac arrest in pregnancy results in absent uterine perfusion, and the fetus will also die. Even when CPR is ideal, it is not possible to generate a cardiac output of more than 30%.

Causes of respiratory and cardiac arrest in pregnancy

- massive haemorrhage (ante or postpartum)
- eclampsia and its treatment
- pulmonary embolism
- major trauma
- myocardial infarction (heart attack)
- amniotic fluid embolism
- severe infection
- local anaesthetic toxicity
- magnesium sulphate toxicity
- high spinal anaesthetic

Physiological changes of pregnancy that make cardiopulmonary resuscitation (CPR) more difficult

1. Pregnant mothers more easily develop hypoxaemia. The enlarged uterus along with the resultant upward displacement of the diaphragm compresses the lower part of both lungs and decreases lung compliance.
2. They have reduced immune function which means that chest infections can be more severe, especially viral infection.
3. The expanding abdominal mass in addition to impairing lung expansion also increases the risk of gastro-oesophageal reflux and the aspiration of gastric contents.
4. The most serious physiological change is compression of the inferior vena cava in the supine position. It is essential that CPR is performed in the left lateral position in any pregnant woman where the uterus is a significant intra-abdominal mass (usually after 20 weeks' gestation).

5. During closed-chest cardiac compression the best cardiac output that can be achieved is between one-fourth and one-third of normal. Although many factors contribute to this, poor venous return to the heart is of paramount importance. At term the vena cava is completely occluded in 90% of supine pregnant patients. This results in a decrease in cardiac stroke volume of as much as 70%. It is helpful to manually displace the uterus to the left in advanced pregnancy (*see* Figure C9. 1).
6. Caesarean section performed early in resuscitation greatly improves the effectiveness of maternal resuscitation.
7. MCAI recommends that CPR for pregnant women includes 5 preliminary rescue breaths and a subsequent ratio of 15 chest compressions to 2 breaths.

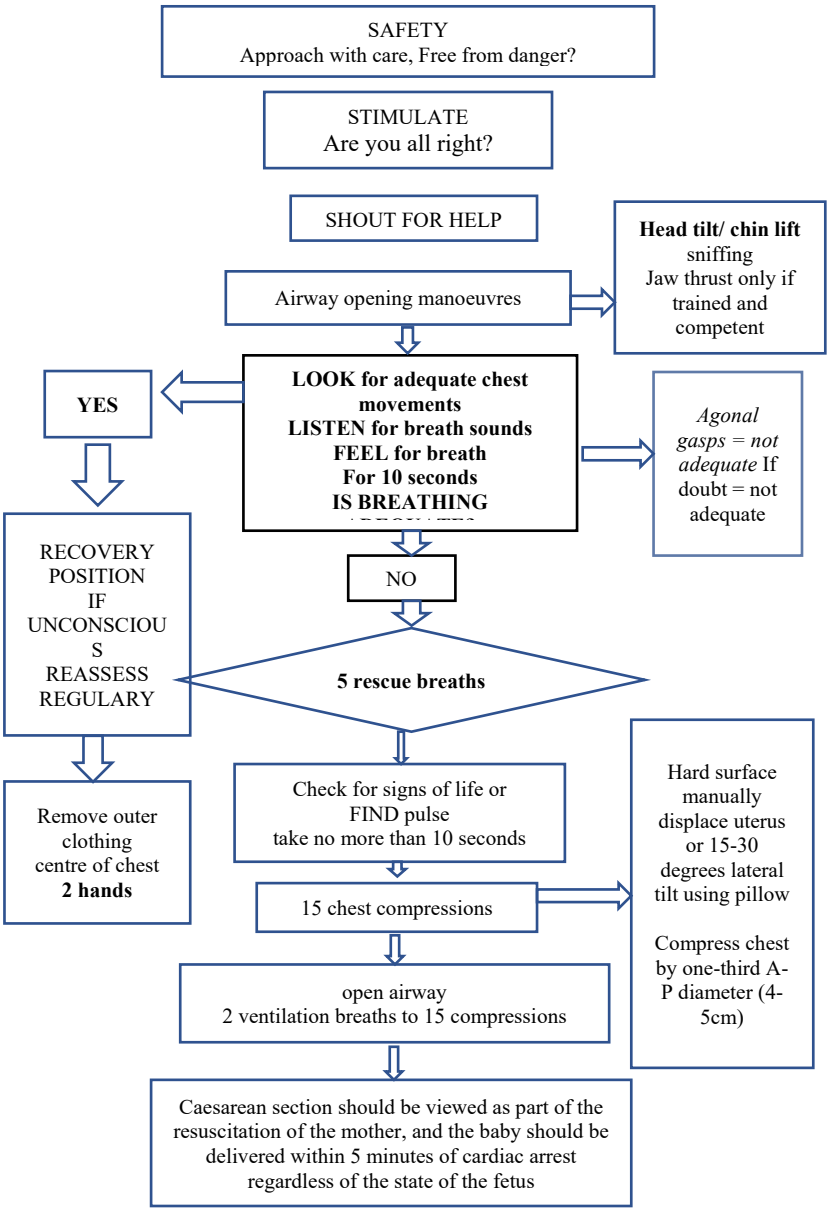


Figure C9.1 *Algorithm for life support in pregnant women.*

The CABCD approach to conditions leading to CPR in pregnancy

Control obvious bleeding, ensure **A**irway is open, ensure patient is **B**reathing adequately, rescue the **C**irculation, **D** place in recovery position once CABC has been achieved and if the patient remains unconscious.

If more than one rescuer is present, one person should start CABCD. The second person should activate the Emergency Medical Services (EMS) system (if there is one) and then return to assist in the life support effort.

The first action must be to **CALL FOR HELP**. Include nurse anaesthetist, obstetrician, operating theatre and laboratory staff.

Control of haemorrhage

Try and stop any obvious bleeding

There are many situations in pregnancy where major haemorrhage can rapidly lead to death if not given basic treatment. Examples include: incomplete miscarriage, antepartum haemorrhage due to placenta praevia, abruption or ruptured uterus, postpartum haemorrhage PPH and major trauma.

For PPH, continuous strong massage of the uterus just above the symphysis pubis can slow down or stop the bleeding giving time for drugs and other procedures. 2. Following major trauma, application of a pressure bandage can stop heavy obvious bleeding.

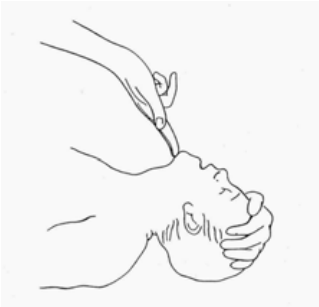
AIRWAY: Equipment and skills for opening and maintaining the airway

'Are you all right?'

An initial simple assessment of responsiveness consists of asking the patient 'Are you all right?' and gently shaking her by the shoulder.

An obstructed airway may be the primary problem, and correction of the obstruction can result in recovery without the need for further intervention. If the patient is unconscious but breathing, the recovery position should be used. For pregnant women with an abdominally palpable uterus the left lateral position must be adopted. If the patient is not breathing, this may be because the airway is blocked by the tongue falling back and obstructing the pharynx. Attempt to open the airway using the **head tilt/chin lift manoeuvre.** The rescuer places their nearest hand on the patient's forehead and applies pressure to tilt the head back gently. The correct position is '**sniffing' (nose up in the air) in pregnancy** (*see* Figure C9.2).

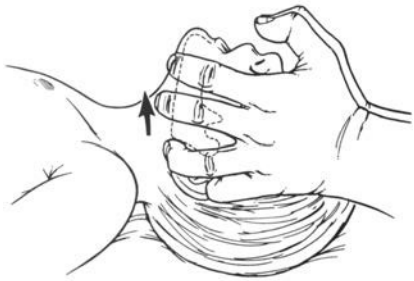
Figure C9.2 *Head tilt with chin lift in 'sniffing' position in pregnancy*



The fingers of the other hand should then be placed under the chin, and the chin of the supine patient should be lifted upwards. As this action may close the patient's mouth, it may be necessary to use the thumb of the same hand to part the lips slightly.

As an alternative to the head tilt/chin lift, the **jaw thrust manoeuvre** can be effective, but requires more training and experience.

Figure C9.3 *Jaw thrust to open airway*



Jaw thrust is achieved by placing two or three fingers under the angle of the mandible bilaterally and lifting the jaw upward (*see* Figure C9.3).

The adequate opening of the airway should then be assessed by

- looking for adequate chest movements
- listening for breath sounds
- feeling for breaths.

This is best achieved by the rescuer placing their face above that of the patient, with the ear over the nose, the cheek over the mouth, and the eyes looking along the line of the chest. They should take no longer than 10 seconds to assess breathing

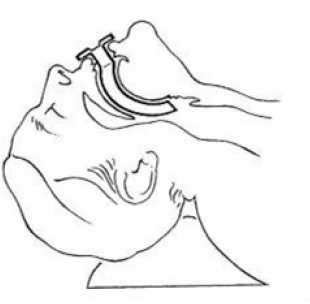
If there is any object obvious in the mouth and it is easy to reach, remove it. **Do not perform a blind finger sweep in the mouth.** A blind finger sweep can damage the soft palate, and foreign bodies may be forced further down the airway and become lodged below the vocal cords.

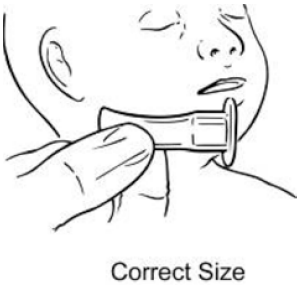
SUCTION: Remove blood and secretions from the mouth with a rigid wide-bore suction tube (such as a Yankauer) under direct vision taking care not to damage delicate tissue or induce vomiting. If attempts to clear the airway do not result in spontaneous breathing, this may be because the airway is still not open or because the airway is open but there is no breathing.

Figures C9.4 and C9.5 measuring the correct size for oropharyngeal airway
The oropharyngeal or Guedel airway is use in the unconscious or obtunded patient to provide an open airway channel between the tongue and the posterior pharyngeal wall. In the awake patient or lightly unconscious patient with an intact gag reflex, it may not be tolerated and may induce vomiting, laryngospasm or apnoea and is therefore potentially dangerous.

A correctly sized oropharyngeal airway when placed with its flange at the centre of the incisor teeth, then curved around the face, will reach the angle of the mandible. Too small an airway may be ineffective; too large an airway may cause laryngospasm. Either may cause mucosal trauma or may worsen airway obstruction. Reassessment following placement is therefore a vital part of safe insertion of an airway device.

Figures C9.4 and C9.5 *measuring the correct size for oropharyngeal airway*





The twist technique is used in pregnancy and means that the convex side of the airway is used to depress the tongue as the airway is pushed into the mouth (Figure C9.6). It is essential not to push the tongue back.

Insertion of one of these devices should result in improvement in the patient's condition. If it does not occur then a re-appraisal of the choice or size of airway is urgently required.

Figure C9.6 *Inserting an airway in pregnancy*

BREATHING: Equipment and skills for helping the patient to breathe

Oxygen

Give oxygen if respiratory distress (recessions, nasal flaring, head bobbing etc.) or if cyanosis (blueness) is central (around lips and tongue or inside mouth) or if shocked or if fitting. If SaO_2 monitoring is available give oxygen if SaO_2 < 95%.

If oxygen supplies are limited, use oxygen at sufficient flow rates to maintain oxygen saturations at >94%. If using low flow rates do not use reservoir bag.

If using oxygen mask, ensure that mask is large enough to cover mouth and nose. Both low and high flow oxygen (up to 15l/min) can be given. Hold mask in place using the elastic strap around back of head. (Figure C9.7)

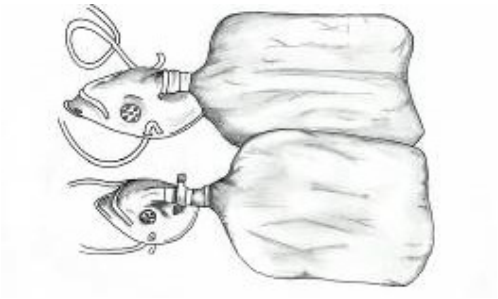


Figure C9.7 *Face mask with reservoir*

Figure C9. 8 *Nasal cannula*

A mask with a reservoir bag (Figure C9.7) allows up to 100% oxygen to be delivered. Without a reservoir, it is only possible to deliver around 40%.

Nasal cannula (Figure C9.8) come in 3 sizes small, medium, large to give oxygen concentrations of up to 40%. Nasal cannula have a curved appearance; apply by placing curve of cannulae into natural curve of nasal passage. Secure with small piece of tape on both cheeks over tubing. Provide a maximum of 4-5 litres/min.

If airway-opening techniques do not result in the resumption of adequate breathing within 5-10 seconds, use a self-inflating bag–mask system to provide lung inflations.
Definition of adequate breathing
A patient may have very slow or shallow breathing, or take infrequent, noisy, agonal gasps. Do not confuse this with normal breathing.

Sources of oxygen
Oxygen cylinders contain compressed gas. A flow meter needs to be fitted to regulate flow. A hissing noise can be heard if gas is being delivered.
Take the reading of flow rate from the middle of the ball. Always switch off flow when not in use; ensure indicator ball is at the bottom of flow meter and not moving.
DO NOT leave anything flammable near to the oxygen supply. **Do not allow smoking near to oxygen.** Check adequate oxygen supply is available at least 3 times a day (use a signed log book). If gauge indicating amount left in cylinder is not available, switch on flow and listen to hiss. Replace cylinders as they empty. Ensure cylinders are stored in an upright position on a flat surface and are secure. Cylinder keys should be tied to each cylinder.

Oxygen concentrators require a source of electricity and give >95% oxygen with a flow of 1-8 L/min.

Face masks with seal over nose and mouth for positive pressure ventilation (Figure 58.9) These are used for bag-mask ventilation. Masks are available in various sizes and the appropriate size to cover the mouth and nose should be chosen.

Figure C9.9 *Close fitting face masks to enable Positive pressure lung inflations*

Self-inflating bags (Figure C9.10)

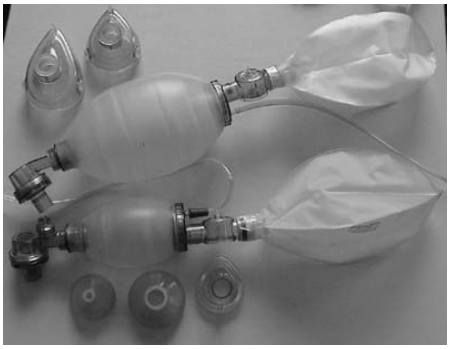
This is one of the most important pieces of emergency equipment allowing ventilation without a supply of gas. The two appropriate sizes are 500ml and 1600ml (the smaller for neonates and the larger in pregnancy). These bags have pressure-limiting valves that operate at between 30 and 45cm H_2O. Test the valve by placing the mask on a surface and pressing the bag and ensuring the valve opens. It can be overridden, if necessary, for stiff, poorly compliant lungs.

The bag connects to the patient through a one-way valve to direct exhaled gas to the atmosphere. The other end connects to the oxygen supply and can attach to a reservoir bag which allows high concentrations of oxygen to be delivered (can be up to 98%). Without the reservoir bag concentrations of up to 40% O_2 are delivered.

The bag itself is easily dismantled and reassembled. It is important to realize that this system will operate without an attached oxygen supply, allowing resuscitation to be initiated before oxygen is available. However, if resuscitation is failing, check that oxygen is being delivered into the bag and patient and that oxygen has not been disconnected.

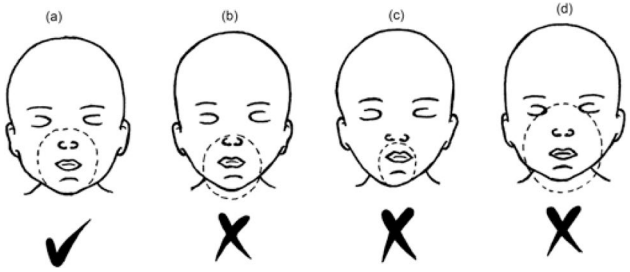
Always use high flow oxygen and reservoir bag during resuscitation
Clean the system after each patient

Figure C9.10 *Self inflating bags and masks*



It is essential that the mask is properly sized and correctly placed over the mouth and nose of the patient. (Figure C9.11)

Figure C9.11 *Showing the correct placement of the close-fitting face mask*



Rescue breaths

If in doubt about the adequacy of breathing, five initial rescue breaths should be given.

If the chest does not rise, the airway is not open. The usual cause is failure to correctly apply the airway-opening techniques discussed earlier. The first step is to readjust the head tilt/chin lift position and try again. If this is not successful, jaw thrust should be tried. If two rescuers are present, one should maintain the airway while the other breathes for the patient.

Failure of both head tilt/chin lift and jaw thrust should lead to suspicion that a foreign body is causing the obstruction (see below).

While performing rescue breaths, the presence of a gag reflex or coughing is a positive sign of life (see below).

Once the patient starts to breathe, replace the bag and mask system with a face-mask and reservoir. Because of the internal valves, it is not possible to breathe spontaneously through the bag and valve system.

Using a pulse oximeter to monitor oxygenation

1. Switch on and make sure any mains supply is also switched on (this will charge the internal battery, if this exists) - the sensor should light up.
2. Apply the sensor to a finger or toe or ear in pregnancy.
3. Fix the sensor in position:
4. flexible sensors should be secured with either their own sticky tape, or additional sticky **tape that stretches,** so arterial pulsations are not impaired
5. rigid sensors, or ‘crocodile clips,’ usually attach on a finger and do not need further fixation
6. It is important that ambient light does not pass between the emitting and receiving light sensors: all the emitted light must go through the tissue.

7. In situations of bright light, or poor skin perfusion, consider covering the sensor using, for example, a dark coloured glove, mitten, or sock.
8. Wait for a short period of time, usually 20 seconds, before reading the measurement of SpO_2 and heart rate from the oximeter, but **only when an adequate arterial plethysmograph pulsation is found.** Most oximeters will have either a bouncing bar display or arterial pulse waveform that is in time with the patients pulse or heart rate.
9. Set the low and high alarm limits for the oxygen saturation (e.g. 94% and 100%) and pulse rate.
10. Take readings of SpO_2 and pulse rate when a good pulsation is present and the values are stable.
11. May not get accurate reading if the patient is shivering, moving, if cold hands or feet, wearing nail varnish or if there is carbon monoxide poisoning, as with for example burns.
12. *Note*: skin colour, sickle cell disease and other haemoglobin disorders do not significantly affect the measurement of SaO_2.

Normal Values for SpO_2

These are usually 95-100% when breathing room air at sea level, and in the presence of good pulse detection. Aim to keep $SaO_2 > 94$ %.

Low levels whilst breathing additional oxygen usually indicate very serious breathing problems. Normal levels whilst breathing additional oxygen do not mean that ventilation is normal (may still have a significant retention of carbon dioxide).

Longer term respiratory support

Respiratory support is needed when the patient fails to sustain adequate ventilation despite treatment of the respiratory condition. Respiratory failure may result from any of the following:

- respiratory illnesses
- severe shock
- coma
- convulsions for example eclampsia
- meningo-encephalitis
- neuromuscular disorders
- raised intracranial pressure (e.g. from trauma).

Pregnant patients in the third trimester are more susceptible to infections and respiratory failure. They have reduced immune function, an expanding abdominal mass that impairs lung expansion, and are more prone to gastro-oesophageal reflux and aspiration of gastric contents.

As respiratory failure progresses, it will ultimately lead to cardiorespiratory arrest and death. Thus, recognition of the severity of the conditions that lead to respiratory failure, followed by appropriate treatment, will reduce morbidity and mortality.
Signs that indicate the adequacy of breathing include the following:

- intercostal, sub-costal and supra-sternal recession
- respiratory rate
- inspiratory and expiratory noises
- use of accessory muscles
- adequacy of breath sounds and chest expansion
- heart rate
- skin colour
- mental status.

In the following situations, however, these signs are less useful because there is absent or decreased effort of breathing:

1 with fatigue or exhaustion (e.g. after prolonged respiratory effort)
2 with loss of cerebral drive from raised intracranial pressure, poisoning or encephalopathy

In these cases, pay more attention to the chest expansion, heart rate, skin colour, mental status and SpO_2. Values of SpO_2 of less than 94% in air (at sea level; see Textbook for values at high altitude) are abnormal and would warrant at least initial treatment with additional inspired oxygen. Values of less than 94% when the patient is receiving oxygen are low, but even values of more than 95% in oxygen may be associated with significant hypoventilation. It is essential to remember that, in respiratory failure, normal SaO_2 while receiving additional inspired oxygen is likely to be associated with significant hypoventilation or intra-pulmonary shunting. Measurement of transcutaneous, end-expired or blood carbon dioxide levels will confirm this.

When respiratory fatigue is severe, oxygenation is poor or deteriorating, or carbon dioxide levels are raised, respiratory support should be used, if available.

Respiratory support by using positive pressure ventilation

1. Monitoring of patient status and airway or mask pressures is necessary when undertaking any form of respiratory support (see below).
2. Positive airway pressure involves a flow of air or other gas mixture to the patient's airways. This flow may be continuous (as in CPAP) or intermittent (as in IPPV). It may vary with inspiration and expiration (as in BiPAP), or to accommodate the leaks or variable compliance of ventilator tubing, airways or lung units.
3. Mask ventilation can be well tolerated.
4. In the presence of excess airway secretions or an open mouth, nasal masks and nasal cannula may not produce as effective airway pressures as ventilation with tracheal intubation (or relatively higher pressures may be needed for the

same effect).

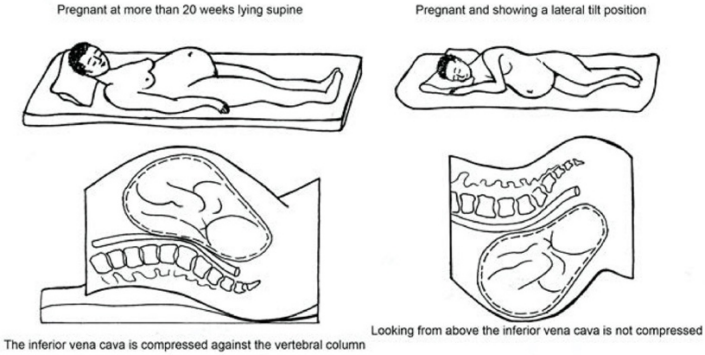
5. The pressures used with masks and cannula may be higher than those used with tracheal intubation, because of the greater potential for air leaks and other volume loss in compliant upper airway structures.
6. Endotracheal intubation should be undertaken by a highly trained health worker, such as a nurse anaesthetist, with rapid sequence drug or gaseous induction, and subsequent analgesia and sedation should be provided.
7. Positive pressure ventilation administered through an endotracheal tube must be accompanied by adequate humidity of the inspired gases.
8. Oxygen may be administered either using a built-in mixer in the ventilator, or by entraining a supply in the ventilator tubing nearer to the patient.
9. Positive pressure ventilators should be able to provide manipulation of either the pressure or volume administered, and the time intervals for inspiration and expiration. There should be alarms for failure to cycle, and for excessive pressure and/or volume administered.

CIRCULATION: Equipment and skills for supporting the patient's circulation before and during cardio-pulmonary resuscitation: CPR

Ideally a venous cannula will be in place, but if not and urgent drugs need to be given intraosseous needle can be a rapid and effective way of accessing the circulation (see Section E13).

Special actions to improve the circulation and if needed, the effectiveness of chest compressions in pregnancy > 20 weeks' gestation where the expanding uterus is compressing the vessels in the abdomen (Inferior vena cava and aorta) (see Figures C9.12 and C9.13)

Figure C9.12 *The supine hypotensive syndrome.*



On the left the mother is lying on her back, her uterus is occluding her inferior vena cava. On the right the mother is lying in a lateral tilt position (the recovery position here) and the inferior vena cava is no longer compressed.

Figure C9.13 *Left lateral tilt (on the left) and manual displacement of uterus (on the right)*

Place the patient on a hard surface in the left lateral tilt position to overcome aortic and vena caval compression. This can be achieved with a wedge placed under the right hip to displace the gravid uterus to the left, or it is possible to improvise with a pillow or towel. If one or more assistant is available, they can manually displace the uterus to the left side of the vena cava (Figure C9.13). Effective chest compressions if required can be accomplished at a 15–30° tilt to the left, but displacement of the uterus is the more effective method.

Referring to Figure C9.1 once the initial five RESCUE breaths have been given successfully, circulation should be assessed and managed as follows.

Check for signs of life and/or pulse (take no more than 5-10 seconds)
Even experienced health professionals can find it difficult to be certain that the pulse is absent within 10 seconds, so the absence of **'signs of life'** is the best indication for starting chest compressions. *'Signs of life'* include movement, coughing, gagging or normal breathing (but not agonal gasps, which are irregular, infrequent breaths). Thus, the absence of evidence of normal breathing, coughing or gagging (which may be noticed during rescue breaths) or any spontaneous movement is an indication for chest compressions.
Inadequacy of circulation is also indicated by the absence of a central pulse for up to 10 seconds, but it can be difficult, and therefore time wasting, to be certain about this – hence the current emphasis on assessing the presence of 'signs of life.'

Start chest compressions if:

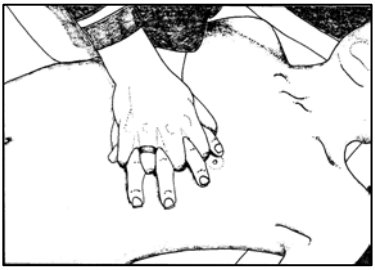
- there are no signs of life *OR*
- there is no pulse In pregnancy (the carotid pulse in the neck may be palpated) *OR*
- there is a slow heart rate measured with a stethoscope (less than 40 beats/minute in an unconscious pregnant woman with poor perfusion)

'Unnecessary' chest compressions are almost never damaging. It is important not to waste vital seconds before starting chest compressions after oxygenating the patient with the rescue breaths. If there are signs of life and the pulse is present (and has an adequate rate, with good perfusion), but apnoea persists, bag and mask ventilation resuscitation must be continued until spontaneous breathing resumes.

Chest compressions

For the best output, the patient must be placed on a hard surface. The chest should be compressed by one third of its depth.

Figure C9.14 *Chest compressions using two hands in pregnancy*



Chest compressions should compress the lower half of the bony part of the sternum. In pregnancy compressions may be achieved most easily by using both hands with the fingers interlocked (Figure C9 14). The rescuer may choose one or two hands to achieve compression of one third of the depth of the chest.

15 compressions should be given to 2 ventilations.

Technique for giving chest compressions in pregnancy

1. Kneel by the side of the patient, who must be positioned on a firm surface, the uterus having been manually displaced (*see* above).
2. Place the heel of one hand in the centre of the patient's chest.
3. Place the heel of your other hand on top of the first hand.
4. Interlock the fingers of your hands and ensure that pressure is not applied over the patient's ribs. Do not apply any pressure over the upper abdomen or the bottom end of the bony sternum (breastbone).
5. Position yourself vertically above the patient's chest and, with your arms straight, press down on the sternum to a depth of 5–6 cm.
6. After each compression, release all the pressure on the chest without

losing contact between your hands and the sternum.

7. Repeat at a rate of about 100 times a minute
8. Compression and release should take an equal amount of time.

Continue with chest compressions and rescue breaths in a ratio of 15:2.

If rescue breaths do not make the chest rise as in normal breathing, then before your next attempt:

- check the patient's mouth and remove any visible obstruction
- recheck that there is adequate head tilt and chin lift
- try the jaw thrust if you are able to do this effectively.

Do not attempt more than two breaths each time before returning to chest compressions.

Effective chest compressions are tiring for the rescuer. If there is more than one rescuer present, a different person should take over CPR about every 2 minutes to prevent fatigue. Ensure that there is minimal delay during the changeover between rescuers.

Stop to recheck the patient only if they start breathing normally; otherwise **do not interrupt resuscitation.** Any time spent readjusting the airway or re-establishing the correct position for compressions will seriously decrease the number of cycles given per minute. This can be a real problem for a rescuer working alone, and there is no easy solution.

If recovery occurs and signs of life return, place the patient in the recovery position until they recover consciousness. Continue regularly to reassess vital signs.

Chest-compression-only CPR.

If a self-inflating bag and mask is not available, and you are either unable or unwilling to give rescue breaths using mouth to mouth resuscitation, give chest compressions only. This is particularly relevant in countries where there is a high prevalence of HIV, hepatitis or TB.

If chest compressions only are given, these should be continuous at a rate of 100 compressions per minute. They also will provide some ventilation due to the compressions and release of the chest wall.

Stop to recheck the patient only if they start to breathe normally; otherwise do not interrupt resuscitation.

Continue resuscitation until:

- qualified help arrives and takes over or
- the patient starts breathing normally or
- you become exhausted.

If available, bag–valve–mask ventilation is always preferable to mouth-to-mouth ventilation.

D Neurology

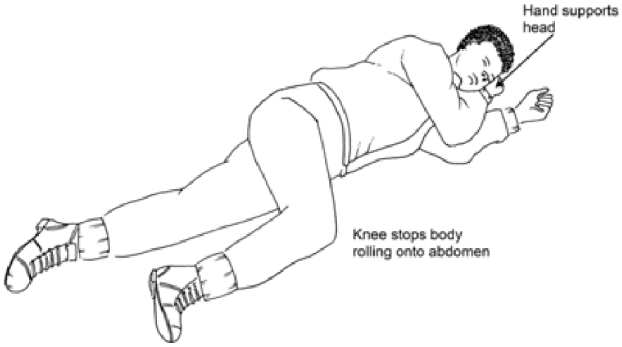
The recovery position

The patient should be placed in a stable, lateral position that ensures maintenance of an open airway with free drainage of fluid from the mouth, ability to monitor and gain access to the patient, security of the cervical spine and attention to pressure points (*see* Figure C9.15).

1. Remove the patient's spectacles (if present).
2. Kneel beside the patient and make sure that both of their legs are straight.
3. Place the arm nearest to you out at right angles to their body, elbow bent with the hand palm uppermost.
4. Bring the far arm across the chest and hold the back of the hand against the patient's cheek nearest to you.
5. With your other hand, grasp the far leg just above the knee and pull it up, keeping the foot on the ground.
6. Keeping their hand pressed against their cheek, pull on the far leg to roll the patient towards you on to their side.
7. Adjust the upper leg so that both the hip and knee are bent at right angles.
8. Tilt the head back to make sure the airway remains open.
9. Adjust the hand under the cheek, if necessary, to keep the head tilted.
10. Check the patient's breathing regularly.

If the patient has to be kept in the recovery position for **more than 30 minutes**, turn them to the opposite side in order to relieve the pressure on the lower arm.

Figure C9.15 *The recovery position*



Management of cardiac arrest in pregnancy

Cardiac arrest occurs when there is no effective cardiac output. Before any specific therapy is started, effective life support (as above) must be established.

Four cardiac arrest heart rhythms can occur:

1. asystole
2. pulseless electrical activity (including electromechanical dissociation)
3. ventricular fibrillation
4. pulseless ventricular tachycardia.

These are divided into two groups.

1. Asystole and pulseless electrical activity (PEA), which do not require defibrillation, are called **'non-shockable' rhythms**.

2. Ventricular fibrillation and pulseless ventricular tachycardia, which do require defibrillation, are called '**shockable' rhythms**.

An electrocardiogram (ECG) is needed to make the diagnosis. *ECG can be monitored directly or as part of an Automatic External Defibrillator (AED) see later in this Section.*

Reversible causes of cardiac arrest

The causes of cardiac arrest in pregnancy are multifactorial, but the two commonest final pathways are through hypovolaemia and hypoxia. All reversible factors are conveniently remembered as the 4Hs and 4Ts (see below). Sometimes cardiac arrest is due to an identifiable and reversible cause, such as shock due to massive haemorrhage, septicaemia or severe diarrhoea. In the trauma setting, cardiac arrest may be caused by severe hypovolaemia or tension pneumothorax or pericardial tamponade (see Section 59).

It is often appropriate to give an early IV 500 ml bolus of Ringer-lactate/ Hartmann's solution as this will be supportive in cases related to severe hypovolaemia. In addition, however, a tension pneumothorax requires definitive treatment by needle thoracocentesis. Continuing blood replacement and the prevention of further haemorrhage may also be required.

Rapid identification and treatment of reversible causes such as hypovolaemic shock, hypothermia, electrolyte and acid–base disturbance, tension pneumothorax and pericardial tamponade are vital.

During CPR it is important to continually consider and correct reversible causes of the cardiac arrest based on the history of the event and any clues that are found during resuscitation.

The 4Hs

1. **H**ypovolaemia is the most prevalent cause in pregnancy with haemorrhage due to obstetric complications being the most common and serious. Significant hypovolaemia may also be associated with trauma, gastroenteritis and sepsis. Control of haemorrhage and urgent IV infusion of blood or crystalloid must be given.
2. **H**ypoxaemia due to respiratory or heart failure is another major cause of cardiac arrest in pregnancy, and its reversal is key to successful resuscitation.
3. **H**yperkalaemia, **H**ypokalaemia, **H**ypocalcaemia, **H**ypermagnesaemia (following overdose of magnesium sulphate in eclampsia) and other metabolic abnormalities may be suggested by the patient's underlying condition (e.g. renal failure, eclampsia), tests taken during the resuscitation, or clues from the ECG. 10 mL of 10% calcium gluconate in pregnancy is indicated in cases of magnesium overdose, hyperkalaemia and hypocalcaemia.
4. **H**ypothermia is associated with drowning incidents and requires particular care. A low- reading thermometer must be used to detect it.

The 4Ts

1. **T**ension pneumothorax in major trauma
2. Cardiac **T**amponade in major trauma
3. **T**oxic substances, resulting either from accidental or deliberate overdose or from a medical mistake, may require specific antidotes.
4. **T**hrombo-embolic phenomena (pulmonary embolus or amniotic fluid embolus).

Non-shockable cardiac arrest

Asystole

This is the most common cardiac arrest rhythm in pregnancy. The response of the heart to prolonged severe hypoxia and shock (which are the usual pathologies) is progressive bradycardia leading to asystole.

The ECG will distinguish asystole from ventricular fibrillation, ventricular tachycardia and pulseless electrical activity. The ECG appearance of asystole is an almost straight line; occasionally P-waves are seen (see Figure C9.16). Check that the appearance is not caused by an artefact (e.g. a loose wire or disconnected electrode). Turn up the gain on the ECG monitor.

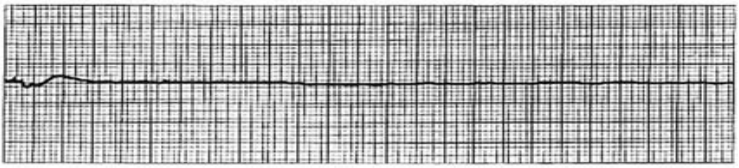


Figure C9.16 *ECG appearance of asystole.*

Pulseless electrical activity (PEA)

This is the absence of a palpable pulse or other signs of life despite the presence on the ECG monitor of recognisable ECG complexes that normally produce a pulse (see Figure C9.17). PEA is treated in the same way as asystole and is often leads into asystole.

PEA can occur with major trauma, often with an identifiable and reversible cause such as severe hypovolaemia, tension pneumothorax or pericardial tamponade. PEA is also seen in hypothermic patients and in those with electrolyte abnormalities.

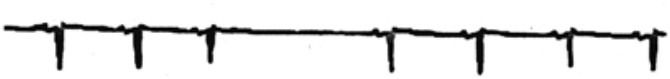


Figure C9.17 *Pulseless electrical activity (PEA) in a patient with no pulse or signs of life.*

Management of asystole/PEA in pregnancy

The first essential step is to establish ventilations and chest compressions effectively. Ensure an open airway, initially using an airway manoeuvre to open the airway and stabilising it with an airway adjunct.

Ventilations are provided initially by bag and mask with high-concentration oxygen.

Provide effective chest compressions at a rate of 100 per minute with a compression: ventilation ratio of 15:2. The depth of compression should be at least one-third of the antero-posterior diameter of the chest, and compressions should be given in the middle of the lower half of the sternum.

If asystole or PEA is identified in pregnancy, give adrenaline 1 mg (1000 micrograms: 1 ml of the 1 in 1000 solution) intravenously or intra-osseous (IO). Adrenaline increases coronary artery perfusion, enhances the contractile state of the heart and stimulates spontaneous contractions. The drug is best given through a central line, but if one is not in place it may be given through a peripheral line. Where there is no existing IV access, the IO route is recommended as the route of choice, as it is rapid and effective. In each case, the adrenaline is followed by a normal flush of 2 mL of R/L or 0.9% saline.

If available, and as soon as is feasible, a skilled and experienced operator (usually an anaesthetist) should intubate the patient's airway. This will both control and protect the airway and enable chest compressions to be given continuously, thus improving coronary perfusion. Once the patient has been intubated and compressions are uninterrupted, the ventilation rate should be around 20 breaths per minute. It is important for the team leader to check that the ventilations remain adequate when chest compressions are continuous. A guideline for non-shockable rhythms is shown in Figure C9.18.

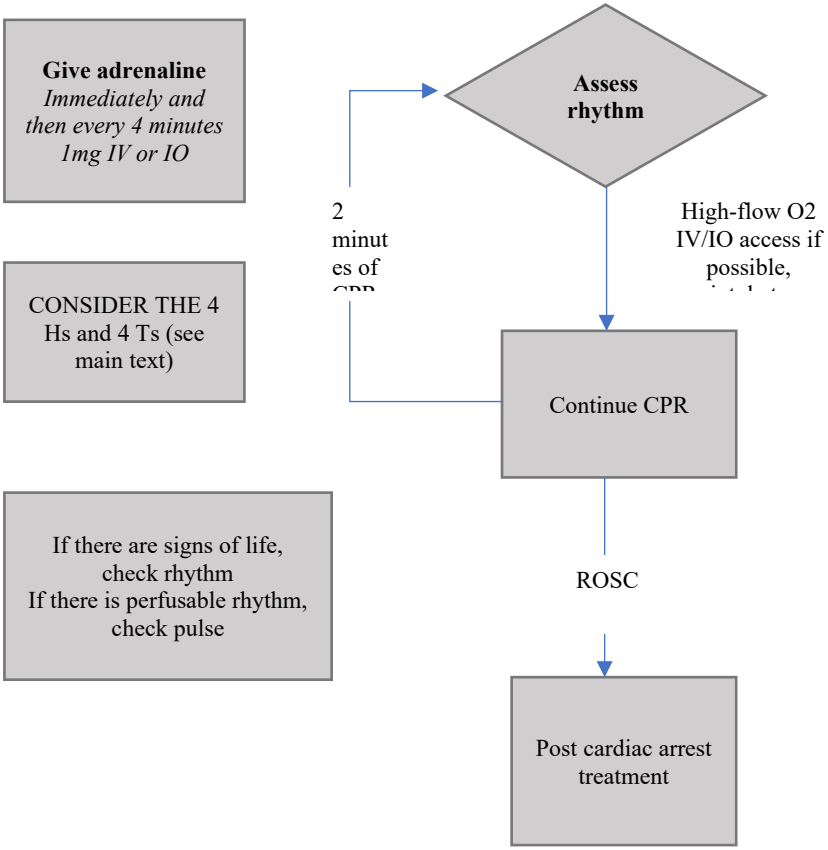
During and following adrenaline treatment, chest compressions and ventilation should continue. The only reason for interrupting compressions and ventilation is to shock the patient if necessary (see below), and to check the rhythm. A brief interruption may be necessary during difficult intubation. Giving chest compressions is tiring for the operator, so if enough personnel are available, change the operator frequently and ensure that they are achieving the recommended rate of 100 compressions per minute together with a depression of the chest wall by at least one-third of its antero-posterior diameter.

At intervals of about 2 minutes during the delivery of chest compressions, pause briefly to assess the rhythm on the ECG monitor or AED. If asystole persists, continue CPR while again checking the electrode position and contact.

- If there is an organised rhythm, check for a pulse and signs of life.
- If there is a Return Of Spontaneous Circulation (ROSC), continue post-resuscitation care, continuing the ventilation rate of 20 breaths per minute.
- If there is no pulse and no signs of life, continue the protocol.

- Give adrenaline about every 4 minutes at a dose of 1 mg IV/IO (1 ml of 1 in 1000 adrenaline)

Figure C9.18 *Guideline for the treatment of non-shockable (asystole and PEA) rhythms in pregnancy. CPR, cardiopulmonary resuscitation; IV, intravenous; IO, intra-osseous; ROSC, return of spontaneous circulation*



Shockable cardiac arrest

These arrhythmias are uncommon in pregnancy but either of them must be considered in patients with sudden collapse, hypothermia, poisoning by tricyclic antidepressants, or cardiac disease. The guideline for treating ventricular fibrillation (VF) (see Figure C9.19) and pulseless ventricular tachycardia (pVT) (see Figure C9.20) is the same and is shown in Figure C9.21.

Figure C9.19 *An episode of ventricular fibrillation.*

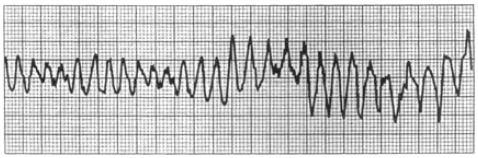
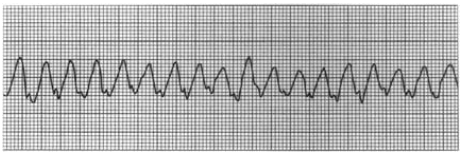


Figure C9.20 *Ventricular tachycardia (pulseless) pVT*



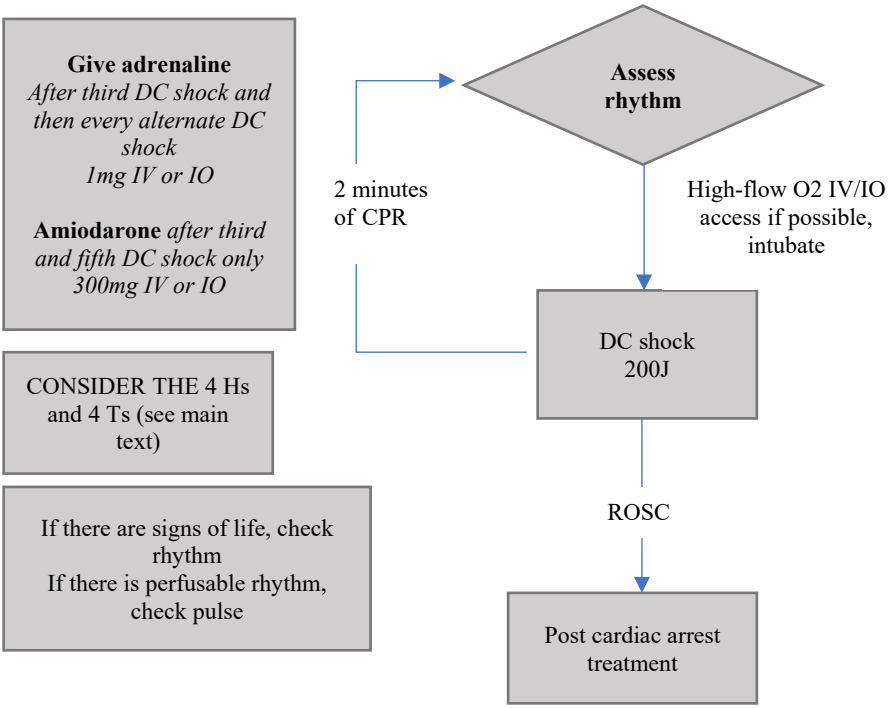


Figure C9.21 *Algorithm for the treatment of shockable (VF and pVT) rhythms in pregnancy. CPR, cardiopulmonary resuscitation; IV, intravenous; IO, intra-osseous; ROSC, return of spontaneous circulation.*

For ECG or AED monitoring, one electrode is placed over the apex in the mid-axillary line, while the other is placed immediately below the clavicle just to the right of the sternum.

If the patient's ECG is already being monitored, the rhythm might be identified before significant deterioration occurs. With immediate identification of VF/pVT, asynchronous electrical defibrillation of 200 Joules should be undertaken immediately and the guideline continued as described below.

In unmonitored patients, basic life support will have been started in response to the collapse, and VF/pVT will be identified when the cardiac monitor or AED is put in place.

An asynchronous shock of 200 Joules should be given immediately and CPR immediately resumed without reassessing the rhythm or feeling for a pulse. Immediate resumption of CPR is vital because there is a pause between successful defibrillation and the appearance of a rhythm on the monitor. Cessation of chest compressions will reduce the likelihood of a successful outcome if a further shock is needed. However, no harm accrues from 'unnecessary' compressions.

If the shock fails to defibrillate, attention must revert to supporting coronary and cerebral perfusion as in asystole. Although the procedures for stabilising the airway and obtaining circulatory access are now described sequentially, they should be undertaken simultaneously under the direction of a resuscitation team leader.

The airway should be secured, the patient ventilated with high-flow oxygen, and effective chest compressions continued at a rate of 100 per minute, with a compression depth of at least one-third of the antero-posterior diameter of the chest, and a ratio of 15 compressions to 2 ventilations. As soon as is feasible, a skilled and experienced operator should intubate the patient's airway. This will both control and protect the airway and enable chest compressions to be given continuously, thus improving coronary perfusion. Once the patient has been intubated and compressions are uninterrupted, the ventilation rate should be 20 breaths per minute.

It is important for the team leader to check that the ventilations remain adequate when chest compressions are continuous.

Obtain circulatory access. Whenever venous access is not readily obtainable, intra-osseous access should be considered early on as it is rapid and effective. In each case any drug is followed by a 2 to 5 ml flush of R/L or 0.9% saline.

Two minutes after the first shock, pause the chest compressions briefly to check the monitor. If VF/VT is still present, give a second shock of 200 joules and immediately resume CPR, commencing with chest compressions. Consider and correct reversible causes (the 4Hs and 4Ts) while continuing CPR for a further 2 minutes.

Pause briefly to check the ECG monitor/AED. If the rhythm is still VF/VT, give a third shock of 200 Joules.

Once chest compressions have resumed, give adrenaline 1 mg IV and amiodarone 300 mg IV or IO, flushing after each drug.

After completion of the 2 minutes of CPR, pause briefly to check the monitor, and if the rhythm is still VF/VT give an immediate fourth shock of 200 Joules and resume CPR.

After a further 2 minutes of CPR, pause briefly to check the monitor and if the rhythm is still shockable, give an immediate fifth shock of 200 Joules.

Once chest compressions have resumed, give a second dose of adrenaline 1 mg and a second dose of amiodarone of 150 mg IV or IO.

After completion of the 2 minutes of CPR, pause briefly before the next shock to check the monitor. Continue giving shocks every 2 minutes, minimising the pauses in CPR as much as possible. Give adrenaline after every alternate shock (i.e. every 4 minutes) and continue to seek and treat reversible causes.

Note: After each 2 minutes of uninterrupted CPR, pause briefly to assess the rhythm on the monitor or AED.
In addition, if at any stage there are signs of life, such as regular respiratory effort, coughing or eye opening, stop CPR and check the monitor.

- If the rhythm is still VF/VT, continue with the sequence as described above.
- If the rhythm is asystole, change to the asystole/PEA sequence.

- If organised electrical activity is seen, check for signs of life and a pulse. If there is ROSC, continue post-resuscitation care.
- If there is no pulse (or a pulse of < 60 beats/minute) and no other signs of life, continue the asystole/PEA sequence.

In VT or VF that does not respond to the above sequence consider giving a magnesium sulphate IV bolus of 8 mmol (4 ml of 50%).
Sodium bicarbonate

If VF/VT is due to tricyclic antidepressant overdose or hyperkalaemia, sodium bicarbonate may be helpful. Give 50 mmol (50 ml of an 8.4% solution or 100 mmol of a 4.2% solution).

Amiodarone

Amiodarone is the treatment of choice in shock-resistant ventricular fibrillation and pulseless ventricular tachycardia. The dose of amiodarone for VF/pulseless VT is 300 mg via rapid IV/IO bolus.

Lidocaine is an alternative to amiodarone if the latter is unavailable. The dose is 100 mg IV or IO as a bolus.

It is DC shock that converts the heart back to a perfusing rhythm, not the drug. The purpose of the anti-arrhythmic drug is to stabilise the converted rhythm, and the purpose of adrenaline is to improve myocardial oxygenation by increasing coronary perfusion pressure. Adrenaline also increases the intensity of ventricular fibrillation, which increases the success rate of defibrillation.

Automatic external defibrillators (AEDs)

The use of the AED is now included in basic life support teaching for adults because early defibrillation is the most effective intervention for the majority of unpredicted cardiac arrests in adults. In pregnancy there may alos be a primary cardiac cause of cardiac arrest, and the use of an AED may be lifesaving.

A guideline for AED use is shown in Figure C9.22. These devices are becoming widely available and are relatively inexpensive. They are life-saving in cases where there is **cardiac arrest with a shockable rhythm** and have been designed for community use.

If defibrillation is to be successful, it must be performed within 15 minutes of the onset of fibrillation (and the earlier it is performed, the greater the likelihood of success). AEDs are also now widely used in the treatment of hospital cardiac arrests and are therefore included here.

1. *Attach AED pads*
2. Expose the chest and place one adhesive defibrillator pad on the patient's chest to the right of the sternum below the right clavicle, and one in the mid-axillary line on the left side of the chest, taking care to avoid breast tissue. Keep the axillary electrode vertical to maximise efficiency.
3. If a shock is indicated, most AED devices will do this automatically, but some will ask the operator to deliver the shock by pressing a button.
4. Immediately after the shock, resume compressions for 2 minutes, after which

there will be a further prompt for a rhythm analysis.

5. **Always make sure any oxygen being given to the patient when activating the AED is switched off to avoid a fire or explosion.**
6. If defibrillation is not indicated, CPR should be continued for 2 minutes, at which stage the AED will prompt further analysis of the rhythm.

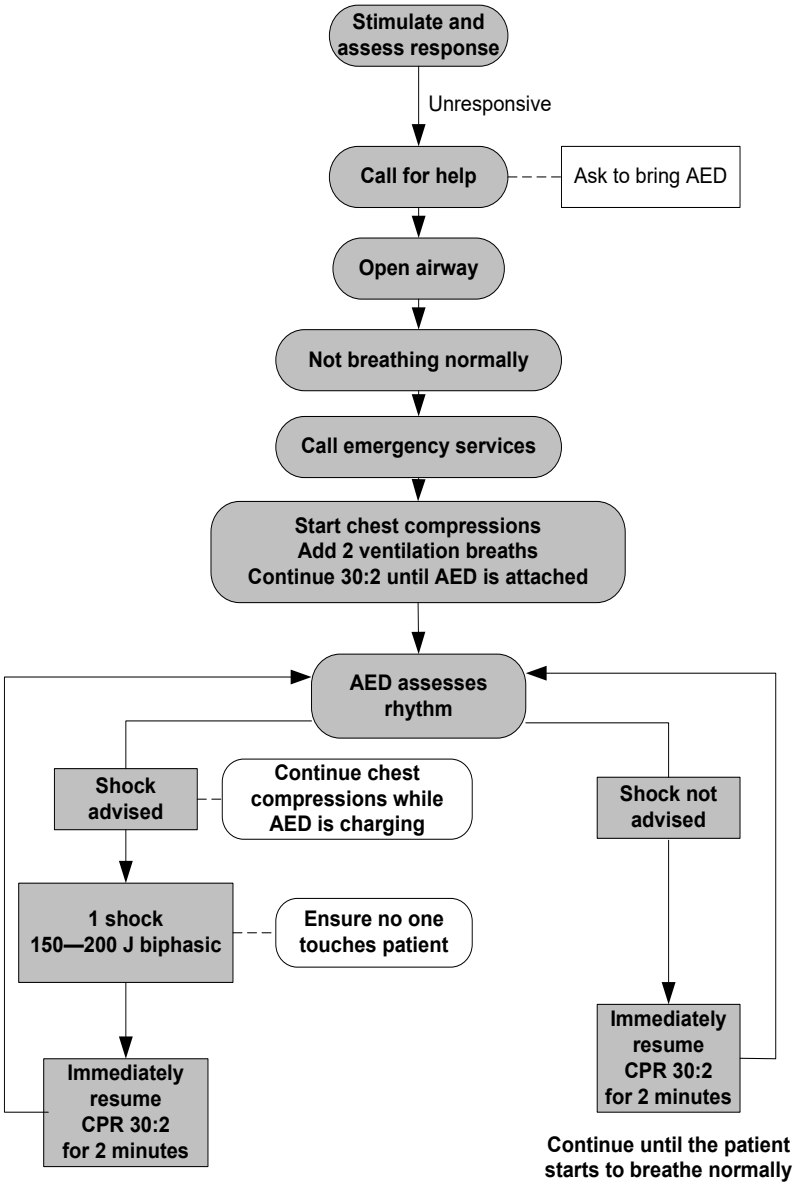


Figure C9.22 *Algorithm for automatic external defibrillator (AED) use*

Drugs used in non-shockable and shockable cardiac arrest

Oxygen

Although 100% oxygen must be used during the resuscitation process, once there is Return Of Spontaneous Circulation (ROSC) hyperoxia can be detrimental to tissues that are recovering. Pulse oximetry should be used to monitor and adjust for oxygen requirement after a successful resuscitation. SaO_2 should be maintained in the range 95–100 %. **Always ensure that oxygen delivery is discontinued during defibrillation shocks, to avoid the risks of explosions and fire.**

Adrenaline

Adrenaline is the first-line drug for treatment of cardiac arrest. Its effect is to increase blood flow to the brain and myocardium. It renders the myocardium more susceptible to defibrillation.

The initial IV or IO dose is 1 mg or 1000 micrograms (1 ml of 1 in 1000 solution). In patients with no existing IV access, the intra-osseous route is recommended as the route of choice, as it is rapid and effective. In each case, adrenaline is followed by a 0.9% saline flush (2 to 5 mL).

Sodium bicarbonate

Good basic life support is more effective than sodium bicarbonate, which may be considered if spontaneous circulation has not returned after the first or second dose of adrenaline. Sodium bicarbonate is recommended in the treatment of patients with VT/VF due to hyperkalaemia and tricyclic antidepressant overdose (see above).

The dose is 50 mmol (50 ml of an 8.4% solution or 100 ml of a 4.2% solution). Note that sodium bicarbonate must not be given in the same intravenous line as calcium, otherwise precipitation will occur. Also sodium bicarbonate inactivates adrenaline and dopamine, so the line must be flushed with R/L solution if these drugs are subsequently given.

Glucose

Hypoglycaemia is defined as a glucose concentration of less than 2.5 mmol/litre (45 mg/dL).

Pregnant patients, for example receiving treatment for severe malaria, can easily become hypoglycaemic. Blood glucose levels should therefore be checked frequently, and hypoglycaemia must be corrected. If it is suspected but blood glucose levels cannot be measured, always give 100 ml of 10% glucose preferably IV or IO or alternatively enterally (via a gastric tube).

Perimortem Caesarean section

Pregnancy seriously interferes with CPR. The enlarged uterus along with the resultant upward displacement of the abdominal viscera decreases lung compliance. The most serious problem is vena-caval compression in the supine position. During closed-chest cardiac compression the best cardiac output that can be achieved is between one-fourth to one-third of normal. Although many factors contribute to this, poor venous return to the heart is of paramount importance. At term the vena cava is completely occluded in 90 percent of supine pregnant patients. This results in a decrease in cardiac stroke volume of as much as 70%.

The UK Resuscitation Council considers that prompt Caesarean delivery should be seen as part of resuscitation in cardiac arrest in advanced pregnancy. Delivery of the fetus will obviate the effects of aortocaval compression and significantly increase the likelihood of successful resuscitation. It will reduce maternal oxygen consumption, increase venous return, make ventilation easier and allow CPR in the supine position.

Caesarean section early in resuscitation vastly improves the effectiveness of maternal resuscitation.

Peri-mortem Caesarean section should be performed as soon as possible. This will immediately relieve the vena caval obstruction and increase the chance of survival for both infant and pregnant woman or girl. CPR must be continued throughout the procedure until spontaneous and effective cardiac activity occurs. A senior health worker should be involved in making the decision to do this procedure.

Without Caesarean section, <10% of mothers having a cardiorespiratory arrest in hospital will survive to discharge. Removal of the infant improves maternal circulation during resuscitation – cardiac output immediately increases by 20 – 25%.

When to perform it

All the evidence suggests that a Caesarean delivery should begin within 4 minutes of cardiac arrest and be accomplished by 5 minutes. Pregnant women develop anoxia faster than non- pregnant women and can suffer irreversible brain damage within 4–6 minutes of cardiac arrest. CPR should be continued throughout the Caesarean section and afterwards, as this increases the likelihood of a successful neonatal and maternal outcome. In practice this means that preparations for surgical evacuation of the uterus should begin almost at the same time as CPR following cardiac arrest. Pregnant women develop anoxia faster than non-pregnant women and can suffer irreversible brain damage within 4–6 minutes of cardiac arrest. CPR should be continued throughout the Caesarean section and afterwards, as this increases the likelihood of a successful neonatal and maternal outcome.

Where to perform it

The woman should **not** be transferred to an operating theatre as this will waste time. She should be delivered at the site of collapse unless this is physically impossible. Diathermy will not be needed, as blood loss is minimal in patients with minimal cardiac output. If the mother is successfully resuscitated, she can be moved to theatre to be anaesthetized and to complete the operation.

How to perform it

A minimal amount of equipment is required in this situation. Sterile preparation and drapes are unlikely to improve survival. A surgical knife is sufficient.

Perform the CS with a midline vertical incision, or whatever the operator is most used to doing, and remove the baby as fast as possible. Remove lateral tilt when baby is delivered.

No one surgical approach in particular is recommended, and the choice of approach should be based on operator preference. The classical midline abdominal approach is aided by the natural diastasis of rectus abdominus muscles that occurs in late pregnancy and the relatively bloodless field in this situation. However, many obstetricians are more familiar with a lower transverse abdominal incision and can deliver a baby in less than 1 minute.

Open cardiac massage during surgery is a possibility when the abdomen is already open and the heart can be reached relatively easily through the diaphragm (if a midline approach has been used).

An anaesthetist should attend at the earliest opportunity to provide a protected airway, ensure continuity of effective chest compressions and adequate ventilation breaths, and ensure adequate pain control.

If resuscitation is successful and the mother regains a cardiac output, appropriate anaesthesia and pain relief will be required, and the woman should be moved to an operating theatre to complete the operation.

Fetal outcome

It must be emphasised that Caesarean section is part of resuscitation and is performed to improve maternal survival, and it is worthwhile performing this procedure after the uterus has reached the level of the umbilicus (i.e. around 20 weeks' gestation). If done promptly, it can also improve fetal survival, although gestational age at the time of delivery also clearly influences the fetal outcome. In one report, 47% of those delivered at more than 36 weeks did survive; all but one of the

cases in this group involved CPR commenced in hospital, demonstrating the advantage of early evacuation of the uterus for the neonate as well as the mother.

Although uterine evacuation is a well-validated step in maternal resuscitation, there is still reluctance among some obstetricians to perform peri-arrest Caesarean section, due to concerns about neonatal neurological damage. However, in a comprehensive review of postmortem Caesarean deliveries between 1900 and 1985 by Katz and colleagues, 70% (42/61) of infants delivered within 5 minutes survived, and all of them developed normally. Only 13% (8/61) of those delivered at 10 minutes and 12% (7/61) of those delivered at 15 minutes survived. One infant in each of the groups of later survivors had neurological damage. Later series confirm the advantage of early delivery for intact fetal survival, although there are a few case reports of intact infant survival more than 20 minutes after maternal cardiac arrest.

The evidence suggests that if the fetus survives the neonatal period, the probability of normal development is high.

The decision to abandon CPR if it is unsuccessful

CPR should be continued if the cardiac rhythm can be monitored with an electrocardiogram and shows ventricular fibrillation (VF)/ventricular tachycardia (VT). The decision to abandon CPR should only be made after discussion with senior clinicians.

When to stop resuscitation

Local guidelines should be in place. Resuscitation efforts are unlikely to be successful, and cessation can be considered, if there is no return of spontaneous circulation at any time after 20 minutes of life support and in the absence of recurring or refractory VF/VT.

The exceptions are patients with a history of poisoning or a primary hypothermic insult, in whom prolonged attempts may occasionally be successful. Prolonged external cardiac compressions during which central (femoral or arterial) pulses were felt have successfully resuscitated patients with tricyclic antidepressant overdose.

The most important points regarding the discontinuing of CPR:

- A staff member (if available) must be designated as the family's support and interpreter of events at all times.
- The team leader, not the family, decides when it is appropriate to stop the resuscitation.
- If the presence of the family is impeding the progress of the resuscitation, they should be sensitively asked to leave.
- The team needs a debriefing session to support staff and reflect on practice.

Section C10 Safety guidelines regarding drug and fluid administration

Enteral fluids

The best method of maintaining caloric intake is through enteral feeding.
If the patient is unable to drink, then pass a gastric tube (*see* Section E14).

When commencing feed by nasogastric tube:

1. Fill the syringe to the required amount with feed.
2. Draw the plunger back as far as possible.
3. Attach the syringe to the tube.
4. Kink the tube and remove the plunger.
5. Allow feed to pass into the stomach using gravity.
6. Observe the patient's colour and respiratory rate for any signs of aspiration.

Oral rehydration solutions are used in gastroenteritis to maintain electrolyte balance. Prepare by adding 1 sachet to 210 mL (7 oz) of clean water.
(One ounce = 30 mL)

Intravenous fluids

Intravenous (IV) fluids must only be used when essential and enteral feeds are not available or not absorbed. Always check the container before use, to ensure that the seal is not broken, the expiry date has not been passed, and the solution is clear and free of visible particles.

Choice of crystalloid fluid

Dextrose/glucose-only fluids

It is clear that although glucose or dextrose is necessary to prevent or manage hypoglycaemia, **fluids containing only dextrose which are hypotonic should never be used for IV fluid replacement or maintenance, or for the emergency management of shock.**

This is because the dextrose is rapidly metabolised, so the effect of a dextrose-only IV fluid may produce hyponatraemia, which could lead to brain damage or death. In addition, this solution is rapidly moved out of the circulation and into the cells, and the state of shock will not be resolved.

Sodium-containing fluids

The fluid traditionally infused into the circulation for the management of shock has been normal saline (0.9% NaCl). This fluid has increasingly been shown to have some dangers, especially in the sick patient. An infusion of normal saline

causes a hyperchloraemic acidosis (a high chloride concentration leading to acidosis) which, in the shocked patient, who is already acidotic, causes a deterioration in the health of cells in vital organs even though perfusion of the cells has been improved by the increased circulating volume.

There are sodium-containing alternatives to normal saline which are safer because they approximate more closely to human serum/plasma in content (*see* Table C10.1), although they are more expensive. We recommend the use of either of these alternatives – Ringer-lactate and Hartmann's solution, which are widely available – for all fluid replacement. Hospitals are advised to change their standard crystalloid from 0.9% ('normal') saline to Ringer-L actate or Hartmann's solution as soon as possible. Not all hospitals will have access to these solutions immediately, so there may sometimes be no alternative but to start fluid
replacement with normal saline. However, if more than 20 mL/kg needs to be given, one of the safer alternatives should be used in very sick patients if at all possible.

TABLE C10.1 Comparison of electrolytes, osmolality and pH levels in IV fluids with those in human serum

Fluid	Na^+ mmol/L	K^+ mmol/L	Cl^- mmol/L	Ca^{2+} mmol/L	Lactate or bicarbonate mmol/L	Osmolarity mOsmol/L	pH
Human serum	135–145	3.5–5.5	98–106	2.2–2.6	22–30	276–295	7.35–7.45
Ringer-lactate/ Hartmann's solution	131	5.0	111	2.0	29	279	6.0
0.9% normal saline	154	0	154	0	0	310	5.4

Putting dextrose into Ringer-lactate/Hartmann's or 0.9% saline

A crystalloid containing approximately 5% dextrose can be obtained by adding 50 mL of 50% dextrose to a 500-mL bag of Ringer-lactate or Hartmann's solution (or 0.9% saline).

A crystalloid containing approximately 10% dextrose can be obtained by adding 100 mL of 50% dextrose to a 500-mL bag of Ringer-lactate or Hartmann's solution (or 0.9% saline).

(It will therefore be necessary to remove 50–100 mL of fluid from the 500-mL bag first.)

Ensure that the above process is performed with a sterile no-touch technique, swabbing the entry point to the bag with an alcohol swab.

Dextrose/glucose solutions that are not in Ringer-Lactate or Hartmann's solution are dangerous for replacing fluid losses. Never infuse plain water IV: this causes haemolysis and will be fatal.

Always specify the concentrations of dextrose and saline solution to be infused.

Maintenance requirement of electrolytes

Daily sodium and potassium requirements in IV fluids:

- sodium (Na^+) 150 mmol/24 hours in pregnancy
- potassium (K^+) 100 mmol/24 hours in pregnancy.

Crystalloids containing a similar concentration of sodium to plasma (Ringer-lactate or Hartmann's solution) are used to replace vascular compartment losses. When infused IV, only around 25% remains inside the vascular compartment; the rest passes into the extracellular space.

All fluids should be prepared and administered using an aseptic technique. It is important to observe the cannula site directly (by removing the dressing) for redness and swelling before each IV injection. Observe the patient for pain or discomfort at the IV site. If there are any signs of inflammation, stop all fluids, reassess the need for continuing IV fluid drugs, and re-site the cannula if necessary.

The rate of administration of fluids can be calculated in drops per minute as follows:

In a standard giving set with a drop factor of 20 drops = 1 mL, then mL/hour divided by 3 = drops/minute.

- Record that rate of fluid intake per hour on a fluid balance chart.
- Ensure that the IV site is kept clean.
- Flush the cannula with 0.9% saline or Ringer-lactate or Hartmann's solution 4-hourly if continuous fluids are not being given.

Prescribing practice and minimising drug errors

Introduction

Oral administration is safer and less expensive, if it is tolerated and if the condition is not life-threatening.

The following antibiotics are as effective when given orally as when administered intravenously, although initial IV doses will increase the blood levels more quickly: amoxicillin, ampicillin, chloramphenicol, ciprofloxacin, co-trimoxazole, erythromycin, flucloxacillin, fluconazole, metronidazole, sodium fusidate.
If a drug is given down an orogastric or nasogastric tube, flush the tube through afterwards so that the drug does not remain in the tube.

Rectally administered drugs are less reliably absorbed than those given orally.

Prescribing

Use approved names.

1. Dosages should be in grams (g), milligrams (mg) or micrograms. **Always write micrograms in full.** Volumes should be in milliliters (mL).
2. Avoid using numbers with decimal points if at all possible (e.g. write 500 mg, not 0.5 g). If decimal points are used, they should be preceded by a zero (e.g. write 0.5 mL, not .5 mL).
3. Write times using the 24-hour clock.
4. Routes of administration can be abbreviated to IV (intravenous), IM (intramuscular), PO (orally), SC (sub- cutaneous), NEB (nebuliser) and PR (rectally).
5. 'As-required' prescriptions must be specific with regard to how much, how often and for what purpose the drug is being given (also indicate the maximum 24-hour dose).
6. 'Stop dates' for short-course treatments should be recorded when the drug is first prescribed.

Measuring drug doses

1. Multiple sampling from drug vials increases the risk of introducing infection, as the vials do not contain preservatives or antiseptics.
2. Dilute drugs so that volumes can accurately be measured. For example, do not use doses of less than 0.1 mL for a 1-mL syringe without diluting sufficiently for you to be able to give an accurate amount of the drug.
3. Do not forget to consider the dead space in the hub of the syringe for small volumes.
4. For dilutions of more than 10-fold, use a small syringe to inject the active drug, connected by a sterile three-way tap to a larger syringe, and then add diluent to the large syringe to obtain the desired volume.

Delivery

1. All IV solutions, including drugs, must be given aseptically.
2. Give IV drugs slowly in all cases.
3. After injecting into the line (e.g. through a three-way tap), use the usual rate of the IV infusion to drive the drug slowly into the patient.
4. If there is no ongoing infusion, give sufficient follow-up (flush) of 0.9% saline, Ringer-lactate or Hartmann's solution or 5% dextrose to clear the drug from the cannula or T-piece.
5. Flush over a period of 2 minutes to avoid a sudden surge of drug (remember the hub).

Infusions

1. These must be given aseptically.
2. Adjust the total 24-hour IV fluid intake so that additional infusions for drugs do not alter the total fluid volume.
3. Never put more drug or background IV into the syringe or burette than is needed over a defined period of time.
4. Check and chart the rate of infusion and confirm this by examining the amount left every hour.
5. Use a cannula, not butterfly needles, for infusions if available.
6. Do not mix incompatible fluids IV.
7. Do not add drugs to any line containing blood or blood products.
8. Infusions of glucose higher than 10%, calcium salts and adrenaline, can cause tissue damage if they leak outside the vein.
9. Most IV drugs can be given into an infusion containing 0.9% saline, Ringer-lactate or Hartmann's solution or up to 10% glucose (the exceptions include phenytoin and erythromycin).
10. If you are using only one line, wait 10 minutes between each drug infused, or separate the drugs by infusing 1 mL of 0.9% saline or Ringer-lactate or Hartmann's solution.

Safe IV infusions when no burettes are available

Mark the infusion bottle with tape for each hour of fluid to be given and label each hour.

or

Empty the infusion bottle until only the exact amount of fluid to be given is left in the bottle.

Or

Ideally use an infusion monitoring system that counts the number of drops given through the giving set (See Section B2)

Intravenous lines

Placement of the line

- Always place the cannula aseptically and keep the site clean.
- Use sterile bungs, *not* syringes, for closing off cannula/ butterfly needles between IV injections.

Care of the line

1. Change the giving set every 3 or 4 days.
2. Change the giving set after blood transfusion, or if a column of blood has entered the infusion tubing from the vein, as this will be a site of potential bacterial colonisation.
3. Always inspect the site of the cannula tip before and during drug injection. Never give a drug into a drip that has started to tissue. Severe scarring can occur, for example, from calcium solutions.
4. Always use luer lock connections to minimise extravasation.

Sampling from the line

1. Clear the dead space first (by three times its volume).
2. Glucose levels cannot be accurately measured from any line through which a glucose solution is infused.
3. Blood cultures should always be taken from a separate fresh venous needle or stab sample.
4. After sampling, flush the line.

Complications

Infection

- Local infection can become systemic, especially in neonates or the immunosuppressed (e.g. HIV-infected patients).
- If there is erythema in the tissue, remove the cannula.
- If lymphangitis is present, remove the cannula, take a blood culture from a separate vein and start IV antibiotics.

Air embolism

- External jugular or central venous lines are particularly high risk.
- Another source of air embolus is through the giving set, especially when infusion pumps are used. Infusion pumps must not be used if there are not enough nurses to closely monitor the infusion.
- Always use a tap or syringe on the catheter, especially during insertion.
- If air reaches the heart it can block the circulation and cause death.

Haemorrhage

- All connections must be Luer locked.
- The connections to the cannula and its entry must be visualised at all times.

Reducing errors with IV infusions

1. Prescribe or change infusion rates as infrequently as possible.
2. Always have the minimum possible number of IV infusions running at the same time.
3. Use a burette in which no more than the prescribed volume is present (especially with drugs such as quinine or magnesium sulphate in pregnancy).
4. Record hourly the amount given (from the burette, syringe or infusion bag) and the amount left.
5. Check the infusion site hourly to ensure that fluid has not leaked outside the vein.
6. Ensure that flushes are only used if they are essential and are given slowly over a period of at least 2 minutes.
7. Be careful with potassium solutions given IV (use the enteral route when possible).
8. Check and double check the following:
    a. Is it the right drug? Check the ampoule as well as the box.
    b. Is it at the right concentration?
    c. Is the shelf life within the expiry date?
    d. Has the drug been constituted and diluted correctly?
    e. Is it being given to the right patient?
    f. Is the dose correct? (Ideally two healthcare workers should check the prescription chart.)
    g. Is it the correct syringe? (Deal with one patient at a time.)
    h. Is the intravenous cannula patent?
    i. Is a separate flush needed? If so, has the flush been checked?
    j. Are sharps disposed of (including glass ampoules)?
    k. Has it been signed off as completed (ideally countersigned)?
    l. If the drug has not been received, is the reason stated?

Intramuscular (IM) injections

1. **IM injections are unsafe for patients in shock**, especially opiates, where a high dose can be released once recovery of the circulation occurs.
2. Use alternate legs if multiple injections are needed.
3. Do not give IM injections if a bleeding tendency is present.
4. Draw back the plunger to ensure that the needle is not in a vein

before injecting (especially if administering adrenaline or lidocaine).

In very resource-limited situations, the IM route might be preferred because the drug may reach the patient sooner than if the patient had to wait in a queue to have an IV line sited. It also requires less nursing time and is less expensive; venous cannulae are often in short supply. The IM route is as effective as the IV route in many situations.

Storage of drugs

Hospitals have struggled for many years to ensure that appropriate medicines are available when needed, while at the same time avoiding the problems of controlling the abuse and illegal use of these substances. Medicines that are of most concern in this respect are narcotics and sedatives. Supplies of these drugs must be available for the treatment of acutely ill patients, at the point of admission, in high-dependency care and post-surgical areas, and in all areas involved in the care of patients with terminal illness. Tragically, many care settings have solved the problem of storage by refusing to have stocks of these drugs readily available, either in the belief that patients do not feel pain, or due to fear of abuse by the patients and their families or healthcare staff.

The responsibility for the safe custody and storage of all medicines and drugs on a ward or department is that of the nurse in charge at any one time. Designated cupboards for the different types of drugs should be available. All cupboards, which should be permanently fixed to an inside wall, should have secure locks that make them inaccessible to unauthorized staff and visitors. Drug cupboards should be kept locked at all times, the keys being the responsibility of the nurse in charge.

Correct storage of drugs is paramount for prolonging the shelf life of the drug, as well as for complying with safety and legal requirements.

Due to the shelf life of some drugs, they need to be stored in a refrigerator, with the temperature set to store the drugs at between 2°C and 8°C. Drugs that need to be stored under these conditions include the following:

- reconstituted oral antibiotics
- eye drops
- rectal paracetamol
- some vaccines
- insulin (although this can be stored for up to 1 month at room temperature)
- oral midazolam
- pancuronium/vancuronium
- ergometrine
- oxytocin.

Calculating and giving the correct dose If well enough, pregnant patients should be weighed. The use of a drug formulary should be considered when calculating the therapeutic dose. To ensure that the correct amount of drug is given from the stock bottle or vial, the following calculation should be used:
prescribed dose divided by concentration of the stock solution) × (volume of stock dose.

For example, 125 mg (the amount prescribed) divided by 250 mg/5 mL (concentration of the stock solution) times 5 mL (volume of stock dose) = 125/250 × 5mL = 2.5mL is the amount given.

Medical staff should change the prescribed dose if after using the above calculation the dose is not easily measurable (e.g. 1.33 mL). To ensure that the calculated dose is given accurately, a pre-marked syringe should be used. The smaller the required dose, the smaller the syringe that should be used, as it will give a more accurate measurement (i.e. a 1- or 2-mL syringe should be used, not a 10-mL syringe).

Other forms of measurement can be used for larger doses, such as 5 or 10 mL. These include a pre-measured medicine pot or a 5-mL pre-measured medicine spoon. For safety, the calculation should ideally be done by two trained practitioners, and the amount dispensed checked by the same two practitioners. Although it is recognised in some hospitals that one trained nurse can check oral medication on their own, ideally IV and IM drugs should be checked by two trained nurses or a nurse and a doctor/clinician.

Section C11: Transport of pregnant women with complications

All resuscitation, emergency treatment and stabilisation must be performed before moving the patient. The basic principles of transport are ongoing CABCD

TABLE C11.1 Transport checklist

Control bleeding	Is there continued bleeding or could bleeding start again during transport?	Yes/No
	Is anti-shock garment available if needed?	Yes/No
Airway/Breathing		
Is the airway safe?	Is there anything that can be done to improve the airway?	Yes/No
Is oxygen required?	Pulse oximeter (battery operated with additional power from the ambulance cigarette lighter) can help to guide the need for oxygen	Yes/No
Is oxygen available?	Oxygen cylinders full and working – enough for the return expected journey	Yes/No
Is ventilatory support required?	Bag-valve-mask of the correct size available and working	Yes/No
Suction	Manual system and catheters available	Yes/No
Circulation		
IV access	Working and secured	Yes/No
Volume	Ringer-lactate or Hartmann's solution bags and delivery kits	Yes/No
Posture	Is lateral tilt needed?	Yes/No
D Neurology		
Temperature	Sufficient blankets available	Yes/No
Blood sugar level	Glucose for IV or gastric tube administration available	Yes/No
Posture	Is recovery position needed?	Yes/No
Other		
Birthing needs	Delivery kit, bag-valve-mask for neonate, towels, oxytocin, misoprostol, magnesium sulphate and condom catheter	Yes/No
Documentation	All relevant documentation with the patient	Yes/No
Family members	Family members know what the plan is	Yes/No
Healthcare communication	Receiving site is aware of the patient and their expected time of arrival	Yes/No

Section D1. Major trauma in pregnancy

Special issues

The anatomical and physiological changes that occur in pregnancy are important in assessment and resuscitation.

Anatomical changes in pregnancy

As the uterus increases in size during pregnancy, it becomes more vulnerable to damage by both blunt and penetrating injury. Before 12 weeks of gestation, the bony pelvis protects it, but thereafter it is an abdominal organ.
The uterine fundus reaches the umbilicus at 20 weeks, and the xiphisternum at 36 weeks.

In the first trimester, the fetus is well protected by the thick-walled uterus and relatively large amounts of amniotic fluid. As the pregnancy progresses, the uterine wall becomes thinner, providing less protection for the fetus.

In late pregnancy, the uterus and its contents shield the maternal abdominal contents, providing a degree of protection for the maternal viscera, at the expense of fetal well-being.

Physiological changes in pregnancy

- increased tidal volume
- blood volume increases by 40% to 100 mL/kg
- basal heart rate increases to 85–90 bpm
- 30% increased cardiac output
- a fall in blood pressure of 5–15 mmHg
- compression of the inferior vena cava as the uterus increases in size from 20 weeks' gestation, with the potential for reduced cardiac output
- upward displacement of the diaphragm as the uterus increases in size, with an impact on lung volume, and predisposition to gastro-oesophageal reflux.

Special issues in the traumatised pregnant woman

Blunt trauma may lead to:

- haemorrhage from abdominal organs, notably the spleen and liver
- uterine irritability and premature labour
- partial or complete uterine rupture
- partial or complete placental separation (up to 48 hours after trauma)
- fetal death
- fetal distress.

Pelvic fractures may be associated with severe hidden blood loss.

What are the priorities?

- Primary assessment and resuscitation according to the CABC structured approach.
- Resuscitation in the left lateral position after 20 weeks' gestation, to avoid compression of aorta and inferior vena cava
- Assessment of fundal height and tenderness, and fetal heart rate monitoring as appropriate.
- Vaginal examination or speculum examination to assess vaginal bleeding, cervical dilatation and rupture of membranes.

If placenta praevia is known or suspected, digital vaginal examination should not be performed, as major haemorrhage may occur. Careful speculum examination is important if there is vaginal bleeding post trauma. An ultrasound scan of the abdomen after major trauma is very important, especially if vaginal bleeding is present.

It is important to be alert to signs of hypovolaemia, which are delayed in pregnancy as the mother has a higher circulating volume. Hypovolaemia may compromise the fetus before the mother's vital signs become abnormal. A fall in maternal blood pressure is a late and dangerous sign. Resuscitation of the mother may save the baby as well.

There are times when the mother's life is at risk and the fetus may need to be delivered in order to save the mother.

Action plan

1 Call for the most senior help available, include nurse anaesthetist, surgeon and obstetrician.
2 Perform standard primary assessment and resuscitation (see below).
3 In addition: assess fetal well-being. Use ultrasound examination to detect the fetal heart rate and to identify any retro- placental or intra-abdominal bleeding. Ultrasound is also useful for determining the presentation of the fetus; transverse lie may suggest rupture of the uterus.

Consider whether Caesarean section is indicated for maternal or fetal reasons.

Indications for Caesarean section (if facilities are available to perform it safely)

1. cardiac arrest (see Section C9)
2. uterine rupture
3. inadequate exposure during laparotomy for other abdominal trauma
4. pelvic fracture causing uncontrolled haemorrhage where pelvic vessels cannot be compressed

5. placental abruption
6. an unstable pelvic or lumbo-sacral fracture with the patient in labour
7. fetal distress with a viable fetus.

Peri-mortem Caesarean section (see Section C9)
This should be undertaken with CPR in progress when maternal cardiac output has not been restored by initial cardiopulmonary resuscitation (CPR). Manual displacement is necessary for effective CPR and should be continued until the baby has been delivered. Delivery should ideally be accomplished within 5 minutes of cardiac arrest.
The rationale behind peri-mortem Caesarean section is as follows:

- improvement in maternal cardiac output due to relief of inferior caval compression
- improvement in maternal oxygenation
- greater efficacy of CPR due to better access
- better chance of fetal survival if in third trimester.

Peri-mortem Caesarean section should be undertaken with a left lateral tilt of 15–30 degrees, or preferably with manual displacement of the uterus to avoid compression of the aorta and inferior vena cava. Manual displacement and CPR should continue throughout, until cardiac output is restored. The operation should take place at the scene of cardiac arrest, rather than after moving the patient to the operating theatre, which wastes precious time. Blood loss is minimal until cardiac output resumes. The woman can be moved to the operating theatre once cardiac output is restored. The fetus may survive, but this is a secondary consideration. The aim of peri-mortem Caesarean section is to save the mother's life, as resuscitation is more likely to be effective if the gravid uterus is emptied.

Specific types of trauma
Blunt trauma
The three commonest causes are road traffic accidents, falls and intimate partner violence. Direct fetal injury is uncommon with blunt trauma owing to the absorption of forces by the uterus, placenta and amniotic fluid. However, fetal injury and death is an indirect result of maternal shock and death.

Uterine rupture due to blunt trauma is relatively rare. However, blunt trauma to the abdomen may cause placental abruption. Kleihauer testing, if available, is useful for detecting feto–maternal haemorrhage as an indicator of placental damage.
Detection of intra-abdominal haemorrhage may be difficult in pregnancy, so early laparotomy should be considered. Remember that the mother may lose a third of her blood volume before the vital signs become abnormal.

Penetrating abdominal wounds
Knife and gunshot wounds are the most common. Penetrating injuries can cause uterine injury at any stage of pregnancy. The uterus, fetus and amniotic fluid reduce injury to the abdominal organs by absorbing energy and displacing bowel upwards and to the side. Penetrating injuries above the uterus may cause extensive gastrointestinal and vascular damage. Exploratory laparotomy is usually required in the management of penetrating abdominal wounds, in pregnancy as in the non-pregnant patient.

Thoracic trauma
Injury to major thoracic structures is particularly dangerous in pregnancy, due to the combination of aorto-caval compression, reduced respiratory excursion and aspiration of gastric contents.

Pathway of care: trauma in pregnancy.

1. Structured approach CABCD
2. If possible, a team leader should be in overall charge of resuscitation
3. Treat the greatest threat to life first
4. Primary assessment and resuscitation
5. Secondary assessment and emergency treatment
6. Definitive care

Primary assessment and resuscitation	Control obvious bleeding
	Airway: increased risk of aspiration – early gastric tube
	Breathing: if chest drain is needed, place at higher level (3rd or 4th intercostal space)
	Circulation: left lateral tilt or manual displacement (the latter is not appropriate in the conscious patient. Abnormalities in pulse rate, blood pressure and capillary refill are late because of high circulating blood volume in pregnancy 'Targeted resuscitation' with IV crystalloids, colloid or blood
	Neurological failure: convulsions may be due to eclampsia as well as head injury

Secondary assessment and emergency treatment:
Assess for:
Ruptured uterus and placental abruption after blunt trauma to abdomen (including seat-belt injury). Uterine tenderness, vaginal bleeding, shock can occur with both ruptured uterus and abruption
Ultrasound scan may show fetal death or intra-abdominal fluid (blood)
Rupture of membranes (by speculum)
Fetal distress (FHR abnormalities)
Evidence of intra-abdominal bleeding or injury to abdominal organs
Consider bowel injury (compressed by uterus and therefore more vulnerable to blunt trauma or penetrating injuries)
Ensure anti-tetanus measures
X-rays as needed if available

On discharge from hospital, patient to report abdominal pain, decreased fetal movements, vaginal bleeding or vaginal fluid leakage

Primary assessment and resuscitation CABC
Control of haemorrhage and Airway management (and cervical spine control)
Breathing
Circulation and continued haemorrhage control
Disability Neurological problems

During the primary assessment, assess and resuscitate in sequence – **C**ontrol of haemorrhage **A**irway, **B**reathing and **Ci**rculation (CABC) – as these, if compromised, can be an immediate threat to life. Although the patient may have obvious severe injuries, the clinician's first task is to prevent further deterioration of the patient's condition by ensuring that vital organs, especially the heart and the brain, are supplied with oxygenated blood by ensuring an open airway, adequate breathing and circulation.

AVOID: hypoxia, hypercapnia, hypovolaemia, hypoglycaemia and hypothermia
Although CABC management is described sequentially, if there are sufficient trained clinicians present, they can be managed at the same time.

If there are limited personnel, the approach must be CA then B then C. If there is only one trained person available, make use of untrained staff such as ward orderlies or relatives to perform tasks under your supervision. For example, if there is visible severe exsanguinating haemorrhage, once you have identified and controlled it, the ward orderly can continue to apply the pressure while you open the

airway and give oxygen, etc. You will need to continually monitor the untrained person's actions to make sure that they are still effective.
Primary assessment and resuscitation: CA (with cervical spine control if needed).
The first priority is stopping obvious life-threatening haemorrhage and establishment or maintenance of airway opening,

Stop visible external exsanguinating bleeding, if any, by applying direct pressure. This bleeding will be from a superficial artery or large vein. Minor bleeding can be left until the vital ABC have been assessed and resuscitated. Internal bleeding will be dealt with first in 'C' by replacing fluid, and then, if necessary, by emergency surgery.

LOOK for chest movement
LISTEN for breath sounds
FEEL for exhaled air
Talk to the patient

If the patient is conscious, ask them to speak, using the question **'Are you all right?'** A patient who can speak must have a clear airway.
If the patient is unconscious, airway obstruction is most commonly due to obstruction by the tongue.
The signs of airway obstruction may include:

- snoring or gurgling
- stridor or abnormal breath sounds
- agitation (hypoxia)
- using the accessory muscles of ventilation/paradoxical chest movements
- cyanosis.

1. Primary assessment and resuscitation of the airway

- Head tilt/chin lift or jaw thrust. Jaw thrust is recommended in trauma, as it does not require any neck movement. However, if a jaw thrust is unsuccessful or the person resuscitating the patient cannot effectively undertake this manoeuvre, try chin lift with some head tilt. A closed airway will always be potentially fatal, so the **airway takes priority**.
- Suction/removal of blood, vomit or a foreign body, if any, but only under direct vision. Do not blindly suck in the mouth or pharynx.
- If there is no improvement, place an oropharyngeal airway. DO NOT place a nasopharyngeal airway if base of skull injury is suspected.
- If the airway is still obstructed, a definitive airway by intubation or surgical airway may be needed.
- Identify the 'at-risk' airway:

Decreased consciousness level (P or U on AVPU scale) mean the airway may not be protected.
Risk of aspiration is increased in pregnancy.
Facial trauma, including burns, is a risk to the airway as swelling/oedema continues over a few hours.

Once the airway is open, give **high-flow oxygen using a mask and reservoir**.
If the airway cannot be maintained and/or protected, consider the need for advanced airway management.
Indications for advanced techniques for securing the airway (intubation or surgical airway) include:

- persistent airway obstruction
- a conscious level of ≤ 8 on the Glasgow Coma Scale, or 'P' or 'U' on the AVPU scale
- penetrating neck trauma with haematoma (expanding)
- apnoea
- hypoxia
- severe head injury
- chest trauma
- maxillofacial injury.

Intubation techniques should be performed by the most experienced anaesthetist available.
For intubation, the following sequence should be followed:

1 Pre-oxygenation with 100% oxygen, with manual lung inflation if required.
2 Administration of a carefully judged anaesthetic induction agent.
3 Application of cricoid pressure.
4 Suxamethonium 1–2 mg/kg.
5 Intubation with a correctly sized tracheal tube.

Have a suitably sized bougie available.

Confirmation of correct placement of the endotracheal tube
Signs such as chest movement and auscultation remain helpful, but are occasionally misleading, especially in inexperienced hands. The **most reliable evidence is to see the tube pass through the vocal cords.** The correct size is a tube that can be placed easily through the cords with only a small leak. Intubation of the right main bronchus is best avoided by carefully placing the tube only 3–4 cm below the cords and noting the length at the teeth before checking by auscultation, which is best done in the left and right lower axillae. Capnography (if available) is a useful adjunct to help to confirm correct tube placement. Look for misting in tube to confirm tracheal intubation. If in doubt about endotracheal intubation, remove tube and replace.

A Seldinger technique for intubating using a bougie may be needed. Also different blades or handles on the laryngoscope can help.

Indications for surgical cricothyroidotomy

- Inability to open or clear the airway, and the patient is losing consciousness due to cerebral hypoxia (usually also cyanosed and bradycardic).
- Inability to ventilate the lungs despite high-level CPAP via a bag-valve-mask system and 100% oxygen through a reservoir attached to the bag.
- Inability to intubate through the larynx, either because this is not possible or due to lack of experience.

Emergency Surgical airway: Surgical cricothyroidotomy

Only in desperate situation if other methods of airway opening procedures have failed

1. Call surgeon (ENT) and anaesthetist (if available)
2. Place supine.
3. Extend neck to improve access. This takes priority over risk of cervical spine injury.
4. Identify cricothyroid membrane in the following manner. Place your finger over the most prominent part of thyroid cartilage (Adam's apple). Move the finger downwards i.e. towards the chest, keeping strictly in the mid-line. The first dip felt is the area of cricothyroid membrane.
5. Prepare skin and, if patient is conscious, infiltrate with local anaesthetic if time permits.

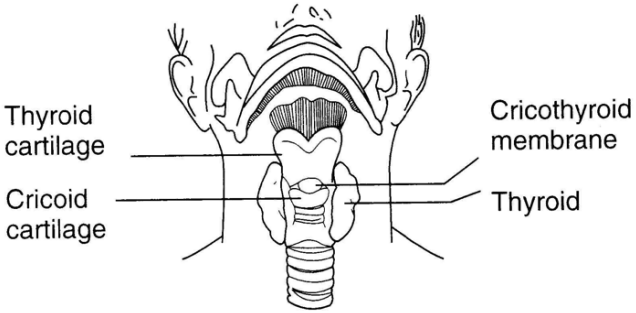


Figure D1.1 *Landmarks for surgical cricothyroidotomy*

6. Place index and middle fingers of your left hand on each sides of midline of neck to stabilise cricothyroid membrane, and to protect lateral vascular structures from injury.

7. Make a small vertical incision in skin, and with the index and the middle fingers of the left hand, press lateral edges of incision outwards, to minimise bleeding.
8. Make a transverse incision through cricothyroid membrane, being careful not to damage cricoid cartilage.
9. Insert a tracheal spreader to open airway.
10. Insert an appropriately sized endotracheal or tracheostomy tube. It is advisable to use a slightly smaller size than would have been used for oral intubation
11. Ventilate patient and check that this is effective – if not and if large air leak after inflating cuff may need to change tube for a size bigger.
12. Secure tube to prevent dislodgement.

Complications

- Asphyxia: Aspiration of blood or secretions: Haemorrhage or haematoma.
- Creation of a false passage into tissues: Surgical emphysema (subcutaneous or mediastinal).
- Pulmonary barotrauma
- Subglottic oedema or stenosis
- Oesophageal perforation.
- Infection.

Cervical spine protection

Cervical spine injury is difficult to diagnose, manage and treat in low resource countries.

Cervical spine immobilisation

Ideally all patients with major trauma should have full spinal stabilisation if feasible from the moment of injury and should be treated as if they have a cervical spine injury until proven otherwise.

Protect the cervical spine with collar, sandbags and tape if the patient is likely to have an unstable cervical spine. It is important to recognise that although protection of the cervical spine may occasionally be beneficial, the opening and maintaining of a clear airway is an absolute priority.

The cervical spine can be mobilised in three ways:

1 In-line stabilisation: the spine is held in the neutral position by the clinician's hands on either side of the patent's head, ensuring that the ears are not covered, as the patient must be able to hear to be reassured and informed. This position must be held until the collar and/ or blocks are in place.

2 A cervical collar can be placed around the neck. Before placing the collar, gently feel around the back of the patient's neck to ascertain if there is any midline tenderness and/or a 'step' indicating a fracture or if there is any bleeding. The collar is used by itself in the combative patient, and in

conjunction with blocks or sandbags in the unconscious or cooperative patient (i.e. one who will remain still).

3 Sandbags or blocks and tape are usually added after the collar has been fitted. They cannot be used in combative patients as their movements to free themselves will cause more injury. They are essential in the unconscious patient who has a possibility of neck injury. These objects are placed on either side of the patient's head to prevent lateral movement, and held in place with two tapes, one across the patient's forehead and the other across the chin part of the cervical collar.

If the patient is combative and resists immobilisation it is safer not to restrain the patient. The risk of making the spinal injury worse is increased if the patient resists immobilisation and attempts to restrain her is attempted.

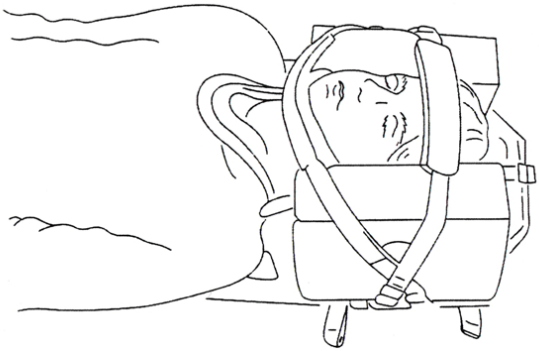
Exceptions

Two groups of patients may prove to be difficult:

- the frightened uncooperative patient (most common)
- the hypoxic combative patient.

In both of these cases, over-enthusiastic efforts to immobilise the neck may increase the risk of spinal injury as the patient struggles to escape. The area of greatest mobility in the cervical spine is the C7/T1 junction, and this is at increased risk in the combative patient

Figure D1.2 *Immobilisation of the cervical spine using head blocks and straps with a cervical collar in place.*



2. Primary assessment and resuscitation of breathing

After management of the airway, the patient's breathing should be assessed. The same approach is adopted as for the patient suffering a serious illness.

Assessment of breathing

- Effort: recession, rate, added noises, accessory muscles, alar nasal flaring.
- Efficacy: breath sounds, chest expansion, abdominal excursion.
- Adequacy: heart rate, skin colour (look for cyanosis), mental status.
- A pulse oximeter is very useful to monitor oxygenation adequacy (SaO_2 should be > 95% when breathing air)
- If patient is breathing spontaneously, high flow oxygen should be given to keep SaO_2 >95%

Unequal breath sounds or poor oxygenation:

- Pneumothorax or haemothorax.
- Misplaced or blocked endotracheal tube.

Looking at the respiratory rate and chest expansion is essential. In addition to the signs listed above, check whether any of the following are present:

- penetrating injury
- presence of flail chest
- sucking chest wounds.

Listen for breath sound character and equality:

- pneumothorax or haemothorax (decreased breath sounds on site of injury)
- detection of abnormal sounds in the chest.

Feel for:

- tracheal shift (sign of tension pneumothorax on side away from the deviation)
- broken ribs
- subcutaneous emphysema.

Percuss for:

- useful in diagnosis of haemothorax (dull on affected side) and pneumothorax (hyper-resonant on affected side).

Continue giving high-flow oxygen (up to15 litres/minute) in all cases.
Careful examination of the trachea, neck veins and chest may indicate the presence of pleural collections of air or blood.
Tension pneumothorax should be treated immediately with needle thoracocentesis in the second intercostal space in the mid-clavicular line (see below).
Assisted ventilation
Provide assisted ventilation if needed to patients with breathing problems, using a bag and mask with a reservoir attached, or by intubation and intermittent positive

pressure ventilation. Do not persist with intubation attempts without oxygenating the patient.

Look for and treat the following:

- airway obstruction (see above)
- tension pneumothorax
- open pneumothorax
- haemothorax
- flail chest
- cardiac tamponade. See below for details.

TABLE D1.1 Serious chest trauma: signs and treatment (see later for more details) and https://www.youtube.com/watch?v=qe-WYYJpBmI&feature=youtu.be

Diagnosis of breathing	Clinical signs	Treatment
Tension pneumothorax	1. Decreased air entry on side of pneumothorax 2. Decreased chest movement on side of pneumothorax 3. Hyper-resonance to percussion on side of pneumothorax 4. Tracheal deviation away from side of pneumothorax 5. Hypoxic shocked patient 6. Full neck veins	1. High-flow oxygen 2. Needle thoracocentesis (Figure D.3) 3. Chest drain insertion (Figure D.4)
Open pneumothorax	Penetrating chest wound with signs of pneumothorax Sucking or blowing chest wound	1. High-flow oxygen 2. Chest drain 3. Wound occlusion on three sides

Diagnosis of breathing	Clinical signs	Treatment
Massive haemothorax: blood in pleural space	1. Decreased chest movement on side of haemorrhage 2. Decreased air entry on side of haemorrhage 3. Dullness to percussion on side of haemorrhage 4. Shock and hypoxia 5. Collapsed neck veins	1. High-flow oxygen 2. Venous access and IV volume replacement 3. Chest drain (a haemothorax of 500–1500 mL that stops bleeding after insertion of an intercostal catheter can generally be treated by closed drainage alone; a haemothorax of > 1500–2000 mL, or with continued bleeding of more than 200–300 mL/hour, may be an indication for further investigation, such as thoracotomy)
Flail chest: paradoxical movement of a chest wall segment associated with underlying lung contusion	Decreased efficiency of breathing	1. Oxygen and pain relief 2. May need intubation and ventilation 3. Transfer if feasible
Cardiac tamponade: blood in pericardial sac causing a decrease in cardiac output	1. Shock associated with penetrating or blunt chest trauma 2. Faint apex beat and/or muffled heart sounds 3. Distended neck veins	1. Oxygen 2. IV access and IV fluids 3. Emergency needle pericardiocentesis (see Figure D.5)

Needle thoracocentesis

This procedure is used for the rapidly deteriorating patient who has a life-threatening tension pneumothorax. If it is used with a patient who does not have a tension pneumothorax, there is a 10–20% risk of producing a pneumothorax or causing damage to the lung, or both. In such cases immediate subsequent insertion of a chest drain is mandatory.

A Chest X-Ray confirming the diagnosis is not required or appropriate. It should be followed by chest drain placement if tension is seen to be relieved.

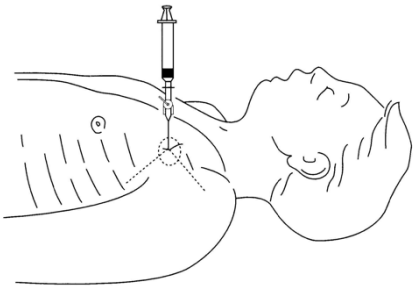


Figure D1.3 *Needle thoracocentesis*

1 Identify the second intercostal space in the mid-clavicular line on the side of the pneumothorax (the opposite side to the direction of tracheal deviation, and the same side as the hyper-resonance).
2 Swab the chest wall with surgical prep or an alcohol swab.
3 Attach the syringe to the over-needle venous cannula.
4 Insert the cannula into the chest wall, just above the rib below, aspirating all the time.
5 If air is aspirated, remove the needle, leaving the plastic cannula in place. Alternatively, insert the over-needle venous cannula without a syringe and note a 'hiss' of air on relief of the tension pneumothorax when the metal stylet is removed from the plastic cannula.
6 Tape the open cannula in place and proceed to chest drain insertion as soon as possible.

Complications of needle thoracocentesis

- Local cellulitis.
- Local haematoma.
- Pleural infection.
- Empyema.
- Pneumothorax.

Insertion of a chest drainage tube

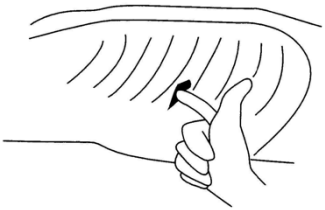
In a trauma emergency that requires a chest drainage tube, fluid resuscitation through at least one large calibre IV cannula, and monitoring of vital signs should be on going. Usually the patient will be receiving oxygen through a facemask with a reservoir.

Chest drain placement should be performed using the open technique described here, as this minimises lung damage. In general, the largest size of drain that will pass between the ribs should be used.

Minimum equipment

- Skin disinfectant and surgical drapes.
- Scalpel with fine straight blade.
- Blunt forceps.
- Artery forceps.
- Large clamps × 2.
- Suture.
- Local anaesthetic if the patient is conscious.
- Scissors.
- Chest drain tube.
- Underwater seal or Heimlich flutter valve.

Figure D1.4 *Sites for chest drain*: normally in the adult in the 4th or 5th intercostal space in the anterior or mid-axillary line (see Figure D14) **but in pregnancy after 20 weeks' gestation use 3rd or 4th intercostal spaces.**



Procedure

1 Consider using analgesia or sedation.

2 Wash your hands and arms to the elbows, and wear a mask, surgical hat (bonnet), sterile gown and sterile surgical gloves.

3 Prepare the underwater seal with an assistant and take the sterile end of the tube, ready to connect to the chest tube once inserted. The 'seal' end should be covered by no more than 1–2 cmH2O.

4 Decide on the insertion site (usually the fourth or fifth OR in pregnancy after 20 weeks third or fourth intercostal space in the anterior or mid-axillary line) on the side with the pneumothorax (see Figure D4).
5 Swab the chest wall with surgical preparation or an alcohol swab.
6 Use local anaesthetic if the patient is conscious.
7 Make a 2- to 3-cm skin incision along the line of the intercostal space, immediately above the rib below to avoid damage to the neurovascular bundle that lies under the inferior edge of each rib.
8 Using artery forceps, bluntly dissect through the subcutaneous tissues just over the top of the rib below and puncture the parietal pleura with the tip of the forceps.
9 Put a gloved finger into the incision and clear the path into the pleura.
10 Advance the chest drain tube (use the largest size that can comfortably pass between the ribs) into the pleural space without the trocar in place but using the artery forceps to help to guide it into the pleural cavity if necessary. Pass about 3 cm and then connect to the underwater seal. Ideally advance the chest drain tube into the pleural space during expiration.
11 Ensure that the tube is in the pleural space by looking for fogging of the tube during expiration.
12 Ensure that all of the drainage holes of the chest drain tube are inside the chest.
13 Connect the chest drain tube to an underwater seal. Check that the tube is in the right place by observing intermittent bubbling of the water in the drainage bottle.
14 Secure the tube using a suture passed through the skin at the incision site (after ensuring that adequate local anaesthetic has been administered) and tied around the tube.
15 Cover the puncture site in the chest wall with a sterile dressing and tape the chest tube to the chest wall.
16 Obtain a chest radiograph if at all possible.
If the chest drainage tube is satisfactorily positioned and working, occasional bubbles will pass through the underwater seal. The water level in the tube will also rise and fall slightly with the respiratory cycle.

Complications of chest drainage tube insertion

- Dislodgement of the chest drain tube from the chest wall or disconnection from the drainage bag.
- Drainage bag elevated above the level of the chest, and fluid flowing into the chest cavity, unless there is a one-way valve system.
- Chest drain tube kinking or blocking with blood clot.

- Damage to the intercostal nerve, artery or vein. This might convert a pneumothorax to a haemo-pneumothorax, or result in intercostal neuritis or neuralgia.
- Damage to the internal thoracic artery if the puncture is too medial, resulting in haemo-pneumothorax.
- In-correct tube position, inside or outside the chest cavity.
- Introduction of pleural infection (e.g. thoracic empyema)
- Laceration or puncture of intrathoracic or abdominal organs which can be prevented by using the finger technique before inserting the chest tube
- Leaking drainage bag
- Local cellulitis
- Local haematoma
- Mediastinal emphysema
- Persistent pneumothorax from a large primary defect; a second chest tube may be required.
- Subcutaneous emphysema (usually at the tube insertion site)

3. Primary assessment and resuscitation of the circulation

Assessment of circulation

Circulatory assessment includes identification of actual and potential sources of blood loss. Closed fractures and bleeding into the chest, abdomen or pelvis may make it difficult to detect how much blood has been lost. The ability to estimate the percentage blood loss is helpful when planning resuscitation. Remember that blood volume in pregnancy is 100 mL/kg, or 5–7 litres.

TABLE D1.2 Effects of blood loss in pregnancy

	Percentage circulating blood loss		
Vital Sign	< 25%	25–40%	> 40%
Heart rate	slight increase	moderate increase	marked increase or bradycardia
Systolic BP	normal	normal	beginning to fall
Pulse volume	normal or decreased	seriously decreased	very seriously decreased
Skin	cool, pale, sweaty, CRT	cool, mottled, sweaty CRT	cool and sweaty CRT

	Percentage circulating blood loss		
Vital Sign	< 25%	25–40%	> 40%
Respiratory rate	slight increase	moderate increase	sighing respirations
Mental status	slight agitation	lethargic or uncooperative	only reacts to pain

* CRT Prolonged Capillary refill time is > 3 seconds.

Note that **blood pressure may be normal until up to 50% of the patient's circulatory volume has been lost.**

The blood pressure is initially well maintained despite continuing bleeding in pregnancy. As an indicator of haemorrhage, it can be falsely reassuring. Tachypnoea and progressively worsening tachycardia are signs, before a fall in blood pressure that haemorrhage is continuing. A monitoring device which displays measurements of pulse rate, ECG trace and blood pressure is useful if available. Ultrasound assessment is probably the most valuable technique in the investigation of major trauma in pregnancy. It includes fetal heart rate, gestational age, presentation, placenta, abruption, evidence of fetal injury, and evidence of intra-abdominal/pelvic fluid.

The focused assessment with sonography for trauma (FAST) examination is best practice at this time. A FAST evaluates four areas where fluid or blood may accumulate in the abdomen including the sub-xiphoid pericardial window, hepatorenal recess, peri-splenic and suprapubic view. Apart from finding evidence of intraabdominal/pelvic fluid it can also document fetal heart rate, gestational age, fetal presentation, placental position, abruption and evidence of direct fetal injury.

Resuscitation of circulation

Management is focused on correcting hypovolaemia and controlling blood loss. Loss of blood is the most common cause of shock in major trauma.

Concealed bleeding severe enough to cause shock can occur into the uterus, pleural cavity, abdomen, pelvis and femur

Stop bleeding

The first priority is to stop obvious bleeding by applying direct pressure. Do not forget that the patient may have a wound on their back that is bleeding into the bed. To examine the back, the patient should be log-rolled, if indicated.

- Injuries to the limbs: tourniquets do not work well and may cause reperfusion syndromes and add to the primary injury. The recommended procedure is the application of a 'pressure dressing'.
  Severe bleeding from high-energy penetrating injuries and amputation wounds can be controlled by sub-facial gauze pack placement, plus manual compression on the proximal artery, plus a carefully applied compressive dressing on the entire injured limb.
- Injuries to the chest: the most common source of bleeding is chest wall arteries. Immediate placement of a chest tube drain plus intermittent suction of the tube plus efficient analgesia (IV ketamine is the drug of choice, if available) expand the lung and seal off the bleeding.

Tranexamic acid This can reduce mortality from haemorrhage in major trauma in pregnancy. This drug should be started as soon as possible, and within the first 3 hours after the trauma, to be effective.

The loading dose in pregnancy is 1 gram over 10 minutes followed by an IV infusion of a further 1 gram over 8 hours.
The slow IV bolus dose is given by injecting 1 gram of tranexamic acid into a 100-mL bag of 0.9% saline and letting it run through over about 10–20 minutes (the exact timing is not crucial).

The 8-hour infusion is given by injecting 1 gram of tranexamic acid into a 500-mL bag of 0.9% saline and giving it over 8 hours (approximately 60 mL/hour). If there is a gap between the initial bolus and the subsequent infusion this probably does not matter too much, but ideally one should follow the other.

Elevate the legs if the patient is in shock.

If there are sufficient helpers available, consider placing the leg segments (1,2, and 3) only of an anti-shock garment to gain time whilst awaiting blood transfusion and surgery (if needed).

Do not apply the pelvic or abdominal segments (4 and 5) of the garment in pregnancy and do not stop other vital activities to arrest the bleeding whilst placing the leg segments of the garment in place. *(see Section A+11)*

IV fluid resuscitation
The goal is to restore oxygen delivery to the tissues. As the usual problem is loss of blood, fluid resuscitation (of blood as soon as possible) must be a priority.

- Adequate vascular access must be obtained. This requires the insertion of at least one, and ideally two, large-bore cannula (14–16 G). Peripheral cut-down or intra-osseous infusion may be necessary.

- Infusion fluids: These should be warmed to body temperature. Remember that hypothermia can lead to abnormal blood clotting. Use crystalloids such as Ringer-lactate or Hartmann's solution whilst awaiting blood for transfusion. Normal (0.9%) saline can be used if these fluids are unavailable, but be aware that, especially in larger volumes, normal saline causes a hyper-chloraemic acidosis which is detrimental to sick or injured patients.
- **Do not give hypotonic solutions** (e.g. 5% Dextrose in water or 5% Dextrose with 1/5N saline, these are dangerous in this situation) but glucose can be added to Ringer–Lactate, Hartmann's or N saline if there is evidence of or concern about hypoglycaemia.
- Take blood for Hb, group and cross match and glucose, electrolytes and amylase for urgent analysis.

Not all cases of hypovolaemia require aggressive fluid therapy. In adults, withholding fluids in penetrating trunk trauma before achieving surgical haemostasis has been associated with an improved outcome. The rationale is to avoid pushing up the blood pressure, which hinders clot formation and promotes further bleeding. Aggressive crystalloid fluid replacement can lead to increased fluid requirements, hypothermia, dilution of clotting factors, excessive blood transfusion and its associated immunosuppression. Aim to give sufficient fluid ONLY to maintain vital organ perfusion. This can be monitored by monitoring the patient's state of alertness that is a measure of brain perfusion in the absence of a head injury.

On the other hand, in severe head injury, cerebral perfusion is critically dependent on maintaining blood pressure. If the patient has both a severe head injury and major trunk bleeding, the apparently conflicting requirements are best managed by maintaining priorities in CABC order and achieving prompt surgical haemostasis. Beyond this strategic conflict, it should be remembered that hypovolaemia mimics head injury, and blood pressure itself is a poor indicator of organ perfusion.

As outlined above, the concept of 'targeted fluid resuscitation' is important if the cause of hypovolaemic shock is haemorrhage from penetrating injury. Here the initial boluses of IV crystalloids required to treat shock should only be given to keep the vital organs (especially the brain, heart and kidneys) perfused before emergency surgery and blood transfusion is available.

Fresh blood is particularly useful to combat the coagulopathy that occurs in major blood loss if specific coagulation components such as platelets are unavailable. Transfusion is best based on clinical assessment rather than lab results.

Penetrating trauma is not common in pregnancy. We suggest that when giving boluses of crystalloid or blood to patients in shock due to bleeding in major trauma, only the amount needed to keep the blood pressure at a level sufficient to perfuse the vital organs should be given. There is no clear evidence to indicate the precise blood pressure that should be achieved in a pregnant woman in shock due to haemorrhage. Adequate perfusion of vital organs may best be indicated by a radial pulse which can be palpated and an alert conscious level (in the patient without a significant head injury). The adequacy of the fetal heart rate may also be helpful. Therefore, to maintain a palpable radial pulse in pregnancy, start with IV boluses of 250 mL of crystalloid or ideally blood, and reassess after each bolus.

After repeating 250 ml boluses up to 4 times (i.e. 1000mL in pregnancy), the transfusion of blood (packed red cells) should if possible be urgently achieved. The most important aspect of fluid resuscitation is the patient's response to the IV fluid challenge. Improvement is indicated by the following:

- a decrease in heart rate
- an increase in systolic blood pressure
- an increase in skin temperature
- faster capillary refill time < or = 3 seconds
- improving mental state.

Failure to improve should prompt an urgent search for chest, abdominal or pelvic haemorrhage, with the immediate involvement of an experienced surgeon. Similar volumes may be repeated if there is continuing evidence of haemorrhagic shock, after re-evaluating the state of the circulation.

Blood transfusion

There may be considerable difficulty in getting blood for transfusion. Blood transfusion is most important and requires blood to be taken for urgent cross matching. Fresh donor blood is the best because it contains platelets and other clotting factors. Remember possible incompatibility, and hepatitis B, C and HIV risks; even among the patient's own family.

Blood transfusion must be considered when the patient has persistent haemodynamic instability despite fluid (colloid/crystalloid) infusion. If the type-specific or cross- matched blood is not available, type O negative packed red blood cells should be used. Transfusion should be seriously considered if the haemoglobin level is less than 7 grams/ dL and if the patient is still bleeding.

As described above, early surgical involvement is essential.

Vascular access
This is essential in all seriously injured patients. A minimum of two relatively large-bore IV cannula is essential.

TABLE D1.3 Infusion IV line flow rates

Colour code	Gauge	Crystalloid flow rate (mL/minute)
Brown	14	240
Grey	16	172
Yellow	17	130
Green	18	76
Pink	20	54
Blue	22	25
Lime green	24	14

Peripheral veins are preferable; the inexperienced should not attempt central venous cannulation. The external jugular vein can be accessed even in shock, but the cannula can become easily displaced and must be very carefully taped in place. (Section E13) A cut-down on to the long saphenous vein at the ankle can also be used. (Section E13)

If venous access is difficult and is taking too long, the new intra-osseous EZ-IO drill is simple to operate and can be life-saving (see Section E13), and should be available in all emergency departments.

Central venous cannulation can permit large volumes to be rapidly infused and also permit central venous pressure measurements. It must be undertaken by a skilled person (e.g. an anaesthetist), and a Seldinger technique should be used. The femoral vein is NOT appropriate in pregnant women where instead the internal jugular or subclavian vein may be used. Peripheral venous access can often be established once peripheral perfusion has been improved.

Both femoral venous and tibial intra-osseous access are best avoided if there is clinical evidence of a pelvic or abdominal injury. In such cases it is better to secure vascular access above the diaphragm. The upper outer aspect of the humerus can be used for intra-osseous access in that case (see Section E13). Blood from a vein or bone marrow should be drawn for typing and cross-matching, haemoglobin, glucose and electrolytes. These tests are clinically accurate on a marrow sample

from an intra-osseous approach provided there has not been prior infusion of blood or crystalloid fluid.

The infused fluids and blood should be warm. Physiological coagulation works best at normothermia, and haemostasis is difficult at core temperatures below 35°C. Hypothermia in trauma patients is common during protracted improvised outdoor evacuations, even in the tropics. It is easy to cool a patient but difficult to rewarm them, so prevention of hypothermia is essential. IV fluids should have a temperature of 40–42°C (using IV fluids at 'room temperature' means cooling!).

Venous cut-down (see Section E13)

External jugular venous cannulation (see Section E13)

Other less common causes of shock in major trauma

Cardiogenic shock
Inadequate heart function may result from:
- myocardial contusion (bruising)
- cardiac tamponade
- tension pneumothorax (preventing blood from returning to the heart)
- myocardial infarction.

Assessment of the jugular venous pressure is valuable in these circumstances. It will be elevated compared with hypovolaemic shock, where it may not be visible. An ECG should be recorded (if available).

Neurogenic shock
This is due to the loss of sympathetic tone, usually resulting from spinal cord injury, with the classical presentation of hypotension without reflex tachycardia or skin vasoconstriction.

Tension pneumothorax
See under "Breathing section" above. This can present with shock as well as breathing impairment.

Cardiac tamponade (see below)

Summary: managing the circulation in major trauma.
Direct pressure on bleeding sites
Consider urgently the need for surgical intervention
Peripheral, intra-osseous access, central venous or saphenous vein cut-down (see Section E13)

Elevate the legs and If there are sufficient helpers available, consider placing the leg segments (1,2, and 3) only of an anti-shock garment to gain time whilst awaiting blood transfusion and surgery.
In pregnancy do not apply the pelvic or abdominal segments (4 and 5) of the garment and do not stop other vital activities to arrest the bleeding whilst placing the leg segments of the garment in place. Only use if the site of trauma allows it.
Fluid resuscitation if shocked
Tranexamic acid
Monitor response and only continue with fluids if needed
Do not give excess fluids, especially to patients with head or chest injuries or malnutrition

The most important aspect of *fluid resuscitation* is the response to a fluid challenge.
Improvement is indicated by

1. Decreased heart rate
2. Increased skin temperature
3. Faster capillary refill
4. Improved mental state
5. Increased systolic blood pressure
6. Improved urinary output
7. If the patient fails to improve, look for chest, abdominal or pelvic blood loss and consider surgical intervention

Tension pneumothorax needs emergency thoracocentesis and insertion of chest drain(s)

Exsanguination needs large fluid boluses and blood transfusion (ideally fresh donor blood)

Pericardial tamponade needs pericardiocentesis

Take blood/bone marrow samples for:
Cross-matching
Haemoglobin and full blood count
Glucose
Electrolytes

4. Primary assessment and resuscitation of neurological failure
Head injury is a major cause of death in trauma.
Rapid assessment using the AVPU score:

AVPU score: A = Alert, V = responds to a Voice, P= response to Pain, U = Unresponsive.

- With a score of 'P' or 'U', intubation should be considered in order to maintain and protect the airway. If there is no one skilled in intubation available, the patient should be placed in the recovery position.
- Remember to check for a pain response above the level of the clavicle, as a patient with a spinal injury may not be able to respond by moving their limbs.
- Look for signs indicative of injury (e.g. bruises, lacerations or haematoma) in the head and neck area.
- Examine the pupils for size, equality and reaction to light. Look for other lateralising signs, such as limb weakness or focal seizures.

At this stage, the brain is best cared for by close attention to managing CABC, and by correction of any hypoglycaemia (unusual).

If there is evidence of raised intracranial pressure (RICP):
- Intubate and ventilate to maintain oxygenation and aim for $paCO_2$ of about 4 kPa if it can be measured.
- Maintain systolic blood pressure.
- Nurse the patient in a 30-degree head-up position.
- Contact a neurosurgeon (if available).

Give 20 grams of 20% mannitol over 15 minutes as soon as cerebral oedema is suspected. Repeat every 4–6 hours. Where possible first exclude any intracranial haematoma. If this is not excluded, there will be temporary improvement due to relief of cerebral oedema, but there may be sudden worsening a short time later due to rapid expansion of the haematoma. An alternative is hypertonic saline (2.7% or 3% at 3mL/Kg) which is less likely to result in rebound brain swelling and unlike mannitol does not induce a diuresis.

Always check the blood glucose level where possible.

Analgesia in major trauma (see Section C7)
Pain increases fear and distress makes the patient less able to cooperate and raises intracranial pressure. If the patient is fully conscious and in severe pain, control of pain is required.
Pain relief takes several different forms:
- Reassurance.
- Splinting of fractures.
- Covering wounds, especially burns.
- Drugs:

There is no place for oral or IM medication in a major trauma situation.
There are three alternatives in severe trauma: ketamine, morphine and IV paracetamol.

Ketamine
The positive inotropic effects of ketamine, and the fact that it is less likely to affect the gag reflex, make this a helpful analgesic, especially if there is or has been shock. Repeated IV doses of 250 micrograms/kg followed by careful reassessment are usually effective.

Morphine
In major trauma 5–10 mg in pregnancy is the drug of choice, followed by careful reassessment. If the conscious level falls, the effect can be reversed with naloxone, showing whether the effect is caused by the morphine or by a worsening brain injury. If there is respiratory depression, first ventilate with a bag-valve-mask before giving naloxone. A head injury is NOT a contraindication to giving morphine unless there is depressed consciousness, when great care is needed.

IV Paracetamol
Table D1.4 Intravenous paracetamol for mild or moderate pain

Age/weight	*Dose*	*Maximum dose in 24 hours*
Pregnant woman less than 50 kg body weight	*15 mg/kg every 4–6 hours*	*60 mg/kg*
Pregnant woman more than 50 kg body weight	*1 g every 4–6 hours*	*4 g*

Intravenous paracetamol
- *Paracetamol IV is formulated as a 10 mg/mL aqueous solution (in ready-to-use 50-mL and 100-mL vials for infusion over 15 minutes).*
- *It is useful, effective and safe.*
- *The peak analgesic effect occurs within 1 hour, lasting approximately 4–6 hours.*
- *Ensure correct dose is given, as serious liver toxicity can occur in overdose.*

- *Side effects are rare but include rashes, blood disorders and hypotension on infusion.*
- *Caution is needed in patients with severe renal impairment, severe malnutrition or dehydration.*
- *Paracetamol helps to reduce the amount of morphine required when used in combination.*

Regional nerve blocks

Valuable if the necessary skills are available

Summary of primary assessment and resuscitation

The injured patient should have:

1. a team approach with an urgent call for surgical and anaesthetic availability
2. if external haemorrhage is present this must be stopped
3. identification of the need for life-saving surgery and preparation under way
4. a clear airway and 100% oxygen for breathing
5. cervical spine immobilisation, where appropriate
6. adequate respiration, achieved by manual or mechanical ventilation and chest decompression when indicated
7. venous access and an initial fluid challenge, if indicated on circulatory assessment
8. blood sent for typing and cross-matching and transfused as soon as possible if bleeding
9. identification of any serious head injury, and attention paid to maximising C, A, B and C
10. Life threatening injuries identified and treated

Table D1.5 Summary of injuries and treatment

Injury	Treatment
Airway obstruction	Head tilt, chin lift and jaw thrust, Oropharyngeal airway, Intubation or Surgical airway
Tension pneumothorax	Needle thoracocentesis and chest drain
Open pneumothorax	Three-sided dressing, then chest drain
Massive haemothorax	IV access, chest drain and blood transfusion
Flail chest	Intubation if needed
Cardiac tamponade	Pericardiocentesis

Before the secondary assessment begins, it should be remembered that:

1. CABC and neurological failure components of the primary assessment and resuscitation require constant re-evaluation, as deterioration can be rapid and unexpected.
2. Emergency operative treatment to control life-threatening haemorrhage should be performed promptly, without waiting for non-urgent examination and imaging.
3. Identification of all anatomical injuries remains an important goal. However, resuscitation of the circulation during the primary survey may require urgent emergency surgery as part of C the circulation before all non-life-threatening injuries have been identified.

Fetal assessment

All pregnancies where the fetus is potentially viable should undergo Fetal Heart Rate monitoring ideally for at least 4 hours and if the patient goes in to labour immediately after the end of every contraction for 60 seconds (see Section A+19).

Secondary assessment and emergency treatment

Secondary assessment and emergency treatment are undertaken only when the patient's CABC's are stable. If any deterioration occurs during this phase, secondary assessment must be interrupted by another primary assessment and resuscitation.

Documentation is required for all procedures undertaken. This involves careful examination from head to toe in a systematic way, including a controlled examination of the back, avoiding spinal movement by log-rolling (see below). Clear documentation of all injuries is required, to serve as the basis of the subsequent management strategy.

1. History The method of injury for example whether as a pedestrian or whether in a vehicle matter. For the latter situation was the collision head-on or from behind, was the woman thrown from the vehicle or was she wearing a seat belt. What was the speed of the vehicle, were others in the vehicle injured or dead. All these give clues as to the likely injuries.
2. Events before and after incident
3. First aid given at scene
4. Past medical history
5. Medications and allergies
6. Immunisation status
7. Last food and drink
8. Adjuncts that can help with protecting the patient and monitoring progress.
    a. Monitoring ECG, SaO2 and blood pressure
    b. Urinary and gastric catheters
    c. Portable X-rays of chest and pelvis
    d. Ultrasound of uterus and abdomen

    e. Baseline blood tests (especially haemoglobin, cross- matching, biochemistry and clotting)
9. Head examination
    a. scalp and ocular abnormalities
    b. external ear and tympanic membrane
    c. periorbital soft-tissue injuries.
10. Head injury patients should be suspected of having cervical spine injury.
11. Neck examination
    a. for a penetrating wound
    b. for subcutaneous emphysema
    c. for tracheal deviation
    d. or neck vein appearance (JVP).
12. Neurological examination
    a. brain function assessment using the AVPU Scale or the Glasgow Coma Scale (GCS)
    b. spinal cord motor activity
    c. sensation and reflexes
13. Chest examination
    a. the clavicles and all ribs
    b. breath sounds, heart sounds, percussion and tracheal position
    c. ECG monitoring (if available).
14. Abdominal examination
    a. is uterus soft or tender
    b. lie of fetus
    c. fetal heart rate
    d. for a penetrating wound of the abdomen requiring surgical exploration
    e. for blunt trauma, for bowel sounds, for tenderness, guarding and rigidity
15. Vaginal examination if bleeding
16. Rectal examination
17. Examination of pelvis and limbs
    a. pain, tenderness on palpation
    b. deformity
    c. wounds.
18. X-rays (if possible and where indicated)
    a. chest X-ray and cervical spine films (it is important to see all 7 vertebrae)
    b. pelvic and long bone X-rays
    c. skull X-rays for fractures when head injury is present
    d. CT scans of the head and abdomen (if available).

Head injury

The scalp and face are examined for bruising, abrasions, lacerations and evidence of fracture.
Basal skull fracture is manifested by signs such as:

- 'raccoon eyes' (bilateral periorbital haematoma), bleeding from the ears or a visible haemo-tympanum
- Battle's sign (bruising over the mastoid process, which is a relatively late sign)
- CSF leakage from the nose, mouth or ears.

The AVPU Scale score or the Glasgow Coma Scale score is again evaluated, allowing a comparison with the primary assessment estimation (unless the patient is now intubated and sedated).

Delay in the early assessment of head-injured patients can have devastating consequences in terms of survival and patient outcome. Hypoxia and hypotension double the mortality of head-injured patients.

The following conditions are potentially life-threatening but difficult to treat in district hospitals especially in low resource settings. It is important to treat what you can with the expertise and resources that you have available, and to triage casualties carefully.

Immediate recognition and early management of the following conditions are essential:
Acute extradural haemorrhage
Classical signs consist of:

- loss of consciousness following a lucid interval, with rapid deterioration
- a rapid rise in intracranial pressure, due to bleeding from the middle meningeal artery
- development of hemiparesis on the opposite side, with a fixed pupil on the same side as the impact area.

The management is surgical, and every effort should be made to do burr-hole decompression.

Acute subdural haematoma
There is bleeding in the subdural space, accompanied by severe contusion of the underlying brain. This condition results from tearing of bridging veins between the cortex and the dura. Again, surgery is needed, but it requires a neurosurgeon, not burr-holes alone.

The following conditions should be treated with more conservative medical management, as neurosurgery does not usually improve the outcome:

1. base-of-skull fractures

2. cerebral concussion, with temporarily altered consciousness
3. depressed skull fracture: an impaction of fragmented skull may result in penetration of the underlying dura and brain
4. intracerebral haematoma, which may result from acute injury or progressive damage secondary to contusion
5. diffuse brain swelling is managed medically, but apart from ventilation and general supportive therapy, recovery is dependent on the severity of the injury and the effect of the initial physiological support of CABC.

Alteration of consciousness is the hallmark of brain injury.

The most common errors in head injury evaluation and resuscitation are:

- failure to perform CABC and prioritise management
- failure to look beyond the obvious head injury
- failure to assess the baseline neurological examination
- failure to re-evaluate the patient who deteriorates.

Management of head trauma

Haemorrhage is controlled, Airway, Breathing and Circulation are stabilised (and the cervical spine immobilised, if possible).

Vital signs are important indicators of the patient's neurological status and must be monitored and recorded frequently.

The Glasgow Coma Scale (GCS) score is interpreted as follows:

- severe head injury: GCS score is ≤ 8
- moderate head injury: GCS score is 9–12
- minor head injury: GCS score is 13–15.

Remember:

- Deterioration may occur due to bleeding or brain swelling.
- Unequal or dilated pupils may reflect an increase in intracranial pressure.
- Head or brain injury is never the cause of hypotension in the adult trauma patient.
- Sedation should be avoided, as it decreases the level of consciousness, and promotes hypercarbia due to slow breathing with retention of CO2.
- The Cushing response is a late sign, reflecting a lethal rise in intracranial pressure, associated with a poor prognosis. The hallmarks are:
  1. bradycardia
  2. hypertension
  3. decreased and erratic respiration.

Basic medical management for severe head injuries includes:

- Intubation and ventilation, producing normocapnia (pCO_2 in the range 4.5–5 kPa, if it is possible to monitor this). This will reduce both intracranial blood volume and intracranial pressure temporarily.

- Sedation with possible paralysis provided that the airway is fully protected by intubation and a means of assisted ventilation present.
- Moderate IV fluid input: do not overload.
- Nursing head up at an angle of 20-30 degrees.
- Prevention and treatment of hyperthermia/fever.
- Avoidance of hypoglycaemia and electrolyte abnormalities.

Management of Chest trauma ***https://youtu.be/qe-WYYJpBmI***

Immediate deaths are usually due to major disruption of the heart or of the great vessels. *Early* deaths due to chest trauma include airway obstruction, tension pneumothorax, cardiac tamponade or aspiration. The majority of patients with thoracic trauma can be managed by simple manoeuvres and do not require surgical treatment.
Respiratory distress may be caused by:

- rib fractures/flail chest
- pneumothorax
- tension pneumothorax: should be recognised and treated during he primary survey/assessment
- haemothorax
- pulmonary contusion (bruising)
- open pneumothorax
- aspiration.

Haemorrhagic shock due to chest trauma may be due to:

- haemothorax
- haemomediastinum.

Thorough re-examination of the chest front and back, using the classical inspection–palpation–percussion– auscultation approach, is combined with a chest X-ray.

- Particular attention is directed to the symmetry of chest movement and breath sounds, the presence of surgical emphysema and pain.
- Tracheal deviation and altered heart sounds are noted.
- On log-rolling the patient, it is important to reconsider flail chest, as a posterior floating segment is often poorly tolerated.

Rib fractures
Fractured ribs may occur at the point of impact, and damage to the underlying lung may produce lung bruising or puncture. The ribs usually become fairly stable within 10 days to 2 weeks. Firm healing with callus formation is seen after about 6 weeks.

Flail chest

The unstable segment moves separately and in an opposite direction from the rest of the thoracic cage during the respiration cycle. Severe respiratory distress may ensue. Treatment is by analgesia, as breathing is painful, and shallow breathing may predispose to pneumonia in this situation. In severe cases, nasal CPAP or assisted ventilation is needed.

Pneumothorax

- A tension pneumothorax develops when air enters the pleural space but cannot leave, increasing the compression of the underlying lung with each breath. The consequence is progressively increasing intra-thoracic pressure in the affected side, resulting in mediastinal shift and signs of respiratory and cardiac collapse (should be detected in primary survey/assessment.. The trachea may be displaced (late sign) and is pushed away from the midline by the air under tension. The patient will become short of breath and hypoxic. Urgent needle decompression (thoracocentesis) is required prior to the insertion of a chest drain (see earlier).
- A simple pneumothorax can be diagnosed by X-ray or ultrasound scanning and, although not life-threatening, may be associated with significant underlying lung injury. All traumatic pneumothoraces require close observation. Small ones often absorb spontaneously, but larger ones frequently require chest drainage.
- Open pneumothoraces, or sucking chest wounds, allow bidirectional flow of air through a chest wall defect. The lung on the affected side is exposed to atmospheric pressure with lung collapse and a shift of the mediastinum to the uninvolved side. This must be treated rapidly again as part of the primary survey and resuscitation. In compromised patients, intercostal drains, intubation and positive pressure ventilation are often required. Alternatively, they can be treated by applying an occlusive dressing, taped on three sides to serve as a flap valve, followed by insertion of a chest drain remote from the site of injury. A better dressing is the customised Asherman chest seal, which consists of an adhesive ring, similar to that on a colostomy stoma bag, which projects into a pipe-shaped flap valve, resembling that in a Heimlich valve. Beware of the possibility of a tension pneumothorax developing when one of these is used.

Pulmonary contusion

This is usually caused by blunt trauma and may occur in association with rib fractures with or without a flail segment. It is common after chest trauma and is a potentially life- threatening condition. The onset of symptoms may be slow, progressing over 24 hours post-injury. Pulmonary contusion is likely to occur in

cases of high-speed accidents, falls from great heights, and injuries by high-velocity bullets.

Symptoms and signs include:

- dyspnoea
- hypoxaemia and cyanosis when severe and not anaemic
- sparse or absent breath sounds
- tachycardia.

Treatment involves supplemental oxygen, careful fluid management and particular attention to pain relief. Endotracheal intubation may be necessary in severe cases.

Traumatic haemothorax

This is more common in penetrating than in non-penetrating injuries to the chest. If the haemorrhage is severe, hypovolaemic shock will occur, and also respiratory distress due to compression of the lung by collection of blood on the involved side. Optimal therapy consists of the placement of a large chest tube with 2 large bore cannulae inserted prior to drainage and with blood for transfusion immediately available. In some instances where the bleeding continues and is significant, open chest surgery is necessary to stop the bleeding (see below).

A haemothorax of 500–1500 mL in pregnancy that stops bleeding after insertion of an intercostal catheter, can generally be treated by closed chest drainage alone.

A haemothorax of greater than 1500–2000 mL in pregnancy with continued bleeding of more than 200–300 mL per hour in pregnancy is an indication for further investigation usually by thoracotomy if available.

The injuries listed below are also possible in severe trauma but carry a high mortality even in well-resourced centres.

1 *Myocardial contusion:* This is associated in blunt chest trauma, with fractures of the sternum or ribs. The diagnosis is supported by abnormalities on ECG and elevation of serial cardiac enzymes (if available). Cardiac contusion can simulate a myocardial infarction. The patient must be closely observed, with cardiac monitoring (if available). This type of injury is more common than realised and may be a cause of sudden death sometime after the accident.

2 *Pericardial tamponade*: Penetrating cardiac injuries are a leading cause of death. It is rare to have pericardial tamponade with blunt trauma. Pericardiocentesis must be undertaken early if this injury is considered likely. Look for pericardial tamponade in patients with:

- shock
- distended neck veins
- no pneumothorax

- muffled heart sounds.

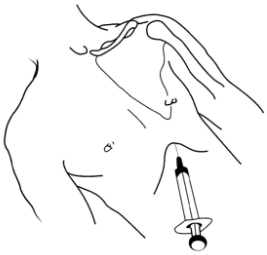
Needle pericardiocentesis

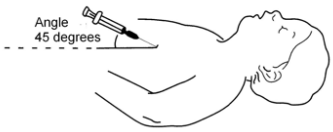
This procedure is used to remove a pericardial effusion that is causing haemodynamic compromise when cardiac tamponade is suspected. This is usually, but not always, caused by a penetrating injury between the nipple line and the shoulder blades. The clinical findings are shock, muffled heart sounds (although this is a difficult sign to elicit with confidence) and distended neck veins. It is important to differentiate between this and tension pneumothorax, in which the trachea is deviated and air entry reduced on the affected side. Ideally this procedure should be carried out under ECG control, but if that is not available, extra care must be taken.

If available, ultrasound is the easiest/safest way of making a diagnosis of cardiac tamponade.

The following equipment is needed for its treatment:

- ECG monitor
- syringe
- skin prep
- local anaesthetic
- over-needle cannula (16- to 18-gauge)
- sterile drapes.





Technique

1 Position the patient supine and attach the ECG. Stand on the patient's right with the ECG monitor at the patient's head so that you can see it easily.

2 Clean the skin from nipples to umbilicus and drape with sterile towels to expose the xiphoid region. This must be a sterile procedure. Infiltrate local anaesthetic at the costal margin just below the xiphoid process.

3 Attach the cannula to the syringe. Insert the cannula just below and to the left of the xiphoid process. Angle the needle at 45 degrees to the skin and pointing towards the tip of the left scapula.

Figure D1.5 *Position for insertion of needle in pericardiocentesis*

4 Advance the needle, holding this position, aspirating all the time and watching the cardiac monitor. As you enter the pericardiocentesis needle is

inserted as close to the sternum as possible in order to avoid the internal mammary artery. Because of the distended pericardial sac, fluid will flow back into the syringe. If the myocardium is touched, the ECG pattern will change (arrhythmia, ectopics, 'injury' pattern). If you can aspirate large amounts of bright red blood you have entered the ventricle, in which case you should withdraw slightly.

5 If successful, cardiac function should improve immediately. Withdraw the needle, attach a three-way tap, and secure the cannula for further aspirations.

6 This is a temporary procedure, and some patients will require a formal pericardiotomy. Pericardial aspiration may not work well for viscous fluids (e.g. clotted blood) in the pericardial sac.

Thoracic great vessel injuries: Injury to the pulmonary veins and arteries is often fatal and is one of the major causes of on-site death.

Rupture of the trachea or major bronchi: This is a serious injury with an overall estimated mortality of at least 50%. The majority (80%) of the ruptures of bronchi are within 2.5 cm of the carina.

The usual signs of tracheobronchial disruption are:

- haemoptysis
- dyspnoea
- subcutaneous and mediastinal emphysema
- occasionally cyanosis.

Trauma to the oesophagus

This is rare in patients with blunt trauma, and more frequent in association with penetrating injury. It is lethal if unrecognised, because of mediastinitis. Patients often complain of sudden sharp pain in the epigastrium and chest, with radiation to the back. Dyspnoea, cyanosis and shock occur, but these may be late features. Urgent IV broad-spectrum antibiotics covering both aerobic and anaerobic organisms, as well as nil-by-mouth nursing, are required.

Diaphragmatic injuries

These may occur in association with either blunt or penetrating chest trauma often as part of road traffic accidents. The diagnosis is often missed.

Diaphragmatic injuries should be suspected in a thoracic wound that is:

- below the fourth intercostal space anteriorly
- below the sixth interspace laterally
- below the eighth interspace posteriorly.

These injuries are more commonly seen on the left side.

Thoracic aorta rupture

This occurs in patients who are exposed to severe decelerating forces, such as high-speed car accidents or a fall from a great height. It has a very high mortality due to rapid exsanguination; the total blood volume may be lost in the first minute following injury.

Abdominal trauma

1. Abdominal injuries in addition to those affecting the uterus, are common and, if unrecognised, may prove fatal. Any patient involved in any serious accident should be considered to have an abdominal injury until it has been ruled out.
2. Unexplained blood loss evident during the primary assessment is frequently due to intra-abdominal haemorrhage.
3. The abdomen is a classical silent area after trauma. It has to be actively cleared of injury rather than simply noted to be soft and non-tender, especially in the face of altered consciousness.
4. Cardiovascular decompensation may occur late and precipitously.
5. The organ most commonly injured in penetrating trauma is the liver, and in blunt trauma the spleen is often torn and ruptured.
6. Thorough history taking and a careful examination of the abdomen may give clues to the origin of bleeding or perforation.
7. Gastric distension may cause respiratory embarrassment, and a gastric tube should be placed.

There are two basic categories of abdominal trauma:

1 Penetrating trauma, where the need for surgical consultation is urgent. For example:

gunshot injury or stabbing.

2 Non-penetrating trauma. For example:

- compression injuries
- crushing injuries
- seat-belt injuries
- acceleration/deceleration injuries.

About 20% of trauma patients with acute haemo-peritoneum have no signs of peritoneal irritation at the first examination, and repeated assessment must be undertaken.

Blunt trauma can be very difficult to evaluate, especially in the unconscious patient. These patients may need abdominal paracentesis, although where ultrasound

and/or abdominal CT is available, peritoneal lavage has been superceded. However, an exploratory laparotomy may be the best definitive procedure if abdominal injury needs to be excluded.

Remember to check for blood at the external urethral meatus.

Complete physical examination of the abdomen includes rectal examination assessing:

- sphincter tone
- integrity of the rectal wall
- blood in the rectum

Women and adolescent girls of childbearing age should be considered pregnant until pregnancy has been excluded. The fetus may be salvageable, and the best treatment of the fetus is resuscitation of the mother. A pregnant mother at term, however, can usually be resuscitated properly only after delivery of the baby. This difficult situation must be assessed at the time (see Section 58).

Abdominal paracentesis (see Section A+6)

Indications

- To detect intra-abdominal injury after blunt trauma in the haemodynamically stable patient in the absence of CT or ultrasound scanning facilities. Haemodynamic instability after penetrating trauma always requires a laparotomy.
- To identify peritonitis.
- To identify ruptured bowel.

The following equipment is needed:

- local anaesthetic
- sterile drapes
- over-needle catheter, 16- to 20-gauge
- 20-mL syringe
- warmed normal saline and infusion set
- urinary catheter and nasogastric tube
- skin prep (iodine/alcohol).

Procedure if the patient is not pregnant

1 The procedure must be sterile.
2 Decompress the bladder and stomach with a urinary catheter and nasogastric tube.
3 Prepare the abdomen (from the costal margin to the pubis). Drape the area with sterile towels, exposing the peri-umbilical region.

4 If the patient is conscious, infiltrate local anaesthetic in the midline (a third of the distance between the umbilicus and the pubis). If pelvic trauma is suspected, infiltrate above the umbilicus.
5 Insert the catheter over needle. Remove the needle and aspirate.
6 If more than 10 mL of fresh blood or turbid or bile-stained fluid or faeces or food debris are present in the aspirate, there is a serious problem, indicating the need for a laparotomy.
7 If none of the above abnormalities are seen on aspiration, instil 10 mL/kg of warm sterile normal saline into the abdomen and allow 5 minutes for it to circulate. Then retrieve the fluid.

Interpreting the results of analysis of the retrieved fluid
Abnormal findings include the following:

- red blood cell count (unspun) > 100000/mL: may need laparotomy if unstable
- white blood cell count (unspun) > 500/mL
- bile staining
- faeces
- Gram stain/microscopy positive

If laparotomy is indicated, withdraw the catheter and cover the wound with a sterile dressing. Then transfer the patient to theatre.
In a severely injured patient, a urinary catheter should be inserted and left in place.
If the patient is pregnant
The paracentesis as describe above should avoid the uterus

Management of severe abdominal injury
Abdominal ultrasound (and CT scanning, if available) have become invaluable adjuncts to the secondary assessment, not only for diagnosing intra-abdominal injury, but also for monitoring progress when a defined injury is being managed conservatively.

Bleeding from solid organs may not show up immediately in the resuscitation room, and evidence of hollow-organ rupture may take 24 hours or more to show as free fluid on ultrasound. This commits the trauma team to a high index of suspicion well beyond the classical ‘golden hour’.

Patients with refractory shock, penetrating injuries or signs of perforation require laparotomy.

Other injuries may be managed conservatively. After initial fluid transfusion, an experienced surgeon may decide that bleeding from an injured spleen, liver or kidney does not require immediate operative intervention. CT scanning (if available)

is an invaluable aid to decision making. Splenic injury is relatively common, and can occur after relatively minor trauma, especially if the spleen is enlarged following an inflammatory process or infection, notably malaria. Signs include left upper quadrant pain and tenderness, with referred pain to the shoulder tip. Non-operative management is used frequently in many centres, but long-term problems of splenectomy are insignificant by comparison with the potential consequences of inadequate supervision of conservative management which requires careful monitoring and fluid management with on-site, round-the-clock theatre, anaesthetic and surgical availability: all of which are difficult to provide in a low resource setting.

Increasingly, liver injuries are also being managed conservatively. Unlike the relatively straightforward operation of splenectomy, operative liver repair or resection is hazardous, and packing plays a major role in the operative management of uncontrolled hepatic bleeding.

Injuries to the retroperitoneal organs, such as the kidneys or pancreas, may present with vague or atypical signs, again requiring a high index of suspicion. A significant kidney injury does not always cause demonstrable haematuria. Ultrasound studies and dynamic contrast CT scans (if available) may provide valuable information on renal structure and function, but false-negative results commonly occur. Intravenous urography remains useful for demonstrating the details of renal and ureteric injury, especially in centres without a CT scanner.

Pancreatic injury may result in a raised amylase level but normal levels can also occur and the amylase level may be raised in the absence of pancreatic damage.

Spinal trauma

Decide whether or not cervical spinal immobilisation is appropriate, especially if it could interfere with airway resuscitation.

Spinal injury should be ruled out in any patient with major trauma capable of damaging the spine. It is often difficult to ascertain whether there has been an injury to the spine or not, particularly in the face of a concomitant head injury.

Distracting pain from a limb injury may lead the patient to ignore and deny neck pain, even when a spinal fracture exists.

Examination of potentially spine-injured patients must be carried out with the patient in the neutral position (i.e. without flexion, extension or rotation), and without any movement of the spine.

The patient should be:
- log-rolled
- properly immobilised (using in-line immobilisation, a stiff neck cervical collar or sandbags)
- transported ideally with the neck in the neutral position.

With vertebral injury (which may overlie spinal cord injury), look for:
- local tenderness
- deformities, as well as (for a posterior spinal cord injury) oedema.

Clinical findings pointing to injury of the cervical spine include:
- difficulties in respiration (diaphragmatic breathing; check for paradoxical breathing)
- flaccidity, with no reflexes (check the rectal sphincter)
- hypotension with bradycardia (without hypovolaemia).

The entire spine should be palpated during a log-roll, when the patient is turned on to their side in a controlled way, keeping the spine in line. The presence of palpable steps, bogginess or tenderness should be noted. The limbs should be examined for sensory and motor signs of focal or segmental deficit.

Log roll (Figure D1.6)
When examining the back of the patient with major injury, it is important to minimise the risk associated with unrecognised spinal injury **and also to avoid disturbing a clot within the pelvis**. It is essential to examine the back of the patient at the end of the primary assessment (or even during it if there is suspicion of serious injury to the back of the chest or abdomen).
The aim of the log roll is to maintain the orientation of the spine during turning of the patient. It requires ideally 4 people in pregnancy. In addition, one person is required for the examination of injuries.

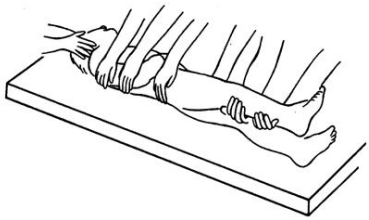


Figure D1.6 *Log rolling*

Neurological assessment
Assessment of the level of injury must be undertaken. If the patient is conscious, ask him/her questions relevant to their sensation, and ask them to try to make minor movements, to enable you to assess motor function of the upper and lower extremities.

Key reflex assessment to determine the level of the lesion is summarised below.

Motor response

- Diaphragm intact level C3, C4, C5
- Shoulder shrug C4
- Elbow flexion (biceps) C5
- Wrist extension C6
- Elbow extension C7
- Wrist flexion C7
- Abduction of fingers C8
- Active chest expansion TI-T12
- Hip flexion L2
- Knee extension L3-L4
- Ankle dorsiflexion L5-S 1
- Ankle plantar flexion S1-S2

Sensory response

- Anterior thigh L2
- Anterior knee L3
- Anterolateral ankle L4
- Dorsum great and 2nd toe L5
- Lateral side of foot Sl
- Posterior calf S2
- Peri-anal and perineal sensation S2-S5

If no sensory or motor function is exhibited, with a complete spinal cord lesion, the chance of recovery is small. A diaphragmatic breathing pattern, bradycardia, hypotension, peripheral vasodilatation suggest a major spinal cord injury.

Throughout the primary and secondary assessments, precautions for spinal protection should ideally be maintained, using a hard collar and side-supports (blocks and straps or sandbags and tape), except for airway procedures and local examination, when manual in-line immobilisation is reinstituted.

If the patient is alert, able to communicate clearly and has no distracting pain from another injury, the spine can be cleared as being damaged clinically without resorting to X-rays. Otherwise, ideally spinal precautions are maintained until radiological clearance is achieved and the patient is re-examined.

If possible, three X-rays of the cervical spine should be taken: cross-table lateral view with arm traction to reveal the C7-T1 interface; antero-posterior view and trans-oral odontoid peg view. These must be assessed by an experienced professional (if available), paying particular attention to the soft tissues as well as the bony structures.

If the mechanism of injury warrants it, thoracic and lumbar views are also required.

If the lower cervical spine is not adequately visualised on the lateral view, oblique views are requested. If the X-rays are inadequate or show suspicious areas, CT scanning (if available) is recommended to confirm or exclude a fracture.

Pelvic trauma

Pelvic injury remains a potentially life-threatening injury, especially if associated with a large retroperitoneal haematoma, or if the fracture site communicates with the rectum. External fixation of the pelvis may be valuable in controlling major venous haemorrhage.

It may be difficult to distinguish retroperitoneal haemorrhage from intra-peritoneal haemorrhage, the latter requiring laparotomy.

Tight compressive binding of the pelvis may help bleeding vessels to clot, although this is not practical in the presence of advanced pregnancy and Caesarean section will be needed to stop bleeding.

The purpose of pelvic binding is to reduce the volume of the pelvis thus tamponading any haemorrhage, as well as providing biomechanical stabilisation. This can be achieved by wrapping a folded sheet around the pelvis. The sheet should centre on the greater trochanters and extend to the iliac crests. Taping the thighs or the feet together also helps maintain the anatomical position of the pelvis.

Not all pelvic trauma is serious. Some pubic rami fractures are minor injuries, with little intervention required. Nevertheless, the pelvis is a ring structure that tends to break in two places. On inspecting the pelvic X-ray, careful attention should be paid to the sacroiliac joints and sacral foramina, to seek subtle evidence of a second break in the ring.

Limb trauma

Examination must include:

- skin colour and temperature
- distal pulse assessment
- grazes and bleeding sites
- limb's alignment and deformities
- active and passive movements
- unusual movements and crepitation
- the severity of pain caused by injury.

Management of extremity injuries
Aim to:
- keep blood flowing to peripheral tissues
- prevent infection and skin necrosis
- prevent damage to peripheral nerves.

Special issues relating to limb trauma
Stop active bleeding by applying direct pressure, rather than by using a tourniquet, as the latter can be left on by mistake, and result in ischaemic damage.

Open fractures
Any wound situated in the vicinity of a fracture must be regarded as a communicating one.
Principles of the treatment are to:
- stop external bleeding
- immobilise and relieve pain.

Early fasciotomy
Compartment syndrome is fairly common, and often underestimated. This condition is caused by an increase in the internal pressure of fascial compartments, which may result from crush injuries, fractures, intramuscular haematomas or amputations. This causes compression of vessels, with resultant hypoperfusion and hypoxia of tissues, including peripheral nerves.
Compartment syndrome is recognised by the following signs in a fractured or otherwise injured limb:
- pain, accentuated by passive stretching of the involved muscles
- decreased sensation
- swelling
- limb pallor
- limb paralysis
- absence of limb pulse.

The final result of this compartment syndrome is ischaemic (or even necrotic) muscles with restricted function.

Fasciotomy involves cutting the fascial bands around the affected muscle to release the pressure within the compartment, allowing the tissues to re-perfuse. The procedure requires a good knowledge of the relevant anatomy and is usually performed by an orthopaedic surgeon.

Continuing care for patients who have suffered major trauma
Tetanus prophylaxis

This is often forgotten in the management of severe trauma. It is particularly important in pregnancy. In the fully immunised patient, an additional booster will depend on a clinical decision as to the possibility of exposure to contamination, the severity of injury and the timing of the last tetanus immunisation. In an unimmunised or incompletely immunised patient, tetanus immunoglobulin should be given and a full course of or a completing course of tetanus toxoid started (using a different limb to the one receiving the immunoglobulin).

Guidance for those injuries prone to develop tetanus:

- compound fractures
- deep penetrating wounds
- wounds containing foreign bodies (especially wood splinters)
- wounds complicated by pyogenic infections
- wounds with extensive tissue damage (e.g. crush injuries, contusions or burns)
- any wound that is obviously contaminated with soil, dust or manure (especially if topical disinfection is delayed for more than 4 hours).

Summary of key aspects when managing major trauma during pregnancy

This clinical practice guideline has modified for low resource settings from that prepared by the Maternal Fetal Medicine Committee, reviewed by the Clinical Practice – Obstetrics, Medico-Legal, and Family Physician Advisory Committees, and approved by Executive and Board of the Society of Obstetricians and Gynaecologists of Canada. J Obstet Gynaecol Can 2015;37(6):553–571

1. Every female of reproductive age with significant injuries should be considered pregnant until proven otherwise by a
pregnancy test or ultrasound scan.
2. A nasogastric tube should be inserted in a semiconscious or unconscious injured pregnant woman to prevent aspiration of
acidic gastric content into the lungs.
3. Oxygen supplementation should be given to maintain maternal oxygen saturation > 95% to ensure adequate maternal and fetal oxygenation.
4. If needed, a thoracostomy (chest drain) tube should be inserted in an injured pregnant woman 1 or 2 intercostal spaces higher than usual.
5. Two large bore (14 to 16 gauge) intravenous lines should be placed in a seriously injured pregnant woman.
6. Because of their adverse effect on uteroplacental perfusion, vasopressors such as dopamine or adrenaline in pregnant women should be used only for intractable hypotension that is unresponsive to fluid or blood resuscitation.
7. After mid-pregnancy, the gravid uterus should be moved off the inferior vena cava to increase venous return and cardiac

output in the acutely injured pregnant woman. This may be achieved by manual displacement of the uterus or left lateral
tilt. Care should be taken to secure the spinal cord when using left lateral tilt.
8. To avoid rhesus D (Rh) alloimmunization in Rh-negative mothers, O-negative blood should be transfused when needed
until cross-matched blood becomes available.
9. The abdominal and pelvic segments of the anti-shock garment should not be used on a pregnant woman because this may reduce placental perfusion.

Transfer to health care facility
10. Transfer or transport to a maternity facility (triage of a labour and delivery unit) is advocated when injuries are neither life- nor limb-threatening and the fetus is viable (≥ 28 weeks) and to the emergency room when the fetus is under 28 weeks' gestational age or considered to be non-viable. When the injury is major, the patient should be transferred or transported
to the trauma unit or emergency room, regardless of gestational age.
11. When the severity of injury is undetermined or when the gestational age is uncertain, the patient should be evaluated in the trauma unit or emergency room to rule out major injuries.

Evaluation of a pregnant trauma patient in the emergency room
12. In cases of major trauma, the assessment, stabilization, and care of the pregnant women is the first priority; then, if the
fetus is viable (≥ 28 weeks), fetal heart rate auscultation and fetal monitoring can be initiated and an obstetrical consultation
obtained as soon as feasible.
13. In pregnant women with a viable fetus (≥ 28 weeks) and suspected uterine contractions, placental abruption, or
traumatic uterine rupture, urgent obstetrical consultation is recommended.
14. In cases of vaginal bleeding at or after 23 weeks, digital vaginal examination should be deferred until placenta praevia is excluded by a prior or current ultrasound scan. Careful speculum examination remains important to identify any bleeding or amniotic fluid arising from the cervix.

Adjunctive tests for maternal assessment in low resource settings
15. In addition to the routine blood tests, a pregnant trauma patient should have a whole blood clotting test (see Section C6).
16. Focused abdominal sonography (ultrasound) for trauma (FAST) should be considered for detection of intraperitoneal bleeding in pregnant trauma patients.
17. Diagnostic peritoneal lavage can be helpful when intra-abdominal bleeding is suspected.

Fetal assessment

18. All pregnant trauma patients with a viable pregnancy (≥ 28 weeks) should undergo intermittent fetal heart rate monitoring for at least 4 hours.
19. Pregnant trauma patients with adverse factors including uterine tenderness, significant abdominal pain, vaginal bleeding, sustained contractions (> 1/10 min), rupture of the membranes, abnormal fetal heart rates, high risk mechanism of injury, should be admitted to a CEmONC facility for close monitoring.
20. Anti-D immunoglobulin should be given to all rhesus D-negative pregnant trauma patients.
21. In Rh-negative pregnant trauma patients, quantification of maternal–fetal hemorrhage by tests such as Kleihauer-Betke should be done to determine the need for additional doses of anti-D immunoglobulin.
22. An urgent obstetrical ultrasound scan should be undertaken when the gestational age is undetermined and need for delivery is anticipated.
23. All pregnant trauma patients with a viable pregnancy who are admitted for fetal monitoring for greater than 4 hours should have an obstetrical ultrasound prior to discharge from hospital.
24. Fetal well-being should be carefully documented in cases involving violence and included in the UNICEF Preventing Sexual Exploitation and Abuse program.

Obstetrical complications of trauma

25. Management of suspected placental abruption should not be delayed pending confirmation by ultrasonography as ultrasound is not a sensitive tool for its diagnosis.
26. Tetanus vaccination is safe in pregnancy and should be given when indicated.
27. Every woman who sustains trauma should be questioned specifically about domestic or intimate partner violence.
28. During prenatal visits, the caregiver should emphasize the importance of wearing seatbelts properly at all times.

Many thanks to the following guidance from Update in anaesthesia: ***Update in obstetric trauma management***
Nesrine Refa, Reham Abdel Rahman Ali and Hala Gomaa *Correspondence email: nesrinerefai@hotmail.com* ***doi: 10.1029/WFSA-D-18-00018***

Section D2. Management of burns in pregnancy

Key Messages

- As in all trauma patients, ABC assessment and resuscitation are priorities
- Burns do not cause shock initially – look for other injuries if present
- Inform anaesthetist immediately if airway burns or smoke inhalation
- Assess type, time, degree and extent of burn and **document details**
- Give IV fluids according to formula below

Primary assessment and resuscitation

Patients should be assessed using an approach to identify the injuries that are the greatest threat to life first. This should include evaluation and management of airway and breathing affected by smoke inhalation and/or burns to the airway

Immediate treatment of pregnant patients with burns starts with the primary assessment, which begins with

CALL FOR HELP *and include* ***anaesthetist and obstetric clinician/doctor***

1. Primary Airway assessment and resuscitation ABCD

Protecting the airway is utmost priority. Potential for inhalational injury and life-threatening airway obstruction.

Particularly at risk are patients with symptomatic inhalational injury, or any thermal injury to face or mouth. Fires in an enclosed space, or if chemicals are involved, predispose to airway injury. Airway may be burnt. Suspect if hoarse voice, burnt eyebrows, soot in sputum or around mouth.

Initial management of the airway - is jaw thrust, chin lift or oral airway device.

A definitive airway, if needed, should be inserted by the most experienced person in airway management.

Airway swelling may happen/get worse some hours after presentation, so it is important to summon anaesthetic help early on and to monitor closely.

Inhalation injury

This must be suspected if:

1 History of exposure within a closed space to products of incomplete combustion

2 On examination, by presence of soot in oral cavity and by facial burns

3 Normal oxygenation or normal CXR do not exclude the diagnosis
4 Signs of hoarseness, sputum containing black carbon, wheeze and dyspnoea are strongly suggestive of inhalational injury

The three consequences of inhalational injury
1) Poisoning due to inhalation of toxic gases produced by burning – for example carbon monoxide, hydrogen cyanide
2) Obstruction of the upper airway due to the effects of heat and subsequent oedema.
3) Injury to lower respiratory system due to the inhalation of noxious chemicals and particles present in smoke

Treatment for suspected or confirmed carbon monoxide poisoning is high-flow supplemental oxygen for at least 6 hours. Remember that SaO_2 on a pulse oximeter can be normal despite severe carbon monoxide poisoning.

Treatment of upper airway burns secondary to smoke inhalation include close observation and monitoring. Patients with upper airway burns should be nursed in the semi-upright position with moderate elevation of the head and trunk. Endotracheal intubation or tracheostomy is indicated if airway opening is threatened.

Prophylactic antibiotics and corticosteroids ARE NOT indicated for the treatment of smoke inhalation injury

2. Primary Breathing assessment and resuscitation
Important to exclude chest injuries eg pneumothorax if blast injury. Give 100% oxygen.

Carbon monoxide poisoning may have occurred with smoke inhalation – SaO_2 will be normal. If suspected, treatment is with 100% O_2

3. Primary Circulation assessment and resuscitation
If the patient is shocked, suspect other injuries. Burns do not cause shock within first 6 hours of presentation. Increased adrenaline produced by the patient after burns means a pulse rate of 100-120 is normal. If higher, look for hypovolaemia, other trauma, and inadequate pain relief.

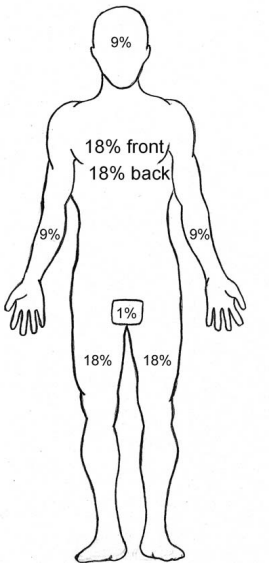
Peripheral and intraosseous routes can be used for intravenous access and placed through burned tissue if necessary.

4. Primary Disability/neurology assessment and resuscitation

Altered mental state may be caused by associated injury, hypoxia and inhalational injury

Exposure
Keep warm
Examination of whole body and removal of clothes, including jewellery
Estimate burn size and depth to **estimate initial fluid resuscitation** (Figure 60 1)

Figure D2.1 *Wallace's 'rule of nines' for burns assessment in adults but when pregnant the abdomen represents a larger proportion of the total body surface area.*



Secondary assessment and emergency treatment
Top to toe, front and back examination for any non-burn related life-threatening injuries that were not found during the primary survey.

Evaluation of burn should estimate total body surface area (TBSA) using a standardised method and recognise burns that need immediate expert advice if available.

Estimated burn size and depth is part of primary survey to give IV fluids. The extent of the burn is usually estimated by the 'Rule of 9s' in non-pregnant adults (see Figure D2. 1). In pregnancy the abdomen is a higher proportion of body area than

the non-pregnant. The palm of the patient's hand, including the fingers and thumb is estimated as 1% of the body's surface area (BSA).

Area of burn

- It is common for inexperienced people to overestimate the size of a burn.
- Erythema must not be included, as fluid is not lost from this alone.
- The decision as to whether or not to start IV fluids is dependent on this initial assessment, and on whether there are other injuries or medical conditions.

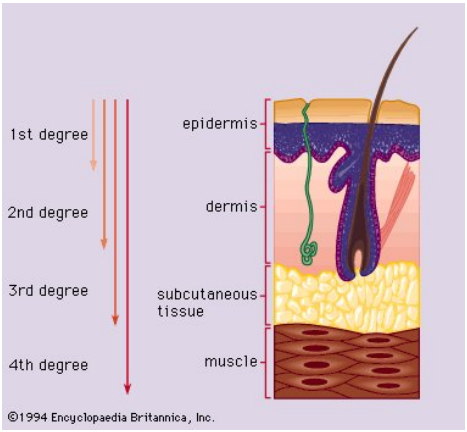
Depth of the burn

The depth of the burn is based on history, appearance and examination (Figure D2.2).

- Flame or hot fat burns are almost always deep.
- Hot water burns (scalds) may be superficial or deep dermal.
- The appearance can be altered if more than a few hours old, or by the application of various first-aid treatments.
- First assess capillary return. Prompt capillary return means a superficial burn.
- Then test sensation. Is it increased (in a superficial partial thickness burn), reduced (in a deep dermal burn) or absent (in a full-thickness burn)?
- The test is done by using a sterile hypodermic needle; ask whether the patient can tell the difference between the sharp and the blunt ends when these are lightly applied to the burn.
- In full thickness burns the area is insensitive to pain and may appear dirty or white (the eschar).
- A simple test to distinguish between partial and full thickness burns is to pull a hair out: if it comes out easily the burn is full thickness.

Many superficial burns become deeper during the first 48 hours after their occurrence and need to be reassessed at 48 hours.

Figure D2.2 *showing the degree of burns*



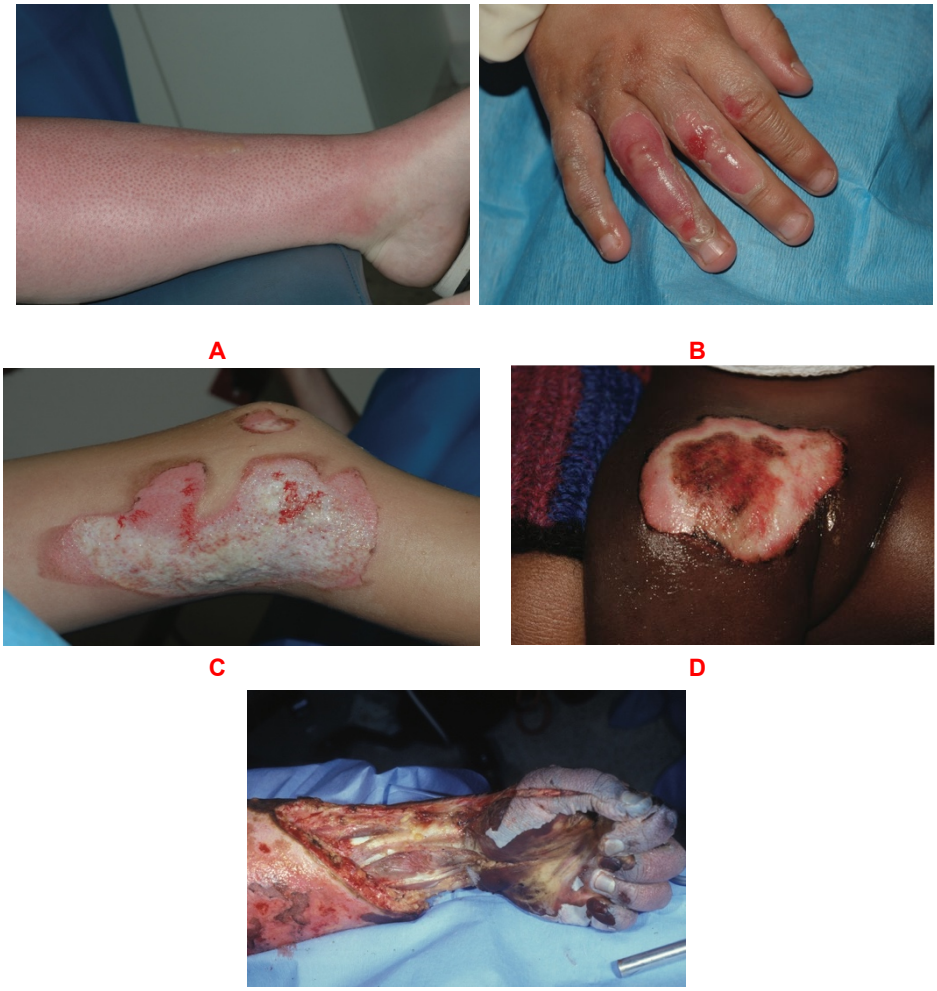


Figure D2.3 *Depth of thermal injury.* ***A,*** *Patient with sunburn on the lower extremity (a superficial or first-degree burn with associated blisters on the anterior tibial surface).* ***B,*** *Partial-thickness injury of the hand (superficial second-degree burn).* ***C,*** *Partial-thickness injury extending beyond the subcutaneous layers (deep second-degree burn).* ***D,*** *Full-thickness (third-degree) burn.* ***E,*** *Full-thickness injury with extensive tissue loss (fourth-degree burn). (From Davis PJ, Cladis FP, Motoyama EK, editors: Smith's anesthesia for infants and children, ed 8, St. Louis, 2011, Mosby.)*

Treatment of skin surface burns

Analgesia

IV morphine analgesia should be given. (see Section C7). Oral analgesia is ineffective, and IM analgesia can be dangerous because when the circulatory volume is re- established and muscle blood flow recommences, the patient can become overdosed. Opiate overdose can be reversed with naloxone given intravenously (see Section C7). However, if morphine is not available IV paracetamol can be used (see Section C7). The ideal treatment for severe pain following burns is a combination of IV morphine and IV paracetamol.

If an anaesthetist is available, IV ketamine can be given if morphine is not available: initial dose is IV injection (over 1 minute) of 500 microgram/kg ketamine.

Appropriate fluid resuscitation should be initiated promptly and tailored based on patient parameters to avoid over- and under- resuscitation

Burns >20% total body surface area (TBSA) need IV fluids to replace fluid loss through the burns, especially in the first 24 hours after injury. Circulatory fluid loss occurs because of increased capillary permeability.

The amount of fluid has to be monitored frequently and adjusted to prevent over-resuscitation.

- Under-resuscitation can cause shock and lead to organ failure.
- Over-resuscitation can cause acute respiratory distress and compartment syndrome of the extremities or trunk.

There are many resuscitation formulae, and each is an **estimate** of the IV fluid needed for burn resuscitation. Also, fluid for burn resuscitation is **in addition** to resuscitation for other injuries and in addition to maintenance fluids.

Hartmanns/ Ringer's lactate, or 0.9% saline if not available, is used as IV fluid for burns resuscitation.

A typical formula is: 2 to 4ml/kg times the % burn over 24 hours as a guide PLUS maintenance fluid (see Sections C2, C10, and B7 for details of maintenance fluid in pregnancy). Half the burn resuscitation fluid should be given over the first 8 hours **from the time of the burn** and the second half over the next 16 hours.

If the patient is shocked when initially seen, patient should be given a bolus of 500 mL IV Hartmanns/ Ringer's lactate or 0.9% saline.

The initial IV fluid calculation is only an estimate.

IV fluids should be adjusted to degree of dehydration, haematocrit, and to obtain urine output of 0.5ml/kg (30ml/hr). For the first 3 hours of resuscitation, urine output may be none, or very little, despite an appropriate rate of fluid administration.

If only oral fluid administration is practical, drinking liquids, (typical of the local diet) equivalent to 15% of the body weight every 24 hour is recommended for 2 days. Ideally, the fluids should be ORS, otherwise 5g tablets of table salt (or the equivalent) must be ingested for each litre of oral fluids.

Tetanus immunisation status should be evaluated and given if indicated
Burn wounds are easily infected and prone to tetanus.

Treatment of the burn itself
If possible, isolate the patient in a warm clean room. The following patients require hospital admission:

- all airway burns or patients with a history of smoke inhalation
- burns of more than 5% TBSA
- deep burns more than 5 cm in diameter
- moderate burns of the face, hands or perineum
- circumferential burns of the thorax or extremities*
- electrical burns
- where there is inadequate social support in the home

*If circumferential full-thickness burns involving the extremities or the chest are present, escharotomy may be necessary.

Dressings
Because a burn is normally caused by hot fluids or flame, the burn wound is initially sterile.

Hands must be washed and sterile gloves must be worn by all members of the team whenever the patient is being touched. Ideally plastic aprons should also be used to prevent cross-infection during dressings.
The purposes of a dressing are:

- to maintain sterility
- to relieve pain
- to absorb fluid produced by the burn wound
- to aid healing.

Placement of the dressing

- The layer of the dressing closest to the wound should be non-adherent (e.g. paraffin gauze) and may contain an antiseptic, such as silver sulphadiazine, although the evidence that antiseptics are useful to prevent infection and promote healing is uncertain.
- On top of this dressing should be placed a layer of gauze and then sterile cotton wool to absorb fluid.
- The whole dressing should be held in place by a bandage.

Dressing changes

- Every time a dressing is changed, there will be pain, and the delicate reforming epithelium will be injured.
- Therefore, dressings should not be changed on a daily basis, particularly in a superficial partial-thickness wound. The initial change should be at approximately 48 hours after the burn, when dressings come off easily, the maximum amount of fluid has been discharged from the wound, and it is possible to reassess the wound for area and depth.
- Effective pain relief is vital at dressing changes or the patient will come to dread the procedure. Providing an anaesthetist is present, Ketamine provides excellent analgesia of up to 15 minutes with an IV injection (over 1 minute) of 500 microgram/kg ketamine. For longer analgesia, an infusion will be needed. A safer alternative, especially in pregnancy, is oral morphine (see Section C7 for doses) given about 30 minutes before the anticipated dressing change.
- If at the first dressing change, the wound is still a superficial partial-thickness burn, the second dressing is left for a further 8 days, by which stage healing should have occurred.
- If the wound is deeper, a decision as to whether to operate must be made (see below), but the second dressing can still be left for at least a week.
- If surgery is not possible or appropriate, dressings can be done initially on a weekly basis but increased to two or three times a week if infection and discharge develops.
- Take a sample for microbiology assessment (if available).

Burns during pregnancy: major considerations

Assess the need to deliver the fetus. The mother becomes hypermetabolic, causing hyperthermia, increased oxygen consumption, tachypnoea, tachycardia and increased endogenous adrenaline and noradrenaline. Metabolic acidosis develops. If 50% TBSA or more burns, and in 2nd or 3rd trimester of pregnancy, urgent delivery should be carried out, as fetal survival is not increased by waiting.

Earlier in pregnancy there is no evidence that that pregnancy affects maternal survival. However, with increasing extent of burn, there will be increased risk of miscarriage, preterm labour or fetal death.

If the burn is <30% TBSA, the prognosis is good for both mother and fetus (depending on gestational age) and depends on prevention of complications such as hypoxia, hypovolaemia and sepsis.

Escharotomy and fasciotomy in burn care

1. Escharotomy should be performed when circumferential or near circumferential eschar of the extremities compromises by compression the underlying tissues or the circulation distal to it. Escharotomy should be performed when eschar on the trunk or neck compromises aeration and breathing
2. **Abdominal** escharotomy should be performed when circumferential or near-circumferential eschar is associated with evidence of intra-abdominal hypertension (IAH) or signs of abdominal compartment syndrome (ACS).
3. **Escharotomy** should be performed in the longitudinal axes of the **affected** part near the neurovascular bundles. The extent of the incision in the eschar should range from normal skin to normal skin. If this is not possible, the range should extend from joint above to joint below. The depth of the incision is limited by reaching healthy tissue at the base.

- Very early release (i.e. within 2 hours) is necessary to prevent severe and irrecoverable muscle and nerve damage. This can be done without any anaesthetic because the deep burn has no sensation.
- The incisions should not overlie superficial bone or tendons and need to go down to the fascia.
- For more severe burns, and in particular high-voltage electrical burns, appropriate incisions are needed to decompress the deep compartments as well.
- Urgent decompression of deep compartments may be required in severe high-voltage electrical burns, which can damage the underlying muscle with no skin damage visible except at the entry and exit points.

4 **The gol**den rule of escharotomy is to p**erform** the procedure if unsure if it is needed. The complications of unnecessary escharotomy are far fewer than those of not performing escharotomy when it is indicated.

Figure D2.4 *Preferred sites for escharotomy incisions. Dotted lines indicate the escharotomy sites. Bold lines indicate areas where caution is required because vascular structures and nerves may be damaged by escharotomy*

incisions. (From Davis JH, Drucker WR, Foster RS, et al: Clinical surgery, St. Louis, 1987, Mosby.

Debridement and dressing a blistering burn

Exactly when to débride burn blisters (see Figure D2 5) is controversial and probably of no consequence to the final outcome (see text), although blisters often thin after the first 24–48 hours and are therefore easier to débride at that time. **Eventually, however, all dead tissue must be removed.**

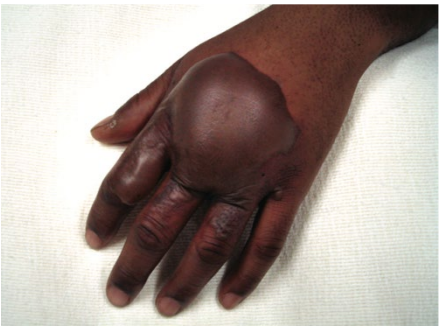


Figure D2.5 *A major blister due to a burn*

The easiest and quickest way to débride blisters is to grasp the dead loose skin with dry 4- × 4-inch gauze and pull it off quickly rather than with slow meticulous instrument techniques. Provide analgesia that is appropriate for the clinical condition (Figure 60 6 B and then Figure 60. 6 C)

Figure D2.6i

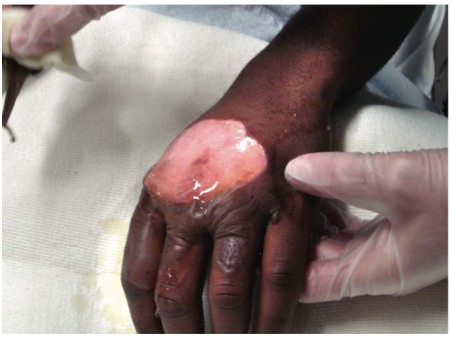
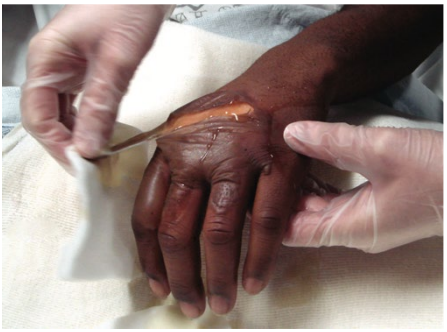
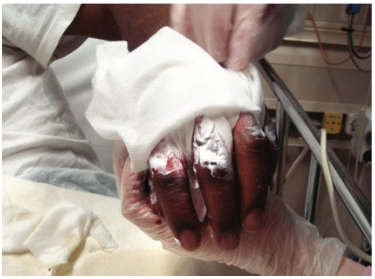


Figure D2.6i



Subsequent to debridement, apply an appropriate ointment to the denuded tissue. (Figure D2 7) (Silvadene [Pfizer] is shown here, but bacitracin can also be used.)

Figure D2.7 *application of ointment to the debrided burn*



Débridement itself is not especially painful, but when the underlying tissue is exposed, pain increases. Hence, dress burn quickly after débridement. Figure D2 8

See also ISBI practice guidelines for burns

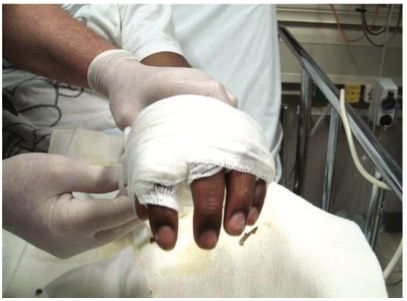


Figure D2. 8 *dressing applied over the ointment* care

https://www.sciencedirect.com/science/article/pii/S0305417916301449

Illustrations from chapter 38 Burn Care Procedures by Anthony S Mazzeo

Section D3. Poisoning in pregnancy

Symptoms and signs of poisoning include:

- respiratory distress
- acidotic breathing
- tachycardia or flushing
- cardiac arrhythmias
- hypotension
- diarrhoea
- vomiting
- drowsiness or coma
- convulsions
- ataxia
- pupillary abnormalities
- hypoglycaemia
- acidosis.

Management of poisoning in pregnancy

Primary assessment and resuscitation
The whole assessment should take less than a minute. Treat any problems with the ABC approach as they are found.

Once Airway, Breathing and Circulation are recognised as being stable, or have been stabilised, definitive management of specific conditions can proceed. During definitive management, re-assessment of ABC at frequent intervals will be necessary to assess progress and detect deterioration.

Secondary assessment and emergency treatment
Identify the substance ingested or inhaled, if at all possible.

Common symptoms/signs after ingestion of poisons

Reduced conscious level or seizures due to hypoglycaemia: test blood glucose levels for all patients, and if hypoglycaemia is present, treat with a sugar drink orally if the patient is conscious. If they are unconscious give glucose by IV or intraosseous routes.

Dilute 50 mL of 50% glucose with 50 mL of Ringer-lactate, Hartmann's or 0.9% saline and give IV over 5 minutes followed by an IV infusion of Ringer-Lactate or Hartmann's containing 5% glucose (see Sections C2 and C10). If blood glucose testing is not available, then treat for hypoglycaemia if this diagnosis is possible.

Convulsions:
Providing these are not due to hypoglycaemia consider a loading dose of diazepam in 2 mg increments IV every 2 minutes up to 10 mg.

Alternatively, in pregnancy the loading dose of diazepam rectally is 20 mg in a 10-mL syringe. Remove the needle, lubricate the barrel and insert the syringe into the

rectum to half its length. Discharge the contents and leave the syringe in place, holding the buttocks together for 10 minutes to prevent expulsion of the drug. Alternatively, the drug may be instilled in the rectum through a catheter.

Ensure close observation after treatment with diazepam and make sure that a bag-valve-mask of suitable size is available and the health worker giving the diazepam knows how to use it.

If convulsions persist consider IV phenobarbital but ensure nurse anaesthetist is present. Give one dose of 10 mg/kg (max. 1 g) administered IV over 20 minutes minimum. If necessary, a second dose of 5 to 10 mg/kg may be administered 15 to 30 minutes after the first dose. Do not administer more than 1 mg/kg/minute.

Reducing the effects of the ingested substance as quickly as possible
1. If the substance is non-toxic give oral fluids liberally.

2. If the substance is corrosive, there may be serious injury to the mouth, throat, airway, oesophagus or stomach. The most dangerous substances are sodium or potassium hydroxide cleaning fluids (e.g. toilet cleaners). Others include bleach and other disinfectants. Serious oesophageal injury can result in perforations and mediastinitis, later leading to oesophageal strictures. The presence of burns within the mouth is of concern and suggests that oesophageal injury is possible. Stridor suggests laryngeal damage.

3. For all poisons/drugs except heavy metals, iron, alcohol and corrosive substances (as above) give activated charcoal 50 grams suspended in water. The sooner it is given the better (preferably within 1 hour of ingestion). Repeat after 4 hours if a sustained-release drug has been taken.

4. Admit all patients with symptoms or signs attributable to poisons, all patients who have ingested iron, pesticides, corrosives, paracetamol, salicyclates, narcotic or tricyclic antidepressant drugs and any patient who admits deliberate ingestion.

Commonly ingested poisons

Local medicines
These are often prescribed for diarrhoea and vomiting. They may cause profound acidosis and respiratory distress. They can also cause paralytic ileus.
- Treat the metabolic disturbance.
- Pass a nasogastric tube if ileus is present.

Iron
Iron poisoning causes severe gastrointestinal effects, with vomiting, diarrhoea, gastrointestinal bleeding and metabolic acidosis. Subsequently, after 12–24 hours, there is encephalopathy, liver damage and circulatory collapse. Late effects include scarring of the stomach, which may produce pyloric stenosis.
- If available, a serum iron level at 4 hours of more than 300 micrograms/dL indicates significant poisoning.
- X-ray may show the number of tablets.

- Do not use gastric lavage in pregnancy.
- Desferrioxamine 2 grams should be given by deep IM injection. IM doses of desferrioxamine of 2 g should be repeated every 12 hours until serum iron is normal (serum iron less than the iron binding capacity). If the patient is very ill, give an IV infusion of desferrioxamine 15 mg/kg/hour up to a maximum dose of 80 mg/kg in 24 hours. Usually reduce the rate after 6 hours.

Opiate or methadone overdose

Give naloxone even if poisoning is only suspected (because of the presence of such drugs in the home) or because breathing is shallow or the patient has stopped breathing.

If the patient is hypoventilating or has stopped breathing, ventilate with bag-valve-mask before giving the naloxone as the combination of raised CO_2 levels in the blood (hypercapnia) with naloxone can cause arrhythmias, acute pulmonary oedema or seizures.

If suspected, give naloxone 400 microgram to 2.0 mg IV; if there is no response, repeat every 2–3 minutes up to a maximum of 10 mg (then review the diagnosis).

Naloxone has a short half-life and further boluses or an infusion of 10–20 micrograms/kg/hour or more may be required.

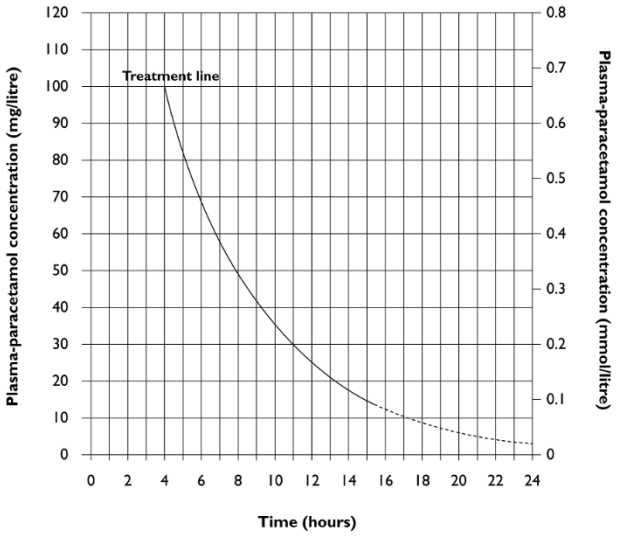
Paracetamol

Paracetamol poisoning can lead to liver and renal failure and if possible, measure the paracetamol level (see Figure D3.1).

- Give N-acetylcysteine or methionine as soon as possible, ideally within 8 hours of ingestion. If the patient is conscious and tolerating oral fluids, and within 8 hours of ingestion, give methionine orally in pregnancy 2.5 g every 4 hours for four doses.
- If the patient presents more than 8 hours after ingestion or this drug cannot be given as an oral preparation, give IV N-acetylcysteine (initially as a loading dose of 150 mg/kg over 15 minutes, then as an IV infusion of 50 mg/kg over 4 hours, and finally as 100 mg/kg IV over 16 hours).

A plasma level that falls above the treatment line at different times indicated in the graph of paracetamol level against time after ingestion indicates moderate to severe poisoning. Treat with N-acetylcysteine.

Figure D3.1
Treatment levels In paracetamol poisoning



Salicylates (aspirin like drugs)
Salicylate poisoning produces acidotic breathing, vomiting and tinnitus. Hyperventilation is due to direct stimulation of the respiratory centre and produces respiratory alkalosis, but also there is a metabolic acidosis from ketosis. Consequently, the hyperventilation is extreme. A fever may occur. There is peripheral vasodilatation. Moderate hyperglycaemia develops.
Treatment
1. There is delayed gastric emptying, so give activated charcoal if available (50 gram and repeat after 4 hours) even if more than 4 hours after ingestion.
2. Give sodium bicarbonate 1 mmol/kg IV as 4.2% or 8.4% solution over 4 hours to correct acidosis and aid excretion of salicylate.
3. Give sufficient IV fluids to compensate for hyperventilation, and give sufficient glucose to minimise ketosis, but regularly monitor blood glucose levels.
4. Monitor electrolytes carefully (if possible) and avoid hypokalaemia and hypernatraemia.
5. In very severe cases, peritoneal haemodialysis (if available) is ideal. In its absence, exchange transfusion may help.

Benzodiazepines
Flumazenil is a specific antagonist. In pregnancy give 200 micrograms IV then 100 micrograms per minute IV up to a maximum total of 1 mg until reversal has occurred.

Tricyclic antidepressants
In overdose these cause drowsiness, ataxia, dilated pupils and tachycardia. Severe poisoning results in cardiac arrhythmias (particularly ventricular tachycardia) and severe hypotension and convulsions.

Treatment

1. Administer activated charcoal through an orogastric tube.
2. Treat convulsions as for any status epilepticus.
3. Monitor the ECG (if available) continuously.
4. Arrhythmias can be reduced by using IV phenytoin which must be diluted **only in 0.9% saline**. Phenytoin is given as a loading dose of 15–20 mg/kg over 30–45 minutes (maximum dose 2 grams) and then 2.5–7.5 mg/kg 12 hourly. The maximum infusion rate is 1 mg/kg/minute (maximum 50 mg/minute). A lidocaine infusion (10–50 micrograms/kg/ minute) is an alternative to phenytoin.
5. Alkalinisation of the intravascular compartment has been shown to reduce the toxic effects on the heart. Give sodium bicarbonate 1–2 mmol/kg slowly over 15 minutes. This can be repeated if necessary. The aim is to increase the arterial pH to 7.45–7.5.
6. Prolonged and effective cardiac massage with ventricular tachycardia can give time for the drug to be excreted.

Poisonous household products

Petroleum compounds such as kerosene, turpentine and petrol
If inhaled these may cause hydrocarbon (lipoid) pneumonia, leading to a cough, and respiratory distress with hypoxaemia due to pulmonary oedema and lipoid pneumonia.
If large amounts are ingested they may cause encephalopathy.
Treatment

1. **Do not induce vomiting.**
2. Additional inspired oxygen may be required.
3. An antibiotic may be needed, but only for secondary chest infections.
4. Dexamethasone may help in lipoid pneumonia.

Organophosphorus compounds and carbamates
Insecticides such as malathion, chlorthion, parathion, TEPP and phosdrin can be absorbed through the skin, lungs or gastrointestinal tract. Symptoms are due to excessive parasympathetic effects caused by inhibition of cholinesterase, and include excessive secretions of mucus in the lungs (bronchorrhoea) with ensuing respiratory distress and sometimes wheezing, salivation, lacrimation, bradycardia, sweating, gastrointestinal cramps, vomiting, diarrhoea, convulsions, blurred vision and small pupils, muscle weakness and twitching, progressing to paralysis, and loss of reflexes and sphincter control.

Treatment

1. **Remove poison** from:
   - the eyes: use copious irrigation
   - the skin: remove contaminated clothing and wash the skin
   - the gastrointestinal tract: give activated charcoal 1 gram/ kg and repeat after 4 hours.
2. Admit all cases, as some effects do not appear until a late stage.
3. In severe cases, particularly where there is bronchorrhoea, give atropine (in pregnancy give 600 micrograms and repeat in doses of 300 micrograms as needed).

4. A specific cholinesterase reactivator can also be given as follows, and ideally within 12 hours of ingestion (it is ineffective after 24 hours).

Pralidoxime 30 mg/kg diluted with 10–15 mL of water by IV infusion at a rate not exceeding 5 mg/ minute. It should produce an improved muscle power in 30 minutes. It can be repeated once or twice as required and as is shown to be effective, or an infusion of 8 mg/kg/hour can be used. Maximum dose is 12 gram in 24 hours.

5. Assisted ventilation may be required (if available).

Bleach (3–6% sodium hypochlorite)

Do not induce vomiting.

- Symptoms: burning sensation, vomiting and abdominal discomfort.
- Treatment: liberal fluids and milk.

Other corrosive agents

Do not induce vomiting.

- Oven cleaners (30% caustic soda).
- Kettle descalers (concentrated formic acid).
- Dishwashing powders (silicates and metasilicates).
- Drain cleaners (sodium hydroxide).
- Car battery acid (concentrated sulphuric acid).

Symptoms: considerable tissue damage to the skin, mouth, oesophagus or stomach; late strictures may occur.

Treatment consists of washing the skin and mouth to dilute the corrosive fluid. No emetic should be given. Milk or water given as soon as possible may be of benefit, especially with solid caustics such as sodium hydroxide crystals. Never give salt to induce vomiting.

If there is a severe stricture it may be necessary to bypass the oesophagus with a gastrostomy tube. Ideally, flexible endoscopy should be performed to identify injury, but this may not be available. A perforated oesophagus will lead to mediastinitis and should be treated with gastrostomy and prophylactic antibiotics (cefuroxime and metronidazole).

Lead poisoning

This is usually a chronic form. The lead can come from paint, lead piping or car batteries. In some cultures, lead-containing substances may be applied to the skin for cosmetic purposes.

Early signs are non-specific (e.g. vomiting, abdominal pain, anorexia).

Anaemia is usually present. There is a microcytic hypochromic anaemia with punctate basophilia.

Prior to encephalopathy with raised intracranial pressure, there may be headaches and insomnia.

Peripheral neuropathy may be present.
X-rays may show bands of increased density at the metaphyses.
Harmful effects on the kidneys result in hypertension, aminoaciduria and glycosuria.
The diagnosis is made by showing a marked increase in urinary lead levels after d-penicillamine, and elevated blood lead levels.

Treatment
Treat by first removing the source of ingested lead.
A diet rich in calcium, phosphate and vitamin D (plenty of milk) should be given if possible.
In cases of lead encephalopathy, give an IV infusion of edetate calcium (EDTA) in 5% glucose or normal saline, 20 mg/kg every 6 hours for 5–7 days at a concentration of no more than 30 mg/mL. Give over an hour.
Boluses of mannitol (in pregnancy give 20 grams of 20% mannitol over 15 minutes as soon as cerebral oedema is suspected. Repeat every 4–6 hours) may also be required for raised intracranial pressure while the above is given.

Carbon monoxide poisoning
Toxic effects are due to hypoxaemia (note that SaO2 using a pulse oximeter my show normal values despite severe hypoxaemia). Cerebral oedema may develop.
Treatment: Move the patient from the source and give them 100% oxygen as soon as possible (the half-life of carbon monoxide is 5 hours in room air, but only 1.5 hours in 100% oxygen). The patient may look pink but is hypoxaemic, so base the duration of oxygen treatment on other clinical signs of hypoxia rather than on cyanosis, which will be masked. For similar reasons, pulse oximeters will give falsely high readings. ABCD management may be required (Section C8).

Section E1. Vaginal examination during pregnancy

Vaginal examination should be performed *only if it is essential.* The risk of infection must be minimised by hygienic hand washing, and always wear *a new set of examination gloves*. At all times, it is important to preserve the patient's dignity and privacy. If you are using a speculum, offer to demonstrate it, explain how it is inserted and ensure that the correct size is used.

In labour, a *chlorhexidine obstetric cream* can reduce the risk of ascending infection.

Always undertake abdominal palpation first.

Never undertake a digital vaginal examination if there is a possibility of placenta praevia. A placental localization ultrasound scan should be carried out on any woman with vaginal bleeding in the third trimester, unless the placental site has already been ascertained.

Where spontaneous rupture of membranes is suspected from the history, speculum examination is carried out, rather than vaginal examination.

Document any blood loss, any discharge and its characteristics, and any amniotic fluid and its characteristics.

If *female genital* mutilation (cutting) is present, record and describe type (see Section A+29).

Document the cervical length, position, dilatation, and application to the presenting part of the fetus.

Determine, if possible, the *presentation* of the fetus, and whether there is *caput and/or moulding* present.

Evaluate pelvic size by examining the position of the ischial spines and the suprapubic arch.

At the end, provide a *clean sanitary pad*, auscultate the *fetal heart rate, describe the results* of the examination to the woman, and *record the findings* in the notes.

Section E2. Urethral catheterisation

Method

Use an appropriate size of catheter, which is one that is slightly smaller in diameter than the external urethral meatus (to minimise the risk of subsequent urethral stricture formation). Usually this will be size 12–14 French gauge.

Using sterile precautions (gloves, etc.), wash the area with gauze swabs soaked with antiseptic and clean from anterior to posterior with downward movements (to avoid faecal contamination). Sterile lubricant should be used to aid passage of the catheter. with the woman lying on her back or in the left lateral tilt position if she is more than 20 weeks' pregnant. The catheter is inserted far enough (urethral length is around 4 cm) for urine to be seen in the tube. Hold the catheter in place while inflating the Foley catheter balloon with sterile water or 0.9% saline to prevent it slipping back into the urethra. If any pain is experienced whilst inflating the balloon deflate it immediately, advance the catheter further into the bladder and then try and inflate the balloon again. Attach a catheter drainage bag.

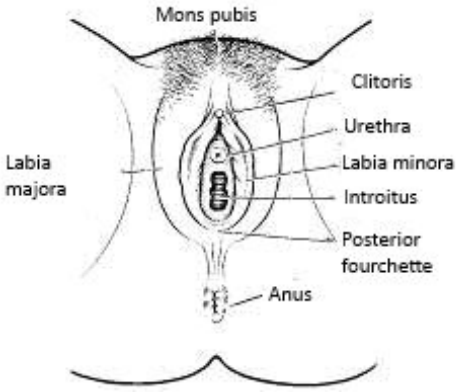


Figure E2.1 *Normal female external genitalia showing urethra.*

Secure the catheter to the thigh with tape, to prevent traction damage to the bladder.

The *balloon must be deflated before the catheter is removed.*

Section E3. Ventouse (vacuum) delivery

Introduction

The ventouse creates a vacuum in a cup attached to the fetal head to assist delivery. This technique is also called vacuum-assisted vaginal delivery or vacuum extraction.

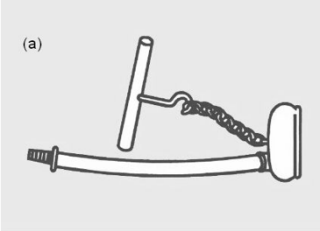
The two main advantages of the ventouse over forceps are:
It takes up no space in the pelvic cavity, as it is in contact with the fetal head only. As a consequence, trauma to maternal tissues is minimized, and usually no analgesia is required.

Rotation of the fetal head from Occiput-Posterior (OP) or Occiput-Transverse (OT) to Occiput-Anterior (OA), can be achieved as part of the vacuum delivery. In the absence of Kielland's rotational forceps (as is commonly the case in low-resource settings), Caesarean section would otherwise often be required for a proportion of OP or OT deliveries.

The ventouse should not be used at less than 36 weeks' gestation, or if maternal expulsive efforts are not adequate. In both cases, straight forceps (such as Anderson's or Neville-Barnes) are appropriate.
It is important that staff are adequately trained, and that they maintain their skills. Significant fetal trauma (including cephalhaematoma and scalp laceration) is uncommon in the hands of skilled staff. The equipment is more complex than forceps, and more difficult to sterilise and maintain.
There are frequent problems with the suction pumps (for example, those from Cooper Surgical last only a few months before internally rusting and no longer providing effective suction). Regular servicing is needed.

There are two types of vacuum equipment.

1. Traditional (Malmstrom) type, with free-standing suction equipment and reusable cups; these may be made from silicone or metal (Titanium, which is expensive or stainless steel).



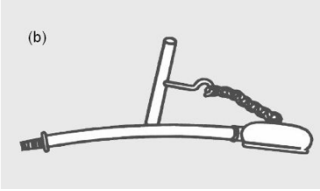


Figure E3.1 *The two types of Bird metal cup. (a) Anterior cup. (b) Posterior cup.*

A number of different types of cups are available.

The Bird metal cup **(see Figure E3.1) has two configurations:**

1 The 5 cm anterior metal cup is used for occiput-anterior positions. The smaller 4 cm cup is reserved for the small fetus (e.g. a second twin).
2 The posterior metal cup is used for occiput-posterior positions, particularly those with significant deflexion. This is also the cup of choice for the deep transverse arrest, as the abnormal angle of the baby's head to the vertical, which is often marked, makes correct placement with the anterior cup difficult.

The plastic cup (50- or 60-mm internal diameter) comes in two main forms:

- a silastic/silicon soft cup (*see* Figure 67.2) is the safest of all for the fetus, but
- has a slightly higher failure rate, especially with occiput-posterior positions

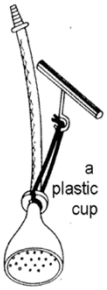


Figure E3.2 *A soft plastic cup*

2. The easy-to-use Kiwi OmniCup (*see* Figure E3.3) This is marketed as single-use, but is commonly sterilized and reused in low-resource settings, as it is expensive. It is convenient to use, and takes less time to achieve suction than does the Malmstrolm device.
https://www.youtube.com/watch?v=TgAcCi9rJhw

Figure E3 3 The Kiwi Omnicup *hand-held 'disposable' vacuum extractor*

The application of negative pressure to the cup, which must include a vacuum gauge to show how much pressure is being applied, is shown in Figure E3.4.

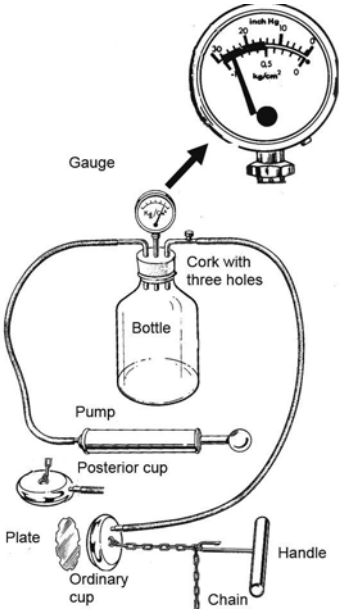


Figure E3. 4 *A vacuum extraction system showing the pressure gauge*

Indications for an assisted delivery using the vacuum extractor

- Delay in the second stage of labour
- Fetal distress in the second stage
- Maternal conditions that require a short second stage (e.g. eclampsia, heart disease)
- Patients who cannot contribute to delivery e.g. exhausted or reduced conscious level

Contraindications

- Undefined position of fetal head
- Face presentation; dangerous injuries
- Gestation < 36 weeks
- Breech presentation
- Cervix not fully dilated: can result in dangerous tears and PPH

The clinical findings that need to be confirmed

1. Full dilatation of the cervix
2. Membranes ruptured
3. The position of the fetal head in relation to the pelvis must be known
   If unsure, consider USS exam
4. Abdominally: the head must be at no more than 1/5 above the symphysis pubis
   Vaginally, the vertex must be at the ischial spines (0 station) or below the spines (+1 or more)
5. Ideally fetus > 36 weeks' gestation. Latest guidelines (RCOG) state that must not use vacuum below 32 weeks and with caution 32 to 36 weeks
6. Ideally, cooperation of the mother to enhance contractions and traction by bearing down
7. Uterine contractions must be present
8. Ensure cervical or vaginal tissue is not trapped under cup
9. Ensure a healthcare worker able to undertake neonatal resuscitation is present at delivery

Basic rules

1. Explain what you are going to do to the patient and obtain consent.
2. If the patient is mobile, ask them to empty their bladder. If not, use an in-out catheter.

If the patient has an in-dwelling catheter, remove it during the delivery and if necessary replace it later.

3. No analgesic is required. (perineal infiltration with lidocaine will suffice if an episiotomy is planned).
4. Lithotomy is the commonest position used. The mother should be propped-up in a 45-degree sitting position, to aid expulsive efforts.
5. The delivery should be clearly achievable after three pulls, with evidence of descent with each pull.
6. The head, not just the scalp, should descend with each pull.
7. The cup should be reapplied no more than twice, provided that it has been in the right position, and that the direction of pull is correct
8. After one detachment, a more experienced operator, if available, should be summoned.
9. If failure with the ventouse occurs despite good traction, do not try the forceps, but proceed to Caesarean section (provided that it is safe, and available within a reasonable time).

Methods for applying an anterior cup (Bird metal or soft plastic)

First check your equipment. Attach the cup to the suction, and ensure the suction is working by testing it. This can be done by briefly holding the cup against your gloved hand while suction is applied.

1) Examine the mother carefully using a sterile procedure and gloves and ideally an obstetric cream such as Chlorhexidine obstetric cream. Estimate the size of the baby by abdominal examination and ensure that the head is fully engaged (no more than 1/5 of the head should be palpable). The membranes should have ruptured.
2) Determine the position of the vertex and the amount of caput by vaginal examination. Identify the posterior fontanelle.
3) Describe the attitude of the presenting part as 'flexed' or 'deflexed'. In a flexed attitude only the posterior fontanelle can be felt, whereas any situation in which the anterior fontanelle can be felt or the posterior fontanelle cannot be found should be described as deflexed.
4) Place two fingers within the posterior introitus to widen the vaginal opening (*see* Figure 67.5).

Figure E3.5 Inserting the cup.

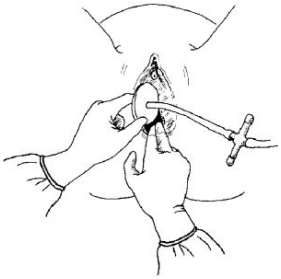


Figure E3.6 Placing the cup at the flexion point.

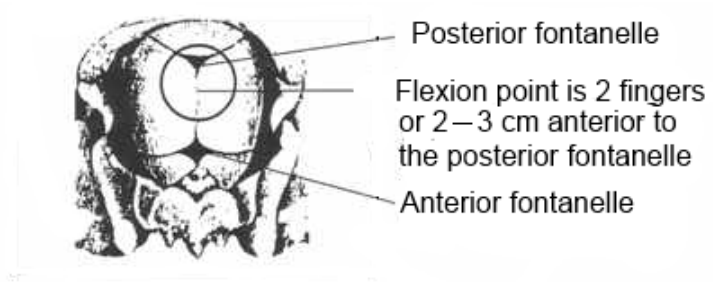
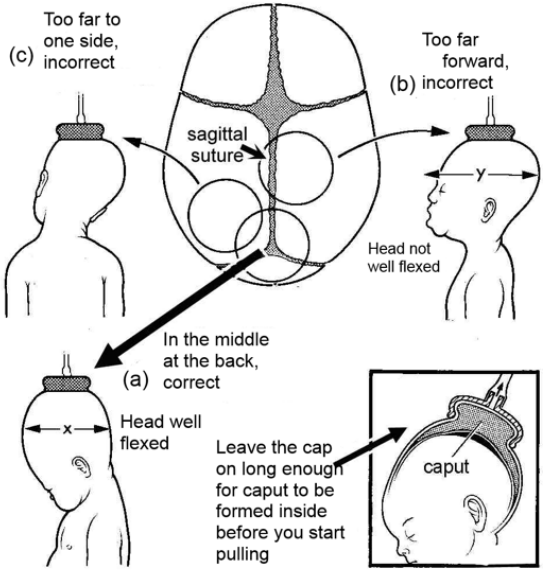
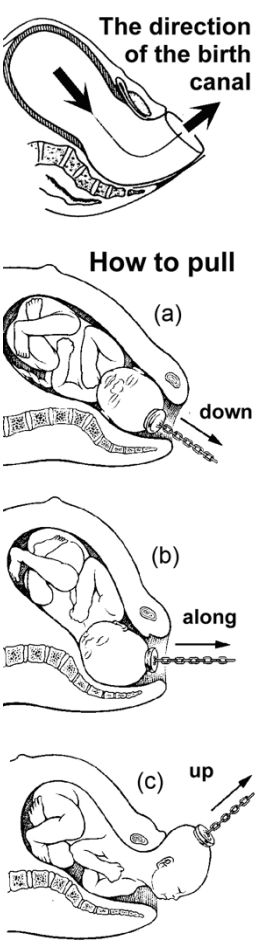


Figure E3.7 *Correct and incorrect positions for the cup.*



5) The metal or plastic cup is lightly lubricated with sterile delivery cream (e.g. chlorhexidine cream) and then inserted sideways into the vagina. Insert the cup, avoiding the urethra.
6) Apply the largest cup that will fit, with the centre of the cup over the flexion point, 2–3 cm anterior to the posterior fontanelle (*see* Figures E3.6 and E3.7). This placement will promote flexion, descent and autorotation with traction. Suction is applied to draw the fetal scalp into the cup.
7) Ensure that no maternal tissue is caught under the edge of the cup.
8) Place the middle of the cup 1–2 cm anterior to the baby's posterior fontanelle/posterior to the anterior fontanelle. This will flex the head during its passage through the pelvis.
9) If you put it more towards the front, it will tend to extend the head, so that it will be less easy to pull out. The distance 'Y' when the head is deflexed (bent backwards) is much longer than the distance 'X' when it is flexed (bent forward).
10) If you put the cup to one side, the head will bend to one side.
11) Connect the cup to the pump (*see* Figure E3.4), and check for leaks prior to commencing the delivery.
12) First increase the pressure to 0.2 kg/cm2, and then, after checking again that there is no maternal tissue caught under the cup, increase the pressure to 0.8 kg/cm2, but never any higher than this.
13) Common problems include suction bottles not tightly screwed in or tubing loosely attached to the metal cup.
14) The metal cup should have a meshed bottom plate, which functions to maintain a clear space between the scalp and the cup so that an effective vacuum can be applied.
15) Only perform an episiotomy when the head stretches the perineum (to avoid blood loss), and only if the perineum is interfering with the delivery.
16) Check the application. Ensure that there is no maternal soft tissue (cervix or vagina) within the rim.
17) During a contraction, encourage the patient to push, and aid her expulsive efforts by applying traction to the cup/fetal head (method described below).
18) Traction should be along the pelvic axis for the duration of the contraction (initially down, then progressively forwards, and finally upwards as the head delivers) and always perpendicular to the cup (*see* Figure E3.8).
19) Always pull in the direction of the birth canal.
20) Pull downwards towards the floor until the head is below the ischial spines.
21) Pull outwards until the head is stretching the perineum.
22) Finally pull upwards until the baby is delivered.
23) During traction keep one finger or thumb on the edge of the cup and another finger on the scalp so that the earliest sign of detachment or slippage is detected (*see* Figure E3.9)

Figure E3.8 *Delivery with the Bird anterior metal cup.*



24) With each contraction, apply traction in a line perpendicular to the plane of the cup rim, to help to prevent the cup slipping off (*see* Figure 67.8). Place a finger on the scalp next to the cup during traction, to assess potential slippage and descent of the vertex (*see* Figure 67.9). Slight side-to-side movements may help to edge the head down the pelvic wall, but side-to-side movements must be small to keep the traction line perpendicular and prevent the cup from detaching.

25) As the head crowns, the angle of traction changes through an arc of over 90 degrees.

If the perineum is stretching as normal, it is simply supported with the hand that was on the cup. An episiotomy must only be undertaken if perineal resistance is preventing delivery. The episiotomy cut should be at a 60 degree angle initiated when the head is descending through the perineum.

26) Occasionally, an edge of the cup might lift off at the introitus (this is more likely to happen if there is caput present). If this occurs, one has to be careful not to catch maternal tissue under the cup as it reattaches. Therefore, this should be rechecked before final delivery of the head.

27) Once the head has delivered, release the vacuum and take off the cup and complete the delivery normally.

Note the following:

- *Never use the cup to actively rotate the baby's head. Rotation of the baby's head will occur naturally with traction, if it is going to rotate.*
- *Do not continue to pull between contractions.*
- *With progress, continue the 'guiding' pulls to achieve delivery. Descent must be seen with each pull, and delivery should be clearly achievable following three pulls.*

Figure E3.9 *How to ensure that the vacuum cup is securely on the infant's head as you pull.*

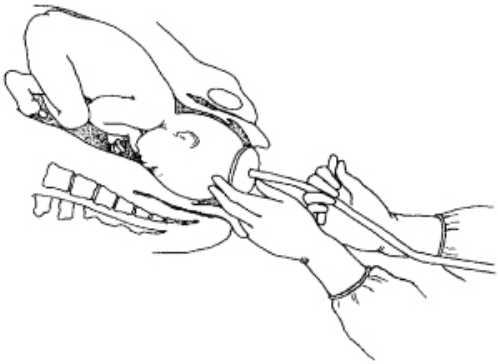
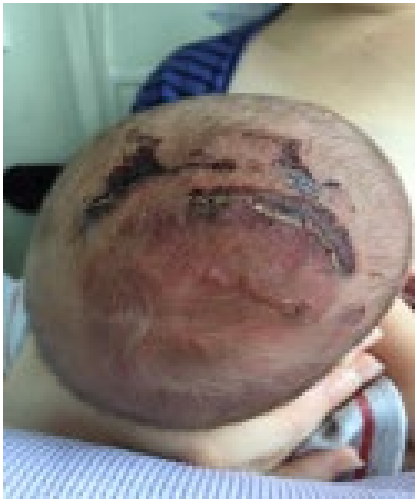


Figure E3.10 *The type of damage that can result from use of the ventouse, especially if it is actively rotated by the operator*



Delivery with the posterior metal cup

For a deflexed head in an occiput-posterior position, the 'OP' cup or a plastic cup, ideally a Kiwi OmniCup, should be used. It is applied as far back on the head as possible, again ideally in the midline over the occiput. To allow good placement of the cup, it sometimes helps to try to flex the head, with two fingers of the left hand pressing on the sinciput, while the right hand inserts the cup behind the head. Once correctly placed, the vacuum can be started and taken directly to the required level. (Because the cup lies parallel to the vagina it is unlikely to catch any maternal tissue but check that no vaginal wall has been caught.)

The first pull will be in the direction required to flex the head. With flexion of the head, the presenting diameter immediately becomes less. Thereafter, traction will be along the pelvic axis.

It is essential not to try to twist the cup to rotate the baby. This will cause trauma, especially spiral tears of the scalp, with the rotational deliveries (see Figure E3 10).

The head will usually rotate as it reaches the perineum. The fetus may also deliver in the OP position.

Overall, occiput-posterior deliveries are the most likely to cause problems. The most difficult ones are those where the head is markedly deflexed or where there is excessive caput. If the cup detaches at this point (after flexion and rotation), put it back on again or consider lift-out forceps providing there has been descent of the head and delivery is imminent.

Between contractions, check the fetal heart rate and secure application of the cup.

Causes and management of failure to deliver with the ventouse

Vacuum extraction has failed if:

- the head does not advance with each pull
- the fetus is not delivered, or delivery is not imminent after three pulls
- the cup slips off the head twice at the proper direction of pull with a maximum vacuum pressure

Every application should be considered a trial of vacuum extraction. Do not persist if there is no descent with every pull.

Generally, delivery is achieved with three pulls. As a minimum, it should be clear after three pulls that the delivery is definitely going to be achieved imminently by the vaginal route.

***Failures** occur for the following reasons.*

1. Inadequate initial assessment
2. The head being too high: a classic mistake is to assume that because caput can be felt below the ischial spines, the head must be engaged
3. Misdiagnosis of the position and attitude of the head: attention to detail will minimise this.
   If the cup placement is found to be incorrect, it may be appropriate to begin again with correct placement (i.e. midline over the flexion point)
4. Traction in the wrong direction
5. Excessive caput. Rarely, even with metal cups, adequate traction is not possible because of excessive caput.
   In these cases, consideration must be given to delivery by Caesarean section unless the head is well down, in which case forceps can be used.
6. Poor maternal effort. Maternal effort can contribute substantially to success. Adequate encouragement and instruction should be given to the mother. This may be a reason for preferring forceps to ventouse if the patient has a reduced conscious level.
7. The incidence of cephalo–pelvic disproportion (CPD) (true failure) is low. However, in settings where the majority of women deliver at home or in community

clinics, it must be remembered that the patient is likely to have been fully dilated for some time before arrival in the hospital, if she has been referred for failure to progress in the second stage. CPD is likely to be relatively common in this group.

One of the main problems with using a ventouse in low-resource settings is difficulty with the availability of reliable suction. Although this is integral to the Kiwi, such devices are expensive. Alternative techniques to provide negative pressure for a plastic cup have been developed by Cooper Surgical but, although supposedly re-usable, the pump fails after 1-2 months due to rust building up within the pressure system. This can be addressed by regular servicing but is not acceptable.

Complications of vacuum extraction

Complications usually result from not observing the conditions of application, or from continuing efforts beyond the time limits stated above.

Fetal complications

1) Localised scalp oedema (artificial caput or chignon) under the vacuum cup is harmless and disappears within a few hours.
2) Cephalhaematoma (see Figure E3.11) requires observation, and will usually clear in 3 to 4 weeks.

Scalp abrasions (common and harmless) and lacerations may occur. (Figure E3.11) Clean and examine lacerations to determine whether sutures are necessary. Necrosis is extremely rare.

3) Sub-galeal haemorrhage is more serious.

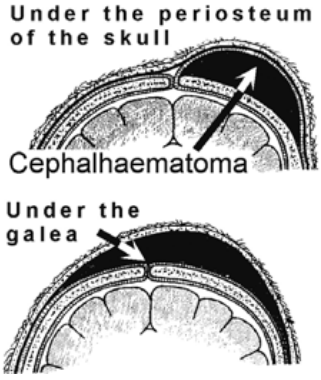


Figure E3.11 *Fetal scalp bleeding complications of ventouse (vacuum extraction).*

4) There have been reports of transmission of herpes viral infections from the mother to the fetal scalp following the use of a metal cup. It is theoretically

possible that hepatitis or HIV infection may also be transmitted in this way.

There is a lower risk of scalp injury using the flexible/plastic cups. Therefore, for straightforward ventouse deliveries, use the flexible cup when possible, bearing in mind that where rotation is needed as part of the delivery, the metal cup is more successful. The metal cup can also deliver a stronger traction force.

Maternal complications

Tears of the cervix or vagina may occur. Examine the woman carefully and repair (see Section A+12 and Section E8).

Complications of trying to use vacuum delivery without full cervical dilatation include cervical tears which can extend upwards to involve the uterus, and therefore may require laparotomy for repair, or even hysterectomy.

If the operator is uncertain about the degree of engagement, degree of cervical dilatation, or the position of the head, a more experienced practitioner should assist (if available).

Forceps delivery after failure to deliver with the ventouse

There is little place for an attempt at forceps delivery if there has been no descent with the ventouse despite adequate traction. However, if traction has been inadequate (due to caput, leaking equipment or no maternal assistance), it may be justified to change to forceps. The most experienced operator should make this decision.

Vacuum extraction and symphysiotomy

If vacuum extraction fails, consider using vacuum extraction in combination with symphysiotomy (see below and if skills are available) or perform Caesarean section.

Vacuum extraction may be considered in combination with symphysiotomy in the following circumstances:

- Caesarean section is not feasible or immediately available
- the head is at least at 0 station or no more than 1/5 palpable above the symphysis pubis
- the provider is experienced and proficient in performing symphysiotomy
- vacuum extraction alone is contraindicated because of the failure to descend adequately
- there is no major degree of cephalo-pelvic disproportion.

In conclusion, the ventouse is the instrument of first choice for operative vaginal delivery, provided conditions for its use are safe and suitable

Section E4. Forceps delivery

Introduction

In low - resource settings, rotational forceps are potential dangerous unless the operator is extremely experienced in their use. Mid-cavity (e.g. Neville - Barnes) or lift-out forceps (e.g. Wrigley's), are suitable provided adequate training has been given. They can be particularly useful in the delivery of the after-coming head of a breech (especially Pipers forceps), for delivery of a mento-anterior face presentation, and delivery before 36 weeks.

Definitions:

1. Outlet position: fetal scalp visible with labia separated, fetal skull has reached the pelvic floor, sagittal suture is in anteroposterior (AP) diameter or right occiput anterior (ROA)/left occiput anterior (LOA) or occiput-posterior (OP) position. Rotation required ≤45°.Fetal head on perineum.

2. Low cavity position: Leading point (not caput) is at +2 station. Rotation ≥45° required. (in which case manual rotation or use vacuum), Rotation ≤45° required.

3. Mid cavity position: Leading point is above +2, but not above the ischial spines. Rotation ≥45° required (either manual or vacuum delivery). Rotation ≤45° required.

4. **High cavity position: do not use forceps or vacuum. Proceed to CS.**

Conditions for possible use of low or mid-cavity forceps

Low or mid-cavity forceps are used when: the fetal head is no more than one-fifth palpable per abdomen, the leading point of the skull is above station plus 2 cm but not above the ischial spines, and rotation is 45° or less. Ideally, the sagittal suture should be in the midline and straight, with an occiput-anterior position.

Indications for low or mid-cavity forceps delivery:

Fetal indications

Fetal distress

To protect the head during breech vaginal delivery

Maternal indications

1) To avoid Valsalva manoeuvres (eg, maternal cardiac disease, including uncorrected malformations)
2) Persistent severe hypertension
3) Inadequate progress **
4) Maternal exhaustion

5) Face malpresentation with chin anterior
6) Entrapped after-coming head in breech delivery; some operators will routinely control the delivery of the head here by using forceps, provided that the cervix is fully dilated. Pipers forceps are particularly valuable in this situation.

**Maternal morbidity increases significantly after delay in the second stage, which is a common occurrence when mothers begin labour in remote or poorly - resourced BEmOC facilities. The most frequent adverse effects in the woman of a prolonged second stage are chorioamnionitis, third- and fourth-degree perineal tears, and subsequent uterine atony with PPH.

Nulliparous women:
Delay diagnosed if active second stage ≥2 hours.

Multiparous women:
Delay diagnosed if active second stage ≥1 hour.

Low and mid cavity forceps for Occiput Anterior positions

The blade on the mother's left always goes in first, and the right blade fits on top of it.

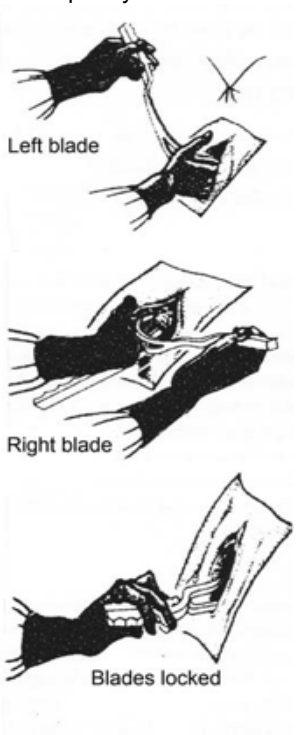
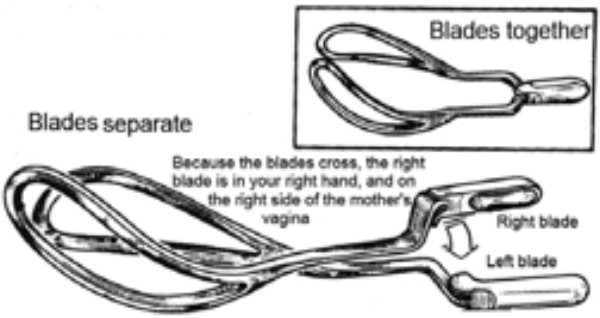


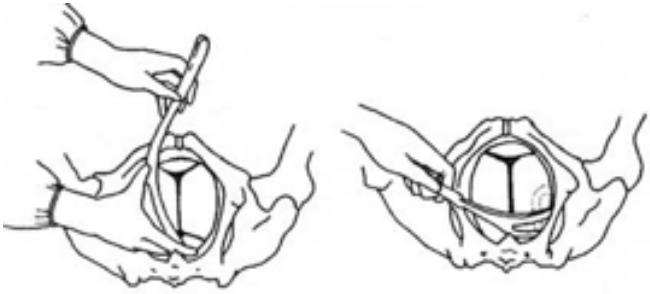
Figure E4.1 *Forceps for OA position.*



Procedure

1. Explain to the mother what is happening and seek consent.
2. Ensure that the head is engaged in the pelvis. Abdominal palpation must always be undertaken.
3. Ensure that an expert in neonatal resuscitation is present at the delivery
4. The bladder must be empty, if necessary, by in/out catheterisation. Do not leave catheter in the bladder during delivery.
5. Pudendal block and perineal infiltration with 1% lignocaine may be required, if time allows
6. Identify the position of the head, ensuring it is Occiput-anterior. Occiput-transverse or occiput-posterior malpositions are indications for ventouse using the OP ventouse cup or Kiwi OmniCup. (Although it may be possible to deliver an OP position with forceps)
7. Ensure that the pair of forceps match. Assemble them and check
8. Lubricate the blades of the forceps with disinfectant cream (e.g. Chlorhexidine obstetric cream)
9. Wearing sterile gloves, insert two fingers of the right hand into the vagina on the side of the fetal head. Slide the left blade gently between the head and fingers to rest on the side of the head (*see* Figure 68.2 and 68.3).

Figure E4.2 *Applying the left blade of the forceps.*



10. Repeat the same manoeuvre on the other side, using the left hand and the right blade of the forceps (*see* Figure E4.3).
11. Depress the handles and lock the forceps (Figure E4.1).
12. Difficulty in locking usually indicates that the application is incorrect. In this case, remove the blades and recheck the position of the head. Reapply only if the head is in the appropriate position for the use of forceps.

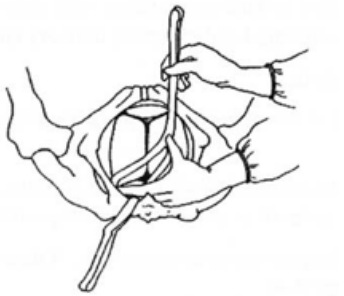


Figure E4.3 *Applying the right blade of the forceps.*

13. After locking, check that the sagittal suture lies vertically in the midline between the shanks of the forceps.
14. Note: these checks do not ensure correct placement but do help detect some instances of incorrect placement.

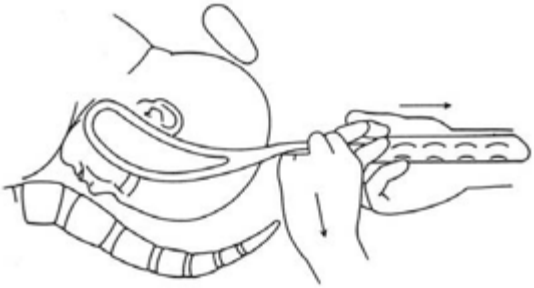


Figure E4.4 The correct way of applying traction with downward pressure.

15. After locking the blades, apply steady traction inferiorly and posteriorly, during each contraction (*see* Figure E4.4). The use of Pajot's manoeuvre (whereby the fingers of the left hand are placed on top of the right hand, as per the diagram), helps to ensure the correct line of traction.
16. Between contractions, the lock should be eased open a little to avoid continuous pressure on the fetal skull.
17. Between contractions, check the fetal heart rate and correct application of the forceps
18. When the head crowns, make an adequate episiotomy
19. Lift the head slowly out of the vagina between contractions
20. The head should descend with each pull. Only two or three pulls should be necessary
21. Ensure that the head rather than the blades of the forceps are descending with each pull by feeling the fingers on the fetal head moving down. It is very

harmful to the fetus if the blades slide down the side of the fetal head.

22. After repairing the episiotomy, ensure that swab and instrument counts are correct
23. Always check for vaginal tears.
24. Do a rectal examination to check the integrity of the anal sphincter and the rectal mucosa

Failure of forceps

This is where the fetal head does not advance with each pull, or the fetus is not delivered after three pulls.

Do not persist if there is no descent with every pull.

If forceps delivery fails, consider a symphysiotomy, or perform a Caesarean section.

Complications of forceps use:

Fetal complications

- Injury to facial nerve(s). This injury is usually self-limiting and only requires observation.
- Lacerations of the face and scalp may occur. Clean and examine any lacerations to determine whether sutures are necessary.
- Fractures of the face and skull require close monitoring. This is unlikely to happen where careful forceps delivery is carried out by a skilled operator.

Maternal complications

Tears of the genital tract may occur. Examine the woman carefully and repair any cervical or vaginal tears and undertake episiotomy repair.

Section E 5. Caesarean section including post-operative care

The WHO suggests that systems should be in place to ensure that Caesarean section is performed in a minimum of 5% of all expected births.

Indications

1. Placenta praevia
2. Abruption with continued severe bleeding or fetal distress
3. Uterine rupture
4. Fetal distress
5. Obstructed labour
6. Prolapsed cord if the fetus is still alive and cannot soon be delivered
7. Mal-presentations/malpositions, for example transverse lie
8. Two or more previous CS
9. Severe maternal illness such as pre-eclampsia or eclampsia where urgent delivery is needed, and where vaginal delivery is unlikely in 24 hrs for pre-eclampsia and in 12 hrs for eclampsia (provided there is no fetal distress in the interim)
10. Failed induction of labour
11. A pregnant woman with a singleton breech presentation at term may be considered for CS.

    However, if she arrives in established labour, with no signs suggesting disproportion, no fetal distress, an estimated fetal body size which is not large (clinically and/or on USS), and no history of a previous CS or medical complication of pregnancy such as pre-eclampsia, it may be appropriate to offer vaginal delivery. This is provided that a competent person trained in breech delivery is present. External cephalic version (ECV) may be attempted for a woman who has a breech presentation at , or after, 36 weeks gestation, if she is not in labour and has intact membranes. Contraindications to ECV include uterine scar or abnormality, fetal distress, vaginal bleeding, or certain medical conditions.
12. Delivery by planned CS should be advised for maternal sickle cell disease with evidence of fetal compromise before the onset of labour.
13. In twin pregnancies where the presentation of the first twin is not cephalic, the effect of CS in improving outcomes for the babies is uncertain. If the leading twin is transverse or oblique, then CS is required. However, if the leading twin is breech, then, provided there are no signs suggesting CPD, no fetal distress, estimated fetal body sizes which are not large (clinically and/or on USS), and no history of a previous CS or medical complication of pregnancy (such as pre-eclampsia), vaginal delivery could be the best option, especially for the mother's safety.

    Again, a competent person trained in vaginal breech delivery and twin delivery must be present.

14. Suspected morbidly adherent placenta, which is a more likely complication if there has been one or more previous CS, and there is an anterior placenta.
15. The presence of large fibroids in the lower segment of the uterus preventing descent of the presenting part.
16. The presence of certain major maternal medical disorders, including cardiac disease, where vaginal delivery might be considered more dangerous than CS.

Note: CS should NOT routinely be undertaken for preterm birth, small for dates fetuses or post-term pregnancy, unless fetal distress is detected, or other signs of placental compromise are present.

Actions that must be undertaken before you undertake a CS

MOST IMPORTANT

1. *Obtain informed consent for CS, and for tubal ligation if appropriate.*
2. *Check mother's name, medical and surgical history, drug allergies and family contact details.*
3. *Avoid performing a CS if the fetus is dead, and there is no maternal indication.*
4. *Take blood for Hb, group & save and cross-match for all Caesarean sections. This is especially important if there is a high risk of bleeding (eg placenta praevia), or if there is severe anaemia.*
5. Listen to the fetal heart rate, before moving to theatre, and just before starting the operation.
6. Examine for fetal presentation, and to assess whether vaginal delivery might be achievable. Ideally use ultrasound examination to confirm.
7. Ensure safely secured IV cannula, and start an IV infusion with a crystalloid such as
   Ringer-lactate/Hartmann's solution or 0.9% saline.
8. Especially if abruption and/or pre-eclampsia are present, check for blood clotting using the 7- minute tube test**.
   If coagulopathy is suspected, try in advance to obtain fresh donor blood for transfusion.
9. Ensure oxytocin and misoprostol are immediately available.
10. Check resuscitation equipment for newborn infant is ready and working.
11. Patient to lie in left lateral tilt position.
12. Ensure protection from exposure to HIV, as well as Hepatitis B and C, by appropriate apron, gown, gloves and visor for the surgeon, assistant and scrub nurse.
13. Insert urinary catheter under strict asepsis, to protect bladder and monitor urine output.
14. Ensure sterile procedure: iodine or chlorhexidine solution and sterile drapes etc.
15. Start 72-hour course of IV antibiotic just before skin incision.

****Test for clotting disorder**

Place 2ml blood into a small glass test tube. Hold in fist to keep at body temperature.

After 4 minutes, start tipping to see if clot is forming. Tip every minute until clot forms and tube can be tipped up. Failure of clot to form after 7 minutes or a soft clot that breaks down is diagnostic of coagulopathy.

ADDITIONAL MEASURES

1. Pre-load IV infusion immediately before surgery if spinal anaesthetic, and ensure lateral left tilt with wedge or pillow
2. Ensure all necessary surgical equipment is available
3. Ensure trained midwife, or ideally neonatal clinician, is present in case neonatal resuscitation is needed. This is especially important for fetal distress, thick meconium or preterm delivery.
4. Ensure emergency anaesthetic drugs and equipment are present and working.
5. Is the indication for CS still valid?
6. Minimise risk of gastric content aspiration. This is a particular risk with Caesareans under GA. For elective Caesareans, nil by mouth for 4-6 hours, plus an antacid such as 30 mL of 0.3% sodium citrate (preferably non-particulate) or 300 mg of magnesium trisilicate. Antacids reduce the stomach acid,thereby minimising damage to the lungs if aspiration occurs.
7. If pubic hair could interfere with incision, shave immediately before disinfection of skin.
8. Have a whiteboard in the operating theatre on which to record swab, needle and instrument counts.

The **urgency of CS** should be documented using the following scheme, to aid clear communication between healthcare professionals:
CATEGORY 1: immediate threat to the life of the woman or fetus
CATEGORY 2: maternal or fetal compromise which is not immediately life-threatening
CATEGORY 3: no maternal or fetal compromise, but early delivery needed
CATEGORY 4: elective

- For Category 1 CS, decision to delivery time should be 30 minutes or less.
- For Category 2 CS, decision to delivery time should be 75 minutes or less.

Urinary catheterization

The woman must be catheterised and her bladder emptied before starting the procedure, both to reduce the risk of injury to the bladder, and to monitor urine output.

Remove the catheter 8 hours after surgery if the urine is clear; if not, wait until it is.

If the urine is heavily bloodstained and does not clear, consider possible damage to bladder or ureter.

Wait >48 hours before removing the catheter if there has been:

- uterine rupture
- prolonged or obstructed labour
- gross perineal oedema
- sepsis with pelvic peritonitis

If the bladder was damaged, leave the catheter in for at least 7 days. The urine should be clear of blood at the time of catheter removal, and remain so after 48 hours. If the woman is not receiving antibiotics, give nitrofurantoin 100 mg (or cefalexin 500 mg or amoxicillin 500 mg) orally once daily until the catheter has been removed.

Skin preparation

Tincture of chlorhexidine, iodophor (such as Povidone iodine) and tincture of iodine are the recommended antiseptic products for preparing the patient's operative site. Apply three times to the incision site using disinfected ring forceps and a cotton or gauze swab. Do not contaminate the glove by touching unprepared skin. Begin at the proposed incision site and work outwards in a circular motion away from the incision site. At the edge of the sterile field, discard the swab.

The use of alcohol or hexachlorophene as a single agent is not recommended unless the patient's skin is sensitive to the recommended antiseptic products. Impregnated adhesive film as skin preparation is not recommended.

All patients should be given a prophylactic antibiotic, ampicillin 2 grams IV, immediately before the skin incision. In the case of penicillin allergy, an alternative antibiotic should be used.

Post-operative thromboprophylaxis in the form of early mobilization and compression stockings should be provided routinely. For those women assessed to be at high risk, low molecular weight heparin, such as Dalteparin, should be administered for a total of 10 days (see Section A+15). The dosage is calculated according to the patient's weight.

Prevention of exposure of staff to HIV and hepatitis

In many operations, micro-holes develop in gloves (not due to needlestick injuries). These micro-holes will of course be more prevalent if gloves are reused, as in some resource-limited settings. If there is a significant risk of HIV or hepatitis B or C, double gloves or special thick gloves should be used. A clear plastic facial shield reduces exposure to blood.

Opening the abdomen

Abdominal and uterine scars are two separate issues. Classical section is a vertical uterine scar, usually but not always associated with a vertical abdominal scar. A vertical abdominal scar may be present with either a classical or lower segment uterine scar.

Skin incision

The choice of skin incision depends on the following:

- the gestational age of the fetus
- the indication for section
- the presence of previous scars
- the operator's surgical experience

A low transverse incision is preferred to the vertical incision, as there is less likelihood of wound dehiscence and hernia.

Length of skin incision

A minimum length of 15 cm is indicated (which accommodates an open Allis forceps). Make the skin incision to the level of the fascia.

Excision of the previous scar is not essential for better healing and cosmetic results, unless there is keloid scarring.

There are two possibilities, namely the Pfannenstiel incision and the Joel-Cohen incision.

The Joel-Cohen incision

The Joel-Cohen technique includes a straight transverse incision through the skin, 3 cm below the level of the anterior superior iliac spines. (This is higher than the Pfannenstiel incision; see below). The subcutaneous tissues are opened only in the middle 3 cm. The fascia is incised transversely in the midline and then extended laterally with a finger. Finger dissection is used to separate the rectus muscles vertically and laterally, as well as to open the peritoneum. All of the layers of the abdominal wall are stretched manually to the extent of the skin incision. The bladder is reflected inferiorly. The myometrium is incised transversely in the midline, but not to breach the amniotic sac, then opened and extended laterally with finger dissection.

The Pfannenstiel incision ('panhandle' in the German language)

This consists of a curved skin incision, two finger-breadths (3-4 cm) above the symphysis pubis, transverse incision of the sheath, blunt separation of the rectus muscles, and incision of the parietal peritoneum in the midline.

The low vertical incision

A vertical incision is made from the base of the umbilicus to the pubic hair line. This is preferred if better exposure is needed, or if local anaesthesia is used. It may be extended upwards to allow access to the upper abdomen. It may be used to provide access for a midline uterine incision. (Classical or DeLee).

Indications for Classical Caesarean or De Lee (low midline) incisions:

*Known difficulty in accessing the lower uterine segment, due to adhesions from previous Caesarean sections

* Transverse fetal lie, with the back down

* Fetal malformations

* Large lower segment fibroids

* Placenta praevia

* Carcinoma of the cervix

*Extreme prematurity, where the lower uterine segment is unformed

Compared with Pfannenstiel-based CS, Joel-Cohen-based CS has been shown to be associated with a reduction in blood loss, operating time, time to oral intake, fever, duration of post-operative pain, analgesic injections, and time from skin incision to birth of the baby.

The surgeon must always ensure that the access to the uterus is adequate to deliver the fetus without difficulty. In the presence of scarring, a Pfannenstiel incision may give better exposure.

Opening the abdominal rectus muscles and fascia

1. Make a 2–3 cm vertical incision in the fascia using a scalpel.
2. Hold the fascial edge with forceps, and broaden the incision from side to side using scissors and finger dissection. Extend laterally to the extent of the skin incision.
3. Ensure all bleeding points from the rectus sheath are closed off.

Opening the peritoneum

1. Grasp and elevate the parietal peritoneum with non-toothed forceps. Ensure bowel or bladder are not caught, and incise and open the peritoneum with scissors.
2. Open visceral peritoneum covering the anterior surface of the lower uterine segment. Elevate the vesico-uterine fold after lifting it with forceps, then ensure bladder is not included and open with scissors 3cm each side from the midline.
3. Push down the bladder with fingers and a swab.
4. Insert Doyen retractor. Ensure bladder is completely reflected, and that ureters not at risk.

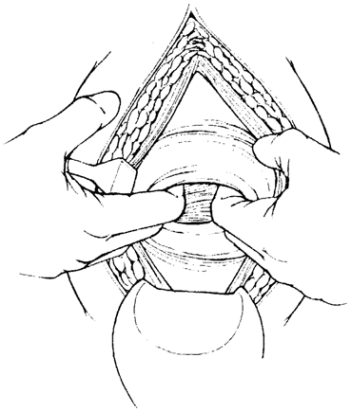
Opening the uterus

1. Use a scalpel to make a 3 cm transverse incision in the lower segment of the uterus. It should be about 1 cm below the level where the vesico-uterine peritoneal fold was incised to bring the bladder down.
2. Widen the incision by placing a finger at each edge and gently pulling upwards and laterally at the same time.
3. If the lower uterine segment is thick and narrow, extend the incision in a crescent shape, using scissors instead of fingers to avoid extension into the uterine vessels.
4. It is important to make the uterine incision large enough to deliver the head and body of the baby without tearing the incision.
5. A high vertical uterine incision is indicated if any of the following are present:
   - an inaccessible lower segment due to dense adhesions from previous Caesarean section
   - transverse lie (with the baby's back down), for which a lower uterine segment incision cannot be safely performed
   - fetal malformations (e.g. conjoined twins)
   - Large fibroids in or over the lower segment
   - placenta praevia
   - carcinoma of the cervix
6. A lower transverse incision is commonly used because:
   - less dissection of the bladder is needed
   - entry into the uterus is easier
   - there is less blood loss
   - there is a lower incidence of uterine rupture with subsequent pregnancies.
7. A lower vertical incision (De Lee's incision) can be useful if the lower uterine segment is poorly formed and thick, in which case a transverse incision would be unwise.
8. If a lower transverse incision has been attempted and found to be inadequate, it can be extended upwards in a J-shaped incision to avoid blood vessels and enable adequate access.

General measures during surgery

- Handle tissue gently.
- Eradicate dead space.
- Transfer sharp instruments directly into a basin/tray.
- Retract tissue with instruments, reposition suture needles with forceps, and ideally remove the needle before the final tying of sutures.

Figure E5.1 *Enlarging the uterine incision.*



Delivery of the fetus and placenta

1. Place one hand inside the uterine cavity between the uterus and fetal head. Using your fingers, grasp and flex the head.
2. Gently lift the baby's head through the incision, **taking care not to extend the uterine incision.**
3. With the other hand ,apply fundal pressure to help deliver the baby. If you have an assistant, he or she could apply fundal pressure.
4. Rotate head to Occiput-Anterior position to deliver through incision (see Figure E5.2), taking care not to extend the incision down towards the cervix.
5. Deliver the shoulders and body.

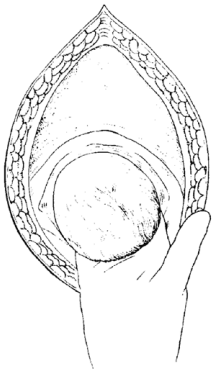


Figure E5.2 *Delivering the baby's head.*

If the baby's head is deep down in the pelvis or vagina, ask an assistant (wearing sterile gloves and using chlorhexidine obstetric cream) to reach into the vagina (which must be sterilised as described above), and push the baby's head up into the uterus. Then lift and deliver the head (see Figure E5.3).

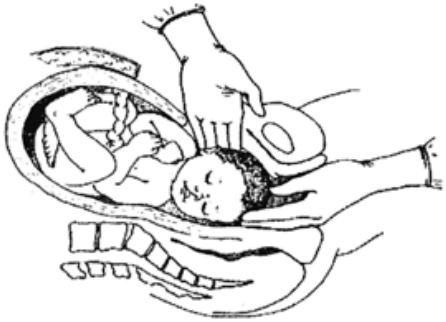


Figure E5.3 *Delivering the deeply engaged head abdominally with assistance via the vagina.*

7. In the following circumstances, delivery of the head can be difficult:

a. Caesarean section in the second stage of labour following failed forceps/ventouse, when the head is very low
b. occiput-posterior position
c. after-coming head of baby with breech presentation
d. transverse lie*
e. prematurity and oligohydramnios ,where the lower segment is poorly formed and thick
f. Before opening the uterus, a transverse lie should be converted to cephalic or breech presentation by pushing the baby gently, encouraging a 'forward roll' in utero.
   If the uterus is opened on a transverse lie, an arm may present, making it very difficult to deliver the baby.

Manoeuvres that may help include the following:

- an assistant can disengage and push the presenting part upwards from the vagina (see Figure E5.3)
- application of forceps when the head is free
- in the presence of transverse lie, grasping a foot and delivering by breech extraction with the fetal back always facing anterior

Be aware of the proximity of the uterine arteries to the ends of the uterine incision (Figure E5.4), and be very careful not to extend the incision by tearing it and damaging these arteries.

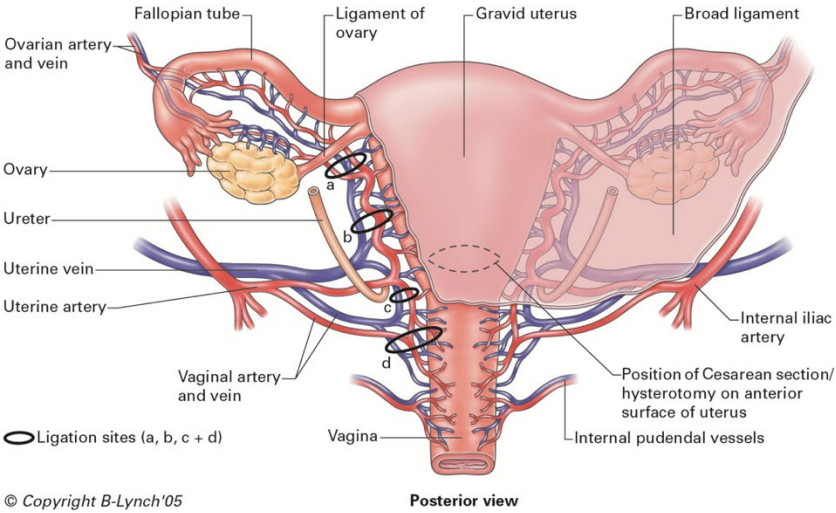


Figure E5.4 *Anatomy of the gravid uterus showing positions of uterine arteries and ureters*

Placenta praevia

Posterior placenta praevia generally has no impact on the delivery of the baby. However, with both posterior and anterior placenta praevia, the uterus is likely to remain atonic following delivery, causing excess blood loss and requiring syntocinon infusion.

If anterior placenta praevia is present, depending on how low it reaches, it may be possible to insert your hand below the placental edge, to access the presenting part and deliver the baby.

If that is not possible, then it is necessary to cut through the placenta (very carefully, to avoid fetal trauma) to access the presenting part and deliver the baby.

In all cases of fetal distress, quick delivery is required.

Following delivery of the baby

- Give oxytocin 5 to 10 IU IV over 2-3 minutes to aid delivery of the placenta, and then infuse 40 units oxytocin in 500 mL of IV fluids (Ringer-lactate/Hartmann's or 0.9% saline) over 4 hours.
- Clamp and cut the umbilical cord. If the baby is in good condition, delayed cord clamping is appropriate.
- Hand the baby to an assistant for initial care.
- If not given prior to incision for CS, give a single dose of a prophylactic

antibiotic after the cord has been clamped and cut; ampicillin 2 grams IV *or* cefotaxime 1 gram IV.

- Keep gentle traction on the cord and massage the uterus.
- Deliver the placenta and membranes.

Delivery of the placenta

Spontaneous delivery of the placenta, after oxytocin has been given immediately after delivery of the baby, and with controlled cord traction, is preferred to manual removal. However, sometimes manual delivery of the placenta will be necessary.

Routine checking of the uterine cavity is essential to ensure that there are no retained placental fragments or membranes present as this cannot always be ensured by inspection of the placenta.

Closing the uterine incision

- Meticulous handling with re-approximation of tissues.
- Avoid strangulating tissue with over-tight sutures or knots.
- Haemostasis: isolate and ligate major bleeding vessels.

Exteriorisation of the uterus?

This may sometimes be necessary in order to visualise the lower segment for suturing, and it may thereby reduce blood loss. It may, however, cause vagal stimulation leading to bradycardia, and may be uncomfortable if performed under spinal or epidural anaesthesia. It is important to inform the anaesthetist of the need to exteriorize the uterus.

Suturing of the uterus

1. Polyglycolic acid (Vicryl) sutures are preferred to catgut. Use of thick suture material causes more foreign body and tissue reaction, but if too thin, sutures will cut through the myometrium.
2. Usually the uterus is closed in two layers.
3. Gently grasp the corners of the uterine incision with clamps.
4. Grasp the bottom edge of the incision with clamps. Make sure that it is separate from the bladder.

Look carefully for any extensions of the uterine incision.

5. Repair the incision and any extensions with a continuous locking stitch using a robust absorbable suture such as No. 1 or 0 chromic catgut, or polyglycolic acid (Vicryl) on a round bodied needle (see Figure E5.5).
6. Begin at the end corners of the incision
7. A routine second layer of sutures is usually undertaken for the uterine incision, as it may help to reduce the risk of haemorrhage and subsequent uterine rupture through the scar.

8. Be very careful not to damage uterine arteries or tie off ureters
9. If there is any persisting bleeding from the incision site, close with figure-of-eight sutures.

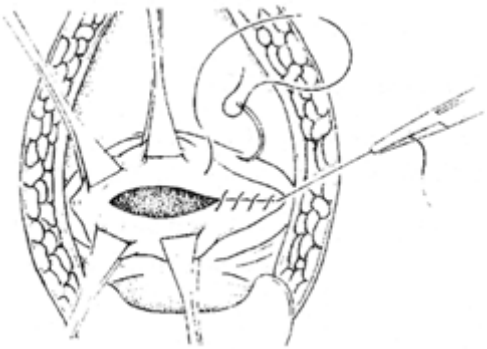


Figure E5.5 *Closing the uterine incision.*

Closing the abdomen (general issues)

1. Look carefully at the uterine incision before closing the abdomen. Make sure that there is no bleeding and that the uterus is firm. Use a sponge to remove any clots inside the abdomen.
2. Examine carefully for any injuries to the bladder, and repair these immediately if present.
3. Ensure that there are no instruments or swabs left inside the abdomen. One way of achieving this is to have a white board in the operating theatre on which is documented every swab or instrument used during the operation, and to ensure that these are available when the abdomen is closed.
4. Closure of the parietal and visceral peritoneum is not necessary, as it makes no difference to the healing and strength of the wound. The duration of surgery is thereby reduced, and there may be less tendency to form intra-abdominal adhesions.
5. Close the rectus sheath with a continuous suture of No. 1 Vicryl.
6. In vertical incisions, mass closure of all layers using synthetic suture is appropriate. Ensure full closure of the sheath to prevent herniation lof abdominal contents.
7. Suction drains should not be used routinely.
8. If there are obvious signs of infection, pack the subcutaneous tissue with gauze and insert loose 0 catgut (or polyglycolic) sutures. Delay closure of the skin until the infection has cleared.

9. Close the fat layer with interrupted Vicryl sutures.
10. If there are no signs of infection, close the skin with an absorbable subcuticular suture or skin clips.
11. Interrupted mattress sutures are recommended in obese patients, and in cases where delayed healing is anticipated. Deep tension sutures, in addition to closure in layers, are especially useful in obese women with a midline abdominal incision.
12. Apply a sterile dressing.
13. Gently push on the abdomen over the uterus to remove clots from the uterus and vagina. Swab out the vagina to remove any clots. Any bleeding subsequently noted will therefore be recognised as fresh loss.

Couvelaire uterus

If a Couvelaire uterus (swollen and discoloured by blood) is seen at CS, as a result of major placental abruption, close it in the normal manner. Administer an oxytocin infusion, as the uterus does not contract well in these circumstances. Monitor the patient closely for 48 hours after delivery.

Types of needle and suture material

In resource-limited settings, there may be only two types of suture material for a Caesarean section, for example:

1. chromic catgut, which can be used on a round-bodied needle for the uterus
2. polyglycolic acid (Vicryl) which can be used on a round-bodied needle for the uterus, and on a cutting/round-bodied needle for the rectus sheath and the skin.

Monitoring urine output

Check and record the volume and colour of the urine in the storage bag at the end of the operation.

Then empty the urine storage bag, to facilitate post-operative monitoring of urine output.

Complications of Caesarean section

1. In cases of previous CS, or a history of abdominal or pelvic surgery, or pelvic sepsis, bowel may be adherent to the undersurface of the peritoneum. Extra care must then be taken when opening the peritoneum, dividing it transversely under direct vision when possible.
   In such cases, the peritoneum should be opened with scissors rather than with the fingers.
2. Bladder may be adherent to the lower segment, and care must be taken to push the bladder well down in order to avoid trauma to the bladder or ureters. Emptying the bladder pre-operatively reduces the likelihood of bladder

damage.

3. Fibroids may obstruct access to the lower segment. A decision has to be made as to whether to make the uterine incision above, below or around the fibroids, or to cut through them. Alternatively, a classical (midline) uterine incision may be necessary, with its attendant greater risk of scar rupture in future pregnancies.
   The temptation to remove the fibroids should be resisted, as there may be a huge associated blood loss.
4. In cases of anterior placenta praevia, the placenta is encountered on making the lower segment incision. This may lead to excessive bleeding.
5. The placenta may be morbidly adherent to a previous Caesarean section scar (placenta accreta). It is important not to damage the uterine wall and its vasculature by delivering the placenta piecemeal. It is necessary to leave the adherent fragment *in situ* and monitor carefully for bleeding and signs of infection. **However, peri-partum hysterectomy may be safer in this situation**, especially in a low resource setting where close post-operative monitoring may not be adequate.
6. Excessive bleeding at Caesarean section is most commonly due to uterine atony, lateral extension of the lower segment incision, or a combination of these two factors (*see* Section A+11 on postpartum haemorrhage).
7. Where a trial of forceps has taken place prior to Caesarean section, care must be taken to identify and suture any vaginal or cervical tears, which may bleed heavily.

Following an unsuccessful operative vaginal delivery, the surgeon should take the opportunity to push the fetal head upwards, to disimpact it prior to carrying out Caesarean section.

Uncontrolled bleeding during CS

The cause of the haemorrhage, whether due to atony or trauma, should be determined. Help should be sought from senior colleagues (if available). The anaesthetist must be informed about the haemorrhage, and blood should already be cross-matched (at least 4 to 6 units).

In cases of vertical extension into the cervix and vagina, suturing should be attempted from the lowest part of the tear before suturing the transverse incision.

Massage the uterus to expel blood and blood clots. The presence of blood clots will inhibit effective uterine contractions.

Broad ligament haematomas

In most cases, these haematomas respond well to pressure (which should be

applied continuously for at least five minutes).
If the haematoma continues to increase in size, the leaves of the broad ligament need to be opened, and the ureters should be identified before suturing the bleeding point.

Atonic uterus
If the uterus is atonic despite IV oxytocin and an oxytocin infusion, massage the uterus, continue to infuse oxytocin, and give:

- ergometrine 200–500 micrograms IM (must not be used if the patient has hypertension or pre-eclampsia),
- *and/or* misoprostol 400–800 micrograms orally or 800 micrograms rectally if the mother is drowsy or unconscious.

These drugs can all be given together or sequentially.

Transfuse as necessary, ideally with fresh donor blood.

Have an assistant apply firm pressure with a fist over the aorta to reduce the bleeding until the source of bleeding can be found and stopped.

If bleeding is not controlled, *see* Sections A+11, E11 and E12 for details of the many methods of treatment that can be adopted. They include B-Lynch sutures or a peri-partum hysterectomy.

Breech delivery at CS
The fetal back should always be kept upwards/anterior during breech delivery. Gentle rotation of the fetal trunk may be required, being careful to grasp the bony pelvis and legs, thereby avoiding damaging the fetal abdomen. The baby is then delivered as if performing a breech extraction vaginally.

In summary, place the fingers of each hand into the groin of the baby and lift out the buttocks and legs. Deliver the arms by the Løvset's manoeuvre; legs and the body up to the shoulders, then deliver the arms. Flex the head and deliver using the Mauriceau–Smellie–Veit manoeuvre. Complete the delivery as for a vaginal delivery (see Section A+23

Transverse lie delivery at CS
Assess the position of the fetus, including the position of the head, before opening the uterus. If the membranes are intact and there is liquor around the fetus, try to convert the transverse lie to a longitudinal lie.

- If the back is upwards, reach into the uterus and find the baby's feet.
- Grasp a foot and pull gently through the incision to deliver the legs and complete the delivery as for a breech extraction.
- If the back is downwards, a high vertical uterine incision may be preferred, but this is too late if only discovered once inside the uterus.

- Following the incision, reach into the uterus and find the feet. Pull them through the incision and complete the delivery as for a breech baby. **Be very careful not to tear the incision.**
- To repair the vertical incision, three layers of suture will be needed.

Placenta praevia

An ultrasound scan prior to the operation will help the operator to judge whether it will be possible to manually displace the placenta in order to access the amniotic cavity.

If a low anterior placenta is encountered, find an edge of the placenta and move the placenta laterally or incise through it and deliver the fetus.

After delivery of the baby, if the placenta cannot be detached manually, the diagnosis is placenta accreta, occasionally seen at the site of a previous Caesarean scar.

There are two approaches to this problem. The placenta can be left *in situ* to degenerate spontaneously, or an immediate sub-total hysterectomy may be performed. If the former approach is followed, a careful watch will need to be kept for any signs of infection in the postnatal period, and prophylactic antibiotics will be required. **In low-resource settings, hysterectomy is the safest option, while the mother is stable.**

Women with placenta praevia are at high risk of post- partum haemorrhage.

- If there is bleeding at the placental site, under-run the bleeding sites with chromic catgut (or polyglycolic acid/ Vicryl) sutures before closing the wound.
- It may also be helpful to compress the lower segment vessels by packing the uterus or inserting a condom-catheter.
- Watch for bleeding in the immediate postpartum period and take appropriate action.
- Re-opening of the abdomen may be needed.
- Fresh donor blood for transfusion is particularly important. Check whole blood clotting time, consider using tranexamic acid (see Section A+11), and always if possible give fresh donor blood transfusion.

POST OPERATIVE MONITORING AFTER A CS

All patients undergoing CS are at potential risk of life-threatening complications

Patients most at risk:

1. Where uterine rupture has been repaired
2. APH, especially due to abruption (loss of clotting factors)
3. Pre-eclampsia, especially HELLP (low platelets)
4. Multiple pregnancy (increased risk of atony)
5. Polyhydramnios (increased risk of atony)
6. Anaemia (low reserve)
7. Previous CS (bleeding from incision site)
8. Prolonged labour prior to CS (atony)
9. Difficulties delivering the fetus: impacted head and possible tear to lower segment or cervix
10. Patients undergoing blood transfusion after surgery

Observe the woman on a one-to-one basis until she has regained cardiorespiratory stability and is able to communicate. Do not leave alone for first hour. Regular checks throughout first 6 hours. Call for assistance if worried (see Post CS chart at end of this section).

If the patient is bleeding heavily internally, there likely will be changes in the observations in the 1st hour.

IV infusion of oxytocin over 4 hours of 40 IU in 500ml 0.9% saline in all high risk cases.

Monitor vital signs every 15 minutes for not less than the first 2 hours postoperatively (as per latest MOH guidelines in Liberia). If all is well at 2 hours, then, after sign-off on the monitoring chart by the responsible senior (doctor or obstetric clinician), recordings continue every 30 minutes for the third hour and then 1 hourly for the next 3 hours. Increase frequency of monitoring if vital signs are deteriorating, and undertake appropriate treatment. **Note that bleeding can be concealed in the uterus, or occur into the abdomen through the incision or through an undetected uterine tear or rupture**:

Observe:

1. Uterine tone (is the uterus still contracted well?)
2. Fundal height (usually at or around the umbilicus after delivery, but helpful to mark on the patient's abdomen the upper position of the fundus immediately following CS and before transfer to the ward)
3. Vaginal and incisional output of any blood
4. Heart rate trend
5. Respiratory rate trend
6. Urine output
7. BP (only changes late in shock in pregnancy)
8. Changes in mental state

9. Hypoxaemia: SpO_2 less than 94%. Ideally, every patient should be on a pulse oximeter
10. Be aware of possibility of shock, best revealed by developing tachycardia and tachypnoea

Use an early warning chart (see attached at end of this section).

Consider involving the mother in assessing the uterus and reporting on any bleeding after delivery.

Continue prophylactic IV antibiotic (e.g. Ampicillin IV 2-gram 6 hourly for 72 hours). CS wound care should include:

1. removing the dressing 72 hours after the CS unless it is wet ,when it should be changed for a dry dressing immediately, and reviewed daily;
2. assessing the wound for signs of infection (such as increasing pain, redness or discharge), separation, or dehiscence;
3. gently cleaning and drying the wound daily if any signs of infection or separation.

If excessive vaginal bleeding occurs, follow treatment guidelines for PPH (see Section A+11), but **be prepared to re-enter the abdomen if there is a possibility that there is intra-abdominal bleeding from the uterus.**

Watch for sepsis (fever 37.5 degrees C or more, tachycardia and foul-smelling vaginal secretions), which are more likely with malnutrition, severe anaemia, HIV, previous PROM or PPROM and prolonged labour.

If evidence of potentially severe infection (endometritis) give the following intravenous antibiotics for 5 to 7 days: — Ampicillin 2 grams IV every 6 hours plus Gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours plus Metronidazole 500 mg IV every 8 hours. Consider adding Ceftriaxone (1 gram IV every 24 hours) if not improving. Investigate for a possible infected retained placental fragments, wound abscess or intra-abdominal abscess. Ultrasound scanning can be helpful here.

Help to prevent deep vein thrombosis and pulmonary embolus by early and regular mobilisation, compression stockings and the avoidance of dehydration. Consider low molecular weight heparin.

Ensure adequate analgesia: involve the nurse anaesthetist.

Regularly check Hb. post operatively, ideally using ward-based stick test haemoglobinometer.

Remove the urinary bladder catheter around 24 hours post-op, once a woman is mobile after a spinal anaesthetic. Leave it in for at least 7-10 days if there is a possibility of fistula , or if bladder damage was repaired during surgery. After removing the catheter, check that the patient is able to pass urine normally, and that there is no retention of urine.

Other aspects of post-operative care

1. Bowel function should be normal after 12 hours.
2. If progress is uncomplicated, give liquids immediately, and solids when the patient is passing gas per rectum.
3. If there was infection, obstructed labour, or uterine rupture, wait until bowel sounds re-appear before giving oral fluids.
4. Keep a dressing on the wound for 72 hours to ensure re-epithelialisation. If blood is leaking, reinforce the dressing or replace it with a new one if it is more than half soaked.
5. Discharge the mother home when her temperature has been normal for at least 24 hours, and she is mobilising and able to eat and drink normally.
6. Notify community midwife on discharge, and warn regarding maternal and neonatal danger signs (see Section A5)

Post Caesarean Section chart to guide safe monitoring (surgeon to identify risk factors to monitoring midwife)

MCAI Maternal & Childhealth Advocacy International

Risk factor	Post-operative complication	Indicators that complication is present
Multiple births Polyhydramnios Prolonged labour before CS Possible retained placental fragments	PPH due to atonic uterus	Floppy hypotonic uterus on palpation Enlarging uterus as blood collects in it (exceeds marker line on abdomen) Heavy vaginal bleeding and/or clots NB Bleeding may occur into the uterus and be held there by a clot and not appear vaginally.
Impacted fetal head Uterine rupture or dehiscence at CS Difficulty identifying edge of incision Previous CS	PPH due to bleeding from uterus (incision or tear)	Suspicion of intra-abdominal bleeding Heavy vaginal bleeding without signs of atony Free fluid in abdomen on USS
Impacted fetal head	PPH due to cervical tear	Heavy vaginal bleeding without signs of atony
Abruption Pre-eclampsia Infection	PPH due to DIC	Blood clotting time > 7 minutes Bleeding from other sites e.g. venous cannula Signs of sepsis
PROM PPROM IUFD especially with history of ruptured membranes before CS	Puerperal sepsis: endometritis	Fever 37.5 degrees C or more. Note not always present with sepsis Foul smelling lochia Tachycardia Fall in BP
History of preeclampsia or eclampsia	Severe pre-eclampsia or eclampsia	Systolic > 160 and or diastolic > 100 Urine protein one plus or more

Name..... Hospital number..... Age ..... Date ..... Chart number.....

Vital sign	Time after CS	15 min	30 min	45 min	1 hour	Sign by Dr or OC if safe to monitor every 30 or 60 minutes ..... If not change to new sheet and continue every 15 minutes until safe to extend to 30 minutes Check urine output	90 min	2 hours	3 hours	4 hours	5 hours	6 hours
A+B Resp. rate	25 or more or <14											
	20 to 24											
	< 20 to 15											
A + B SpO_2	< 92%											
	92-94%											
	95 to 100%											
C Pulse rate	120 or higher											
	90 to 119											
	60 to 89											
	< 60											
C Systolic BP	170 or higher											
	160 to 169											
	110 to 159											
	90 to 109											
	< 90											
Uterine tone	Contracted											
	Soft and large											
Uterine position	As after surgery											

Section E6. Management of labour/delivery in women who have previously delivered by Caesarean section

Women who have previously had **two or more deliveries** by caesarean section (CS) and become pregnant must deliver again by CS and this should be planned during the pregnancy. If such a woman presents to a clinic where comprehensive EmONC (CEmONC) is not available in labour, she should urgently be transferred to the nearest hospital for an emergency CS.

If, however, a mother comes in fully dilated and obviously about to deliver she should have a vaginal delivery, with the post-delivery observations outlined below.

Any woman who has previously had **one delivery** by CS can aim for vaginal birth (**VBAC – Vaginal Birth after Caesarean Section**) provided there are no other complications. Women who have previously undergone a CS are ALWAYS at risk of uterine rupture, even if they have had a successful vaginal birth since the last CS. VBAC labours should therefore be planned at the CEmONC hospital not a peripheral clinic. If a woman suitable for VBAC presents in labour to a clinic where CEmONC is not available, she should be urgently transferred to the nearest hospital where these services are available. If delivery is imminent, however, she should have a vaginal delivery with the post-delivery observation outlined below.

Uterine rupture after CS usually occurs during labour but can occasionally occur in the antenatal period. If a woman with a previous CS presents in pregnancy with significant abdominal pain +/- IUFD, uterine rupture should be considered as a possible diagnosis.

Uterine rupture occurs in 1 in 200 VBAC labours after one CS [RCOG 2015] but may be higher after two CS. VBAC labours must therefore be carefully monitored in hospital, and the delivery plan changed to a plan for urgent CS if problems are identified.

Induction of labour (IOL) for women with a previous uterine scar:
Women with a CS scar should not be induced with prostaglandins or misoprostol. Women with a previous CS in spontaneous labour should not have their labour **augmented** with oxytocin although this drug may be used carefully after ARM to **induce** labour.

There is evidence that prostaglandins or misoprostol increase risk of uterine rupture therefore the preferred method of IOL is artificial rupture of membranes (ARM) followed by careful oxytocin infusion. If the cervix is not ready for ARM, a Foley catheter may be used to dilate the cervix prior to ARM (see Section 5). The Foley catheter could remain in situ for 12 hrs, before hopefully making the cervix suitable for ARM.

Following ARM, oxytocin should be titrated to get to 3 contractions in 10 minutes, max 4 in 10 minutes and then try to decrease the oxytocin to allow the patient to have her own contractions.

After 4 hours of oxytocin perform a VE, record the findings. Vaginal assessments should then be every 2 hours, especially if any oxytocin is being used. If there is no progress, perform a CS.

Women who have had a successful vaginal delivery after CS and are having IOL may need to have their oxytocin reduced or stopped once they are in established labour (see above).

The risk of rupture of a CS scar is higher, in induced labour, than in spontaneous labour. Most ruptures occur when arrest occurs at 6 cm dilatation.

Management and decision for VBAC or Caesarean section when presenting in spontaneous labour:

Women should be advised to come to hospital early in labour (as soon as possible after the onset of the first contraction). If an antenatal decision about mode of delivery has not been made, the woman should be reviewed by the doctor, or the obstetric clinician, as soon as possible after admission, and a plan for VBAC or delivery by CS made.

VBAC aims to:

1. Monitor the condition of the baby and use this to make a judgement on the likelihood of uterine rupture
2. Avoid prolonged or uncorrected dysfunctional labour and do not augment labour with oxytocin or misoprostol.
3. Keep the woman safely prepared for urgent CS, if needed.

VBAC Care:

1. Site an intravenous cannula
2. Take blood for full blood count, group and save. Ideally request relatives or close friends to donate fresh blood for transfusion if it is needed. If it is not needed it can be stored (if this is safe and possible) for a subsequent patient
3. Teach the mother to self monitor the fetal heart rate immediately after the end of every contraction, and make sure that she understands that she must promptly report any changes to the midwife (55-72% of uterine scar ruptures are preceded by an abnormal fetal heart rate pattern); (RCOG, 2007).
4. Restrict oral intake to clear sugary/salty drinks only once in established labour.
5. Administration of cimetidine (400 mg 8 or 12 hourly) and metoclopramide (10mg every 8 hours) until delivered.
6. If the woman requires delivery by CS give 30ml sodium citrate 0.3% immediately before her spinal or general anaesthetic.
7. Strict use of partogram. Progress should be assessed by both cervical dilatation & descent of the head (by abdominal and sterile vaginal assessment).
8. Observe for suggestions of a uterine rupture or imminent rupture:
    - abnormal fetal heart rate
    - vaginal bleeding
    - constant scar pain or tenderness, particularly when sudden in onset.
    - development of haematuria
    - maternal tachycardia, hypotension or shock.
    - cessation of uterine contractions.
    - shoulder tip pain
    - loss of station of presenting part
    - Bandl's ring

If the midwife identifies any symptoms or signs of possible scar problems, she/he must promptly inform the doctor or obstetric clinician on duty.

Progress in labour should be closely monitored, and as per partogram deviations must be reported to the doctor or obstetric clinician, promptly. If progress is slow, delivery by CS must be advised. **Never augment labour with oxytocin or misoprostol.**

Management of Second Stage:

- The length of the second stage should be carefully monitored.
- Progress should be reviewed by the midwife after 30 minutes of active pushing and if delivery is not imminent the doctor, or obstetric clinician, must review the woman.

- If birth is not imminent within 45 minutes of active pushing, expedited delivery should be advised, usually an operative vaginal delivery, but if the descent is not adequate CS may be required (ideally this should have been recognised earlier in the labour).

Management if uterine rupture suspected:

- If suspected uterine rupture occurs during the first stage of labour deliver as soon as possible by CS.
- Only consider tocolysis (250 micrograms terbutaline subcutaneously) if there is a fetal heart rate abnormality (usually a bradycardia) **AND** the women is contracting very frequently (> 3 contractions in 10 minutes).
- If suspected uterine rupture occurs during the second stage of labour promptly perform an assisted vaginal delivery if safe (head 0/5 to 1/5 palpable per abdomen with the head at or below the spines on vaginal examination). If assisted vaginal delivery is not an immediate option do not wait, proceed to delivery by CS as soon as possible.
- If suspected uterine rupture occurs in the second stage of labour, and the baby has delivered vaginally, the need for laparotomy will be determined by maternal condition (see below).

Management after successful vaginal birth:
As a 'silent' uterine rupture can occur in the second stage of labour, a woman who has had a successful vaginal birth after a VBAC labour must be carefully monitored in the early post-natal period.

Perform routine 'post caesarean section' observation, and record these on the new post CS chart. The midwife should promptly report any concerns about these observation to the doctor or obstetric clinician

Section E7. Episiotomy

Indications

- delay in the second stage
- complicated vaginal delivery (e.g. breech, shoulder dystocia, forceps, vacuum delivery)
- scarring from female genital mutilation (cutting)
- fetal distress
- previous third- or fourth-degree tears
- where significant perineal trauma is anticipated if it is not performed

Procedure

1) Apply antiseptic solution to the perineal area
2) Use local infiltration with 1% lignocaine. Make sure that there are no known allergies to lignocaine or related drugs
3) Infiltrate beneath the vaginal mucosa, beneath the skin of the perineum and deeply into the perineal muscle (*see* Figure E7.1) using 5–10 mL of 1% lignocaine solution
4) Aspirate (pull back on the plunger) to be sure that no vessel has been penetrated.
   If blood is returned in the syringe with aspiration, remove the needle. Recheck the position carefully and try again. Never inject if blood is aspirated.
5) After local anaesthetic infiltration, wait for 2 minutes and then pinch the incision site with forceps. If the mother feels the pinch, wait a further 2 minutes and then retest.

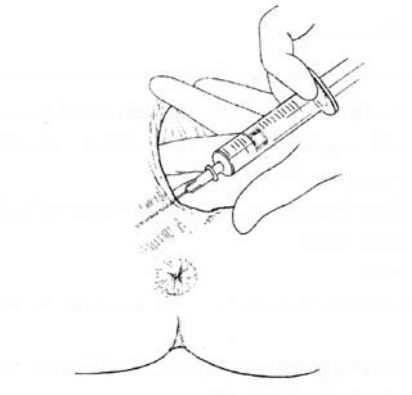
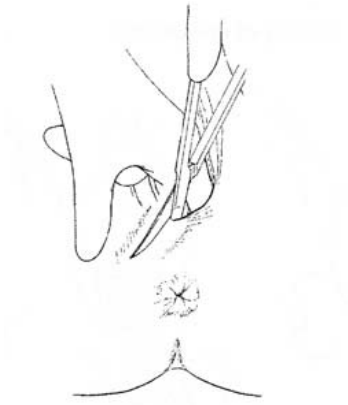


Figure E7.1 *Infiltration of the perineum with local anaesthetic*

Figure E7.2 *Using two fingers to protect the baby's head while making the incision.*



6) Do not perform an episiotomy until the perineum is thinned out and 3–4 cm of the baby's head (not just caput) is visible during a contraction
7) Performing an episiotomy will cause bleeding, so it must not be done too early
8) Wearing sterile gloves, place two fingers between the baby's head and the perineum
9) Use scissors to cut the perineum about 3–4 cm in the medio-lateral direction (see Figure E7.2). It is essential that the episiotomy cut is not made where, if it turns into a tear, it will involve the anal sphincter. That is, it must be at an angle away from the anus, as shown in Figure E7.2.
10) Control the baby's head and shoulders as they deliver, ensuring that the shoulders have rotated to the midline to prevent an extension of the episiotomy
11) Carefully examine for extensions and tears, and repair them (see below)

Repair of episiotomy

1) Absorbable, polyglycolic sutures such as Vicryl are ideal for closure. They are preferred to chromic catgut because of their tensile strength, non-allergenic properties and lower risk of infection and episiotomy breakdown. However, chromic catgut is acceptable where there is no alternative.
2) Apply antiseptic solution to the area around the episiotomy.
3) If the episiotomy has extended (torn) through the anal sphincter or rectal mucosa, which should not happen if the original cut has been away from the vertical (see above), manage as third- or fourth-degree tears, respectively. (see Section E8)

4) Close the vaginal mucosa using continuous 2-0 suture.
5) Start the repair about 1 cm above the apex (top) of the episiotomy. Continue the suture to the level of the vaginal opening.
6) At the opening of the vagina, bring together the cut edges of the vaginal opening.
7) Bring the needle under the vaginal opening and out through the incision and tie.
8) Close the perineal muscle using a continuous 2-0 suture.
9) Close the skin using a subcuticular or interrupted 2-0 suture.
10) Rectal examination should take place before and after repair of the episiotomy. **However, be very careful to change gloves before repair of the episiotomy.**

Complications of episiotomy

Haematoma

This presents as a painful vulvo-perineal swelling. which may have evolved over several hours.
It requires re-opening of the episiotomy wounds under spinal or local anaesthesia. After evacuation of the clot, there will usually be a bleeding point visible; this needs ligation, followed by re-suturing of the surrounding tissues, in layers.

Infection

The management depends on the appearance of the wound.

Most commonly, there is superficial erythema and swelling, with separation of the skin edges.
This should be managed with oral antibiotics, and daily review.

If the infection is more deep-seated, leading to dehiscence of the perineal body musculature, IV antibiotics should be administered for 24 hours, before laying open the wound and re-suturing it under GA or spinal anaesthesia.

Appropriate antibiotic regimes are as follows:

Superficial infection:
Ampicillin 500 mg orally four times a day for 5 days
plus metronidazole 400 mg orally three times a day for 5 days

Deep infection:
Ampicillin 500 mg IV every 6 hours
plus gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours

plus metronidazole 500 mg IV every 8 hours.

The IV regime should be administered for at least 48 hours and changed to the oral regime as for superficial infections once the woman has been fever-free for 48 hours.

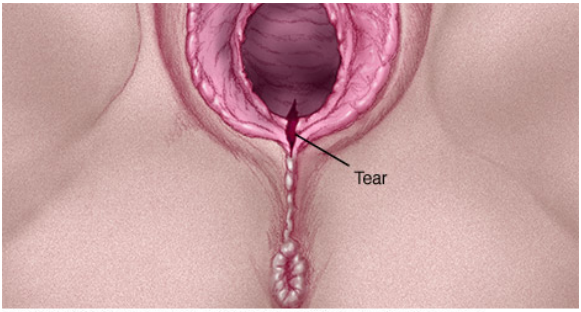
Any necrotic tissue requires wide surgical debridement, followed by secondary closure in 2 to 4 weeks, dependent on resolution of the infection.

Section E8. Managing major perineal tears after childbirth

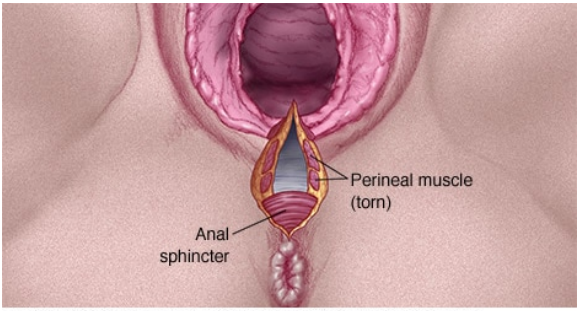
Perineal trauma involves any type of damage to the female genitalia during labour, which can occur spontaneously or as a result of an episiotomy or instrumental delivery. Anterior perineal trauma can affect the anterior vaginal wall, urethra, clitoris and labia. Posterior perineal trauma can affect the posterior vaginal wall, perineal muscle, perineal body, external and internal anal sphincters, and anal canal. During labour, the majority of perineal tears occur along the posterior vaginal wall, extending towards the anus. Vaginal lateral wall tears can occur with other tears but also on their won. It is important to examine the whole of the vagina after delivery.

Degrees of tear

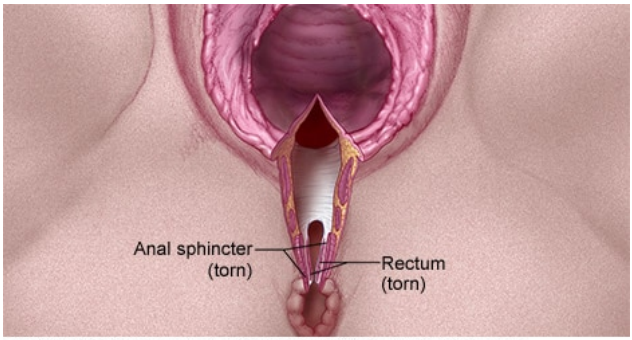
1st degree. Laceration of the vaginal mucosa or perineal skin only. First-degree tears are the least severe, involving only the perineal skin — the skin between the vaginal opening and the rectum and the tissue directly beneath the skin.



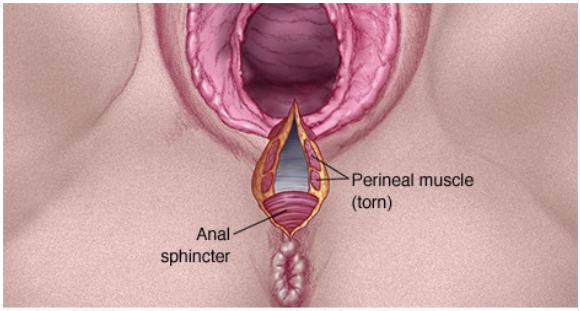
2nd degree Laceration involving the perineal muscles Second-degree tears involve the skin and muscle of the perineum and might extend deep into the vagina. Second-degree tears typically require stitches and heal within a few weeks.



3rd degree. Laceration involving the anal sphincter muscles. These tears usually require repair with local anesthesia in an operating room — rather than the delivery room — and might take longer than a few weeks to heal.
Complications such as stool leakage (faecal incontinence) and painful intercourse are possible.



3A Where <50% of the external anal sphincter is torn
3B Where >50% of the external anal sphincter is torn
3C Where the external and internal anal sphincters are torn



4th degree. Fourth-degree vaginal tears are the most severe. Laceration extending through the anal epithelium (resulting in a communication between vagina epithelium and anal epithelium) They extend through the anal sphincter and into the mucous membrane that lines the rectum (rectal mucosa). Fourth-degree tears usually require repair with local or spinal anaesthesia in an operating room — rather than the delivery room — and sometimes require more specialized repair. Healing also might take longer than a few weeks. Complications such as faecal incontinence and painful intercourse are possible.

More than 85% of women will suffer from some degree of perineal tear during labour, with 0.6–11% of all vaginal deliveries resulting in a third-degree or fourth-degree tear.

Role of episiotomy
There is conflicting evidence about the effectiveness of mediolateral episiotomy in the prevention of obstetric anal sphincter injuries (OASI). If episiotomy is performed it is vital that the right medio-lateral cut is made at least 60 degrees from the midline to reduce the risk of 3rd or 4th degree tears.

The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) does not promote the routine use of episiotomies, and advises that an episiotomy is only recommended if there is one or more of the following:

1. a high likelihood of third-degree or fourth-degree perineal tear
2. soft tissue dystocia
3. a requirement to accelerate delivery of a compromised fetus
4. need to facilitate operative vaginal delivery
5. evidence of female genital mutilation. However de-infibulation in the antenatal period, or during labour, is usually more appropriate than a 'routine' episiotomy.

Diagnosis and Management of perineal tears:
The perineum should always be assessed after a vaginal birth to determine the presence of any lacerations. This examination should include a digital rectal examination to evaluate the tone of the anal sphincter.

First degree: left to the clinician's discretion to determine if suturing is required. Usually only needed if bleeding.
Second degree: sutures should be placed to facilitate better wound approximation (noticeable benefits seen at six
weeks postpartum)

Principles of all 3rd or 4th degree tear repairs:

1. The repair should be completed by an experienced clinician as soon as possible after birth
2. Broad spectrum antibiotics should be given.
3. Good lighting and access are important – ideally, the procedure should be conducted in an operating theatre with the patient in lithotomy.
4. Adequate anaesthesia should be used (local or if 4th degree possibly a spinal)
5. Resorbable sutures should be used, with the knots of each layer buried as this reduces the risk of dyspareunia and vaginal discomfort following the recovery.
6. Each layer should be repaired independently to restore function.

7. Perineal repair must ALWAYS be performed in the following order:
    - Anal repair – 4th degree tear
    - Internal anal sphincter – 3C tear
    - External anal sphincter – 3A/B tear
    - Vaginal wall
    - Perineal muscle
    - Skin

If bleeding is a problem, put stitches in to control the bleeding and then perform the repair in the order above.

Procedure for repair of first- and second-degree tears and episiotomy:

- Count swabs, needles and instruments before starting procedure.
- Clean perineal area.
- Inspect perineum, labia, vagina, cervix and anal sphincter and a rectal examination to check sphincter
- Identify apex of wound and commence suturing from above apex, using a continuous non-locking stitch for vaginal wall.
- Repair should restore anatomy and achieve haemostasis. Perineal muscles should be repaired using a continuous non-locking suture where practical.
- Skin edges are approximated, if not bleeding and well opposed skin sutures are not necessarily required. If skin is sutured continuous subcuticular repair is preferred, if practical.
- Always perform a vaginal and rectal examination after completing the repair to confirm that the apex of the wound has been closed, that there are no stitches in the rectum and that no swab or pack has been left in situ. If problems are identified remove all stitches and re-do the repair.
- After the repair and checks clean vulval area
- Check swabs, instruments and needles.
- Tell the mother that the suture material will dissolve and inform her that postnatal perineal inspections will be carried out. Advise mother on perineal hygiene. There is no evidence to support the use of salt or 'Savlon' over normal bathing water.

Procedure for repair of third and fourth-degree tears:

- Count swabs, needles and instruments before starting procedure.
- Inspect perineum, labia, vagina, cervix and anal sphincter and perform a rectal examination.
- Give the following antibiotics:
- The torn anal epithelium must be repaired with interrupted or continuous polyglactin (Vicryl™) 2/0 with the knots tied in the anal lumen.

- **Internal anal sphincter** tears must, if identifiable, be repaired separately by end to end approximation with interrupted Polydioxanone (PDS™) 3/0 or polyglactin (Vicryl™) 2/0 sutures.
- The torn ends of the **external anal sphincter** must be identified and grasped with tissue forceps. The muscle is then mobilised and pulled across and repaired "end to end" with 3/0 PDS™ or polyglactin (Vicryl™) 2/0 sutures.
- Perform remainder of repair as for 2nd degree tear.
- A Foley catheter should be placed in the bladder either at the start or at the end of the procedure and should be left in situ for 24 hours.

Post-operative care after repair of third and fourth-degree repairs:

- Paracetamol and/or NSAIDs for pain control. Avoid opiate drugs as they can induce constipation
- Give plenty of oral fluids and if possible fresh fruits and consider a prophylactic stool softener such as docusate sodium 100 mg once daily (if available) to help prevent constipation and wound dehiscence during defaecation.
- Ensure that the wound is washed and patted dry after toileting. The patient should inspect the wound daily
- with the use of a hand mirror for any signs of wound breakdown.
- Perineal hygiene as for first and second-degree tear repairs.
- Follow-up after 6-8 weeks and check anal tone.

Future deliveries

The following advice should be considered following an obstetric anal sphincter injury concerning future pregnancies and mode of delivery?

- Family planning must be offered, and possible avoidance of future pregnancies should be discussed with the patient.
- The role of prophylactic episiotomy in subsequent pregnancies is not known and therefore an episiotomy should only be performed if clinically indicated.
- All women who have sustained anal sphincter injury in a previous pregnancy and who are symptomatic as a result should be counselled regarding the option of elective caesarean birth.

Section E9. Symphysiotomy

Background

Symphysiotomy is performed for the management of cephalo–pelvic disproportion in selected situations in resource-limited countries or ill-equipped obstetric units. It may be required for the delivery of the trapped after-coming head with a breech delivery, or for shoulder dystocia. Symphysiotomy results in a temporary increase in pelvic diameter (up to 2 cm) by surgically dividing the cartilage of the symphysis under local anaesthesia. Symphysiotomy in combination with vacuum extraction can be a life-saving procedure in areas where Caesarean section is not immediately available.

Symphysiotomy leaves no uterine scar, so the risk of ruptured uterus in subsequent pregnancies is not increased. Caesarean section can have high morbidity and mortality rates in resource-limited healthcare facilities. Mortalities of up to 5%, and uterine scar rupture in 7% of subsequent pregnancies, have been reported.

Symphysiotomy has a very low maternal mortality, with 3 deaths reported in a series of 1,752 symphysiotomies. These deaths were unrelated to the procedure.

However, symphysiotomy has risks of complications, which include urethral and bladder injury, infection, pain and long-term difficulty in walking. Therefore, it should only be performed when there is no safe alternative.

Symptoms following symphysiotomy include pain in the symphysis pubis and groin, hip or thigh pain, backache and stress incontinence.

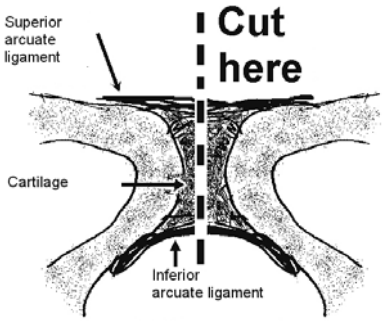


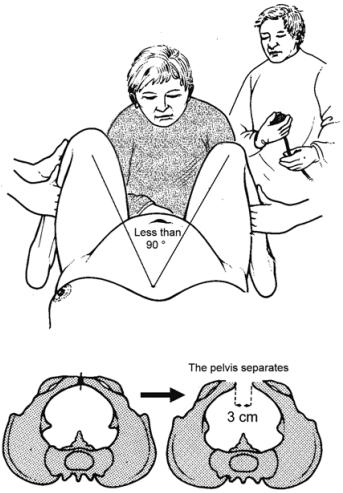
Figure E9.1 *Site of the symphysiotomy incision.*

The majority of mothers (73%) have been reported to have an uncomplicated vaginal delivery in a subsequent pregnancy.

Indications for symphysiotomy

- Trapped after-coming head in breech delivery, in the presence of full cervical dilatation.
- Shoulder dystocia, where all other methods have failed.
- A live fetus with vertex presentation and presumed cephalo–pelvic disproportion (i.e. prolonged second stage, no head descent after adequate augmentation, and failure or anticipated failure of vacuum extraction alone).
- The cervix should be fully dilated, and the head should be at –2 station or below, and no more than 3/5 above the symphysis pubis, with no overriding of the head above the symphysis.

Technique



Figures E9.2 *Legs abducted no more than 45 degrees from vertical.*

Ask two assistants to support the woman's legs with her thighs and knees flexed. The thighs should be **abducted no more than 45 degrees from the midline**. This is McRobert's position, not the lithotomy position.

Do not abduct the thighs more than 45 degrees from the midline as this may cause tearing of the urethra and bladder.

1. Apply antiseptic solution to the suprapubic skin.

2. Infiltrate the anterior, superior and inferior aspects of the symphysis with 1% lignocaine solution,
   and wait for it to take effect.
3. Insert a firm sterile urinary catheter to identify the urethra.
4. Wearing sterile gloves:
   a. Place the index and middle fingers of the left hand into the vagina.
   b. Using the index finger, push and hold the catheter, and with it the urethra, away from the midline to the patient's right side.
   c. The middle finger lies centrally under the symphysis to guide the incision.
5. With the other hand, use a firm-bladed scalpel to make a vertical incision over the symphysis, in the midline, at the junction of the upper and middle thirds.
6. Cut down through the cartilage joining the two pubic bones until the pressure of the scalpel blade is felt on the finger in the vagina.
7. The upper third of the uncut symphysis is used as a fulcrum against which the scalpel is levered to incise the lower two-thirds of the symphysis.
8. The scalpel is then removed and rotated through 180 degrees, and the remaining upper third of the symphysis is cut.
9. Once the symphysis has been divided, the pubic bones will separate.
10. The symphysis should open as wide as the operator's thumb.
11. An episiotomy is required to relieve tension on the anterior vaginal wall. A vacuum extractor can be used to pull the fetus downward at this point.
12. Delivery of the head and trunk of the baby occurs in a downward direction, taking care to avoid the temptation to lift the baby up until it is completely delivered.
13. After delivery of the baby and placenta, the symphysis is compressed between the thumb above and the index and middle fingers below, for several minutes, in order to express blood clots and promote haemostasis.
14. There is no need to close the incision unless there is bleeding.
15. Reinsert the urinary catheter.

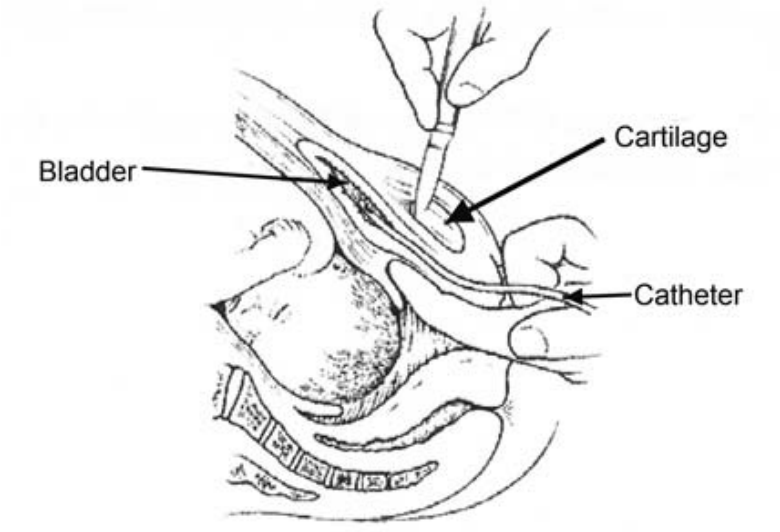


Figure E9.3 *Sagittal view of symphysiotomy.*

Figure E9.4 *The symphysiotomy incision.*

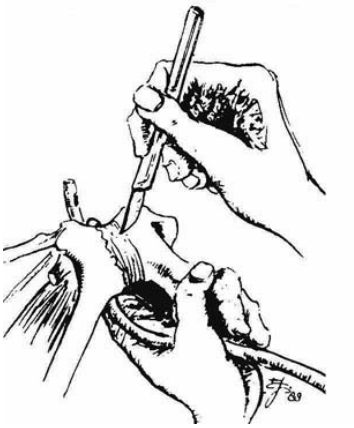
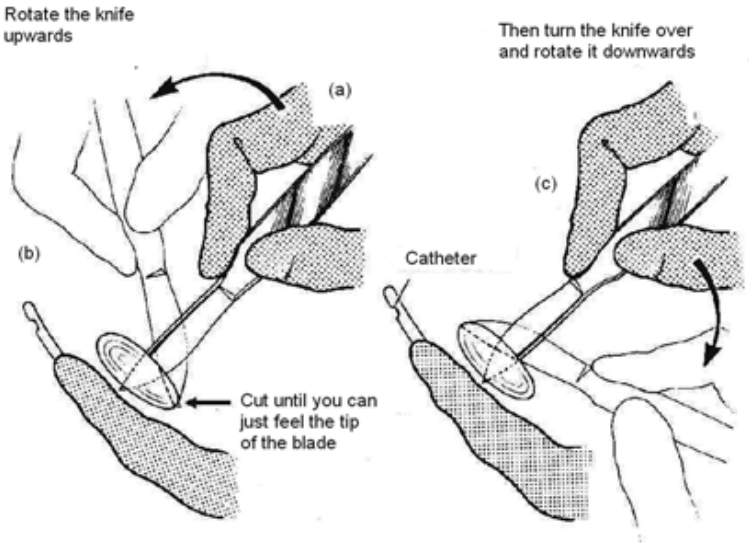


Figure E9.5 *Cutting through the cartilage.*



Post-procedure care

1. If there are signs of infection or the mother has a fever, give a combination of antibiotics until she has been fever-free for 48 hours
    a. Ampicillin 2 grams IV every 6 hours
    b. *plus* Gentamicin 80 mg IV/IM every 8 hours or 5 mg/ kg body weight IV/IM once every 24 hours
    c. *plus* Metronidazole 500 mg IV every 8 hours.
2. Give appropriate analgesia.
3. Apply a binder or sheet or elastic strapping across the front of the pelvis from one iliac crest to the other to hold the pelvis together to aid pelvic healing and reduce pain. Nurse the woman on her side to allow gravity to aid pelvic healing.
4. Leave the urinary catheter in for at least 5 days.
5. Encourage oral fluids to ensure a good urinary output.
6. Encourage bed rest for 7 days after discharge from hospital.
7. Encourage the mother to begin walking with assistance when she is ready to do so.
8. If long-term walking difficulties and pain occur (2% of cases), treat with physiotherapy.

Section E10. Destructive operations

Background

Where fetal death in utero (IUFD) occurs in low-resource settings, vaginal delivery should ideally take place rather than Caesarean section. This is to avoid the associated operative and anaesthetic risks in such settings, as well as to avoid a scarred uterus in future pregnancies.

The longer a dead fetus is left in utero before delivery, the higher the risk to the mother of chorioamnionitis and disseminated intravascular coagulation (DIC).

Spontaneous or induced labour may achieve a normal vaginal delivery of a dead fetus, but failing that, destructive procedures should be considered.

Obstructed labour is one of the commonest causes of maternal death in low-resource settings.

Not uncommonly, the fetus succumbs during labour. Destructive procedures should be considered in that situation.

Consequently, expertise in destructive procedures is essential.

Reasons for IUFD:

1. Strong and continuous contractions (sometimes made worse by maladministration of oxytocic drugs, or administration of non-prescription uterotonic drugs) interfering with placental function
2. Delay in diagnosing and managing obstructed labour
3. During vaginal breech delivery, the after-coming head may be trapped by an incompletely dilated cervix, or may not be deliverable because of cephalo-pelvic disproportion, or extension of the fetal head
4. Prolapsed umbilical cord
5. Ascending infection, leading to chorio-amnionitis, due to prolonged ruptured membranes, and/ or unsterile vaginal examinations
6. Ruptured uterus. Note that a CS will always be needed in this situation.
7. Antepartum haemorrhage due to either placenta praevia or abruption. Note that a CS will always be needed if there is placenta praevia
8. Shoulder dystocia, where management has not been effective
9. Sometimes, IUFD may occur without any evident cause

Destructive operations

These comprise: *Craniotomy, craniocentesis, decapitation,cleidotomy and evisceration*

The fetus must be dead for a destructive procedure to be undertaken

- Ensure that the mother is adequately resuscitated
- Ruptured uterus and placenta praevia must be excluded. An ultrasound scan can be extremely valuable
- Ensure anaesthesia (general or regional), or sedation and analgesia with morphine, midazolam and/or ketamine).

General issues relating to destructive procedures

- The operator must be competent at destructive procedures
- Destructive procedures are most safely done at full cervical dilatation but may be performed when the cervix is 7 cm or more dilated. If there is hydrocephalus, it is best to drain the CSF at diagnosis without waiting for full dilatation, as the hydrocephalic head may cause uterine rupture.
- The bladder must be catheterized, and drainage continued for 24 hours after the procedure
- If there is any possibility of chorio-amnionitis, give triple IV antibiotics
    - Ampicillin 2 grams IV every 6 hours
    - *plus* gentamicin 80 mg IV/IM every 8 hours or 5 mg/ kg body weight IV/IM once every 24 hours
    - *plus* metronidazole 500 mg IV every 8 hours.

Craniotomy

Craniotomy is used for the delivery of a dead fetus with cephalic presentation, when labour is obstructed. The head may be impacted in the pelvic brim. If the head is mobile, craniotomy may be difficult and Caesarean section may be safer (if circumstances are suitable).

The head may need to be dis-impacted from the pelvis to facilitate urinary catheterisation.

A 3 cm incision is made on the posterior aspect of the skull using Mayo scissors. The index finger of the left hand is inserted into the incision and the suture and fontanelle are identified. The scissors are then pushed though the fontanelle into the cavity of the skull. Thereafter, the brain is evacuated, and Kocher's forceps are clamped on to the edges of the parietal bones. A weight is attached to the Kocher's forceps with a length of bandage. The mother's legs are taken out of the lithotomy stirrups and placed on two stools for support. Delivery will take place

within a period ranging from a few minutes to several hours. This method can be used when the cervix is at least 8 cm dilated.

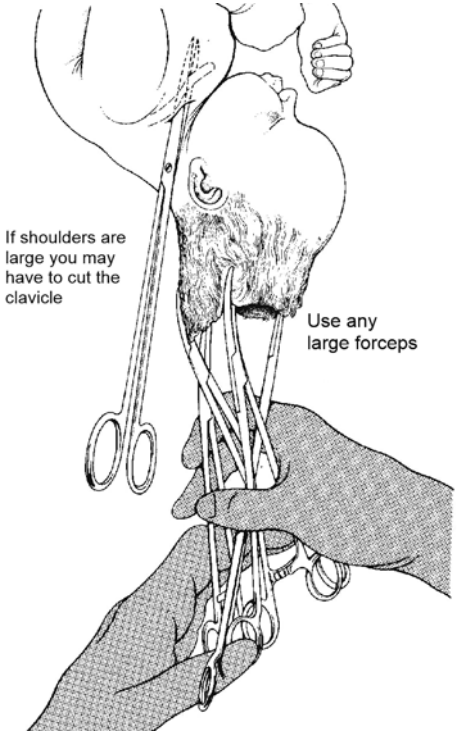


Figure E10.1 *Craniotomy. This baby's skull has been opened and the brain removed.*

Figure E10.2 *X-shaped fetal skull incision.*

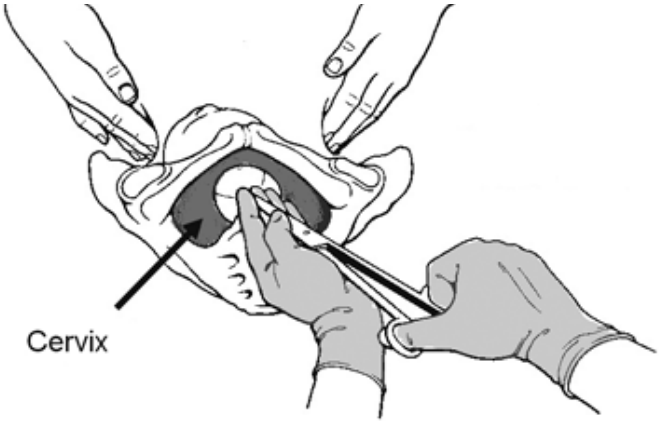


Figure E10.3 *Perforating the skull: the assistant is pushing the baby's head into the mother's pelvis. An X-shaped incision has been made in the skin of the baby's scalp. A suture line has been identified and a strong pair of scissors have been inserted through it.*

Breech presentation with an entrapped head and dead fetus

- Make an incision through the skin at the base of the fetal neck
- Insert a craniotome (or large pointed scissors or a heavy scalpel) through the incision and tunnel subcutaneously to reach the occiput
- Perforate the occiput and open the gap as wide as possible
- Apply traction on the trunk to collapse the skull as the head descends

Hydrocephalus: cardiocentesis where obstructed labour and dead fetus

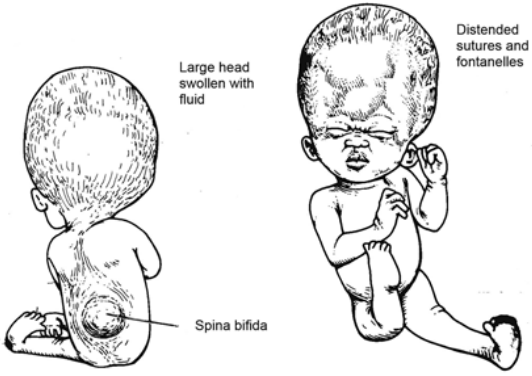


Figure E10.4 *Hydrocephalus. A child with one abnormality may have several others as well.*

Craniocentesis with a fully dilated cervix

- Pass a large-bore spinal needle through the dilated cervix and the sagittal suture line or fontanelles of the fetal skull (*see* Figure E10.5)
- Aspirate the cerebrospinal fluid until the fetal skull has collapsed. Then allow normal delivery to proceed

Craniocentesis with a closed cervix

- Palpate for the location of the fetal head
- Apply antiseptic solution to the suprapubic skin
- Pass a large-bore spinal needle through the abdominal and uterine walls and through the hydrocephalic skull
- Aspirate the cerebrospinal fluid until the fetal skull has collapsed. Then allow vaginal delivery to proceed

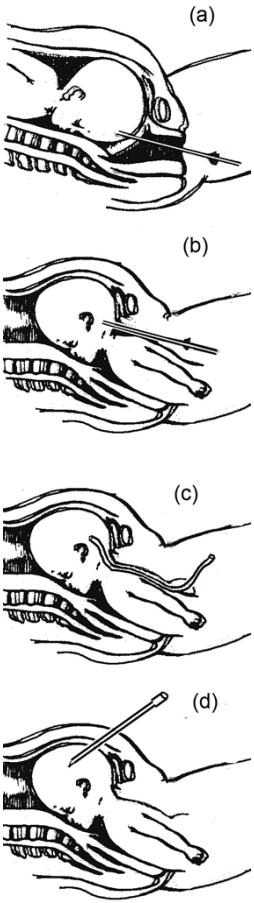


Figure E10.5 *Draining a hydrocephalus.*
(a) Draining the vertex. (b) Draining the occiput.
(c) Draining through a meningo-myelocele.
(d) Draining through the mother's abdomen.

- Where there is hydrocephalus and accompanying spina bifida, CSF can also be withdrawn by exposing the spinal canal and passing a catheter into the canal and up into the cranium. Alternatively, the hydrocephalic head can be decompressed trans-abdominally using a spinal needle. (see Figure E10.5 c)

Craniocentesis in breech where the delivery of the hydrocephalic head has become obstructed and the fetus is dead

- When the rest of the body has been delivered, insert a large-bore spinal needle through the dilated cervix and foramen magnum.
- Aspirate the cerebrospinal fluid and deliver the after-coming head as in breech delivery.

Decapitation

This procedure is summarised in Figure E10. 6.below

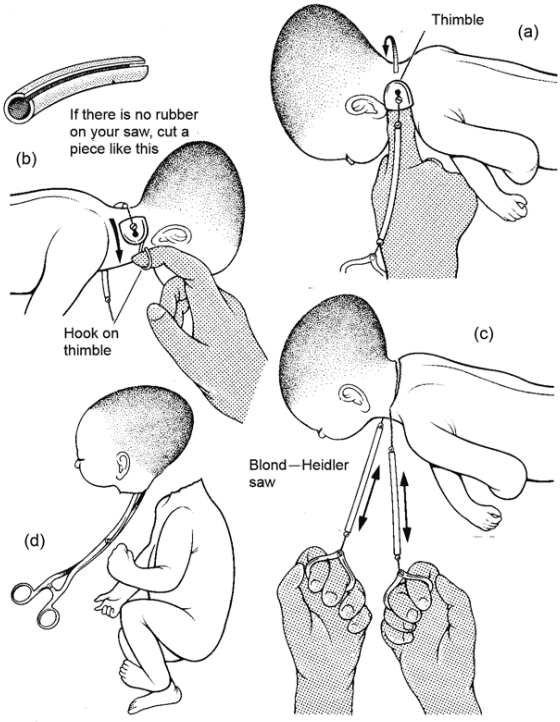


Figure E10.6 *Decapitation of dead fetus. (a) Fix the saw to the thimble and push it over the neck. (b) Remove the thimble and fix the handles to each end of the saw. (c) Saw to and fro. (d) Grasp the stump of the neck.*

In cases of neglected obstructed labour with shoulder presentation and a dead fetus, decapitation is the treatment of choice. The lower uterine segment may be distended due to obstructed labour and is consequently vulnerable to trauma.

If the fetus is small, the neck can easily be severed with stout scissors. However, for the larger fetus, where the neck is not easily accessible, the Blond–Heidler decapitation tool is probably the safest instrument (see Figure 72. 6). If possible, an arm of the fetus is brought down in order to facilitate access and exposure of the neck. The saw is threaded around the fetal neck, and by keeping the handles at the ends of the saw close together, injury to the vagina is prevented and the neck can be severed with a few firm strokes. Delivery of the trunk is straightforward, and the after-coming head is delivered by grasping the stump with a heavy vulsellum forceps.

Cleidotomy

Cleidotomy, division of one of the clavicles, is indicated where the impacted shoulders of the dead fetus prevent delivery. The most accessible clavicle is divided first **using** stout scissors.

Evisceration

This is sometimes necessary for an abdominal tumour, or for a very large fetus following craniotomy. An incision is made in the abdomen or thorax. The viscera are then extracted digitally. Once the bulk of the fetus has been reduced, the fetus can be extracted easily.

Complications of destructive procedures

Instruments or sharp pieces of bone may cause a vesico- vaginal fistula. The vagina, cervix and perineum must be carefully examined after these procedures.

Alternative to destructive operations

Caesarean section may be preferred, if available, especially if the operator is inexperienced in performing destructive procedures. However, Caesarean section will create a risk for scar rupture during a subsequent pregnancy, and in low-resource settings, this could result in maternal and fetal death.

Post-procedure care

- After delivery, examine and repair any tears to the cervix or vagina, and/or undertake episiotomy repair.
- Leave a self-retaining catheter in place until bladder injury has been excluded.
- Ensure adequate fluid intake and urinary output.
- Consider a course of antibiotics.

Section E11. Obstetric hysterectomy (peri-partum hysterectomy)

Introduction: see video at this link:
https://www.youtube.com/watch?v=7kbhRhLBeU4

Hysterectomy is a relatively uncommon procedure in obstetric practice. However, it is crucial that midwives, obstetricians, obstetric clinicians and anaesthetists are aware that this major operation may be required as a life-saving procedure.

The range of prevalence is wide (0.2–5.4/1000), with the higher figures usually found in low-resource countries. Maternal mortality in one review (Baskett TF) was documented to have a wide range, from zero to 23.8%, with deaths tending to occur in, but not limited to, low-resource areas. Severe maternal morbidity was high in all reports and manifested by disseminated intravascular coagulation (DIC), injuries to the bladder and ureter, re-operation, sepsis and the need for intensive care.

This document provides an outline of the indications for obstetric hysterectomy, as well as technical details of the procedure, and other related issues.

Indications for obstetric hysterectomy

Obstetric hysterectomy generally takes place very shortly after delivery. It may follow Caesarean section or vaginal delivery, either spontaneous or assisted. There is a history of Caesarean deliveries in both the index and previous pregnancies.

Obstetric hysterectomy may be indicated where there is uterine rupture or trauma, uterine atony, especially when accompanied by DIC, morbidly adherent placenta (usually placenta praevia and/or accreta), or severe sepsis.

Taking each of these indications in turn:

Uterine rupture /trauma (see Section A+4)
Traumatic rupture, that is perforation or laceration of the uterus, can occur with a variety of obstetric manipulations, including internal version and breech extraction, especially in obstructed labour; instrumental manipulation, such as the classical application of the anterior blade of Kielland's forceps; manual exploration of the uterus and manual removal of the placenta or its fragments after obstructed labour with a ballooned and thin lower uterine segment; and during curettage for secondary postpartum haemorrhage.

Caesarean section in the second stage of labour with the fetal head deeply impacted in the vagina may be associated with lateral extension of the lower uterine segment

incision into the major vessels. This is more likely if the surgeon has used a straight line as opposed to a curved or 'smile' incision. On occasions, the extent of this tear may necessitate hysterectomy, especially if one or both uterine arteries are lacerated and a hematoma obscures the surgical repair.
Some other causes include abnormal lies (for example transverse lie), even with an intact uterus.

Use of local topical herbs in Liberia, called chalk, that have been seen to actually cause uterine hyperactivity (research is required to find out the pharmaceutical agent responsible).

Uterine rupture may also be caused by direct abdominal trauma, such as in a motor vehicle accident or intimate partner violence. In Liberia, it more commonly occurs during labour (or occasionally pre-labour), in the presence of one or more previous Caesarean Section (CS) scars, particularly common after Classical CS.

In addition, rupture of the intact uterus can occur in multiparous women in response to inappropriate use of oxytocic agents or lack of adequate monitoring during treatment with oxytocic agents in the first and second stages of labour.

In remote areas with limited resources (much of rural Liberia), uterine rupture can occur in obstructed labour, especially in multiparous women, and where there is delay in reaching a hospital where comprehensive EmOC is available.

Uterine rupture generally presents with severe abdominal pain with signs of shock, with or without vaginal bleeding. The main differential diagnosis is major placental abruption. It may be difficult to distinguish these two serious conditions, but the presence of haematuria, plus or minus abnormal fetal lie with easily palpable fetal parts, will point to a diagnosis of uterine rupture.

Although detection and diagnosis is relatively straightforward for anterior uterine rupture, it is more difficult to diagnose when it involves the posterior wall. Posterior ruptures, in most cases, mimic abruptio placentae in their presentation, with no easily palpable fetal parts, but just a tender uterus, usually with absent fetal cardiac activity. This can confuse practitioners, and hence be a major cause of fatality.

Fetal distress may occasionally be the first sign of uterine rupture, due to reduced perfusion of the fetoplacental unit.

Factors predisposing to uterine rupture include multigravidity; prolonged, induced or augmented labour; previous Caesarean section or myomectomy; cephalopelvic disproportion, malposition and malpresentation.

It is important to remember that previous classical (upper uterine segment) Caesarean section carries a significantly higher risk of uterine rupture than does transverse lower segment Caesarean section. Crucially, rupture of the classical uterine scar may occur in the third trimester of pregnancy, before the onset of labour.

Uterine rupture may be suspected either during labour, or soon after vaginal delivery. In either case, urgent preparation for laparotomy should take place, at the same time as carrying out resuscitation and ordering at least four units of cross- matched, whole, and ideally fresh, donor blood for transfusion.

The abdomen may be opened by either a midline incision or a curved transverse suprapubic incision, depending on the presence of previous scars and the surgeon's preference. Either way, speed is of the essence.

Once the abdomen is open, the presence and extent of uterine rupture can be assessed. There may be more than two litres of fresh blood in the peritoneal cavity, with ongoing bleeding from the traumatised uterus.

It is important to mention here the distinction between uterine rupture and uterine scar dehiscence, to avoid errors of classification. Uterine scar dehiscence may occur in the presence of a previous lower segment Caesarean section, where the musculature of the uterine scar gradually pulls apart in the third trimester, leaving only serosa and visceral peritoneum covering the amniotic sac. Dehiscence may be an incidental finding at Caesarean section, with intact and relatively avascular myometrial edges. Haemorrhage and fetal distress are generally not associated with dehiscence.

Uterine atony (see Section A+11)
Uterine atony is a common occurrence after all types of delivery, be it vaginal or Caesarean.

Predisposing factors include; multiparity; fetal macrosomia; polyhydramnios; precipitate labour; prolonged labour; placenta praevia; abruptio placentae with Couvelaire uterus (in which blood seeps between the fibres of the myometrium, inhibiting contraction; retained placenta, or retained fragments of placenta or membranes.

Uterine atony can cause massive haemorrhage, due to the absence of the physiological compression of the uterine vasculature by the fibres of the myometrium.

In all cases of uterine atony, the standard resuscitation procedure should be followed, including rubbing up a uterine contraction while calling for help and carrying out assessment and management of CABC: Control bleeding, Airway, Breathing and Circulation.

The four main causes of massive obstetric haemorrhage should be considered and addressed, namely atony, retained products, trauma, and coagulation problems.

There are times when uterine atony is refractory to all standard treatments. This may occur with prolonged, augmented and/or obstructed labour. Simply stated, the exhausted and infected uterus may be incapable of responding to oxytocic agents.

Where haemorrhage continues, and where pharmacological and medical interventions (for example uterine tamponade procedures) are ineffectual, obstetric hysterectomy should be undertaken without delay. This is especially true if DIC is contributing to the intractable haemorrhage. Urgent transfusion with fresh donor blood is required, to ensure that the opportunity for saving the woman's life is not missed.

Morbidly adherent invasive placenta (Section A+10)

This descriptor comprises placenta accreta, placenta percreta and placenta increta. These conditions are distinguished by the depth of adherence of the placenta to the uterine myometrium, any penetration of the uterine wall, and any involvement of other organs, notably the bladder.

Sepsis (Section A+14)
In well-resourced settings, sepsis is rarely a reason for emergency hysterectomy. However, in low resource settings such as Liberia, it still may be necessary in cases with extensive uterine sepsis, particularly with clostridial infections and myometrial abscess formation+/- pyometra. Antibiotic treatment may have been started too late, or not at all. Sometimes, hazardous counterfeit antibiotic drugs may have been supplied, which, of course, fail to control the infection.

Other septic causes of secondary PPH include Caesarean scar infection and necrosis, uterine trauma and infection, and endometritis associated with retained placental fragments.

Informed consent to obstetric hysterectomy

Consent must be sought from the patient. However, it may be impossible to seek informed consent for obstetric hysterectomy, as the woman may already be anaesthetised for Caesarean section, or she may have a reduced conscious level as a result of shock and blood loss.

In such situations, the surgeon and anaesthetist must act in the patient's best interests. Wherever possible, the next of kin should be kept informed.

Wherever possible, ensure that the patient understands that she will not be able to become pregnant again, and will not have periods.

Essential anatomy needed to understand how to do obstetric hysterectomy

Figure E11.1 *Posterior view of the pelvic anatomy*

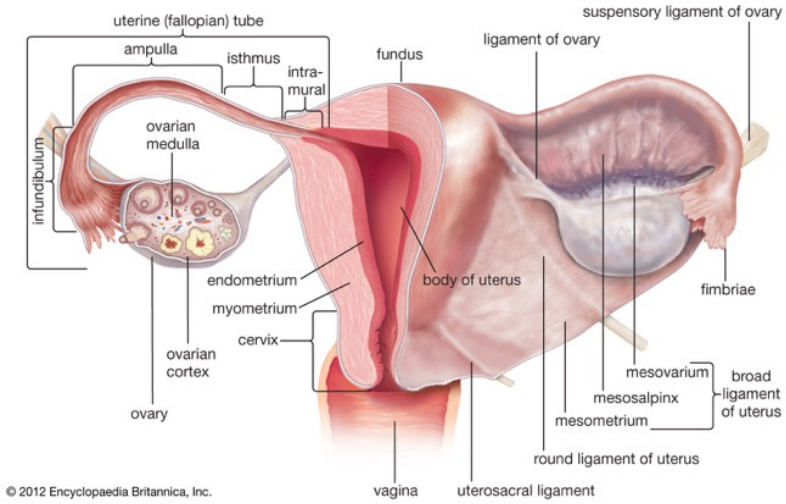
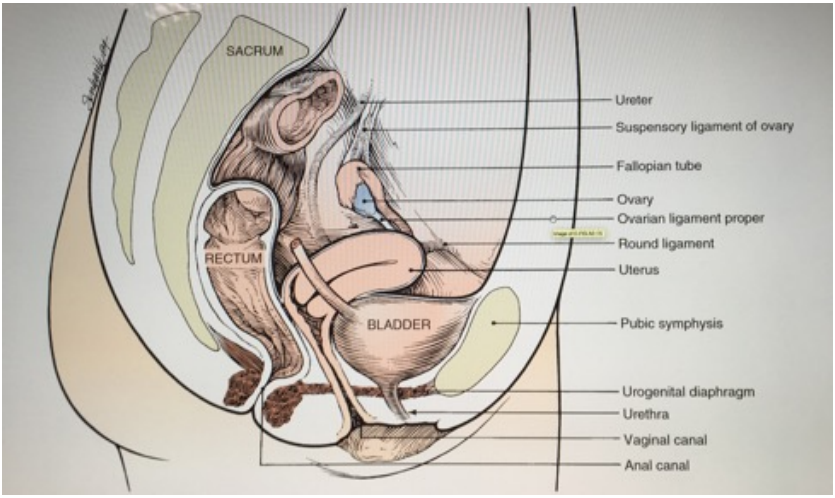


Figure E11.2 *A sagittal section showing the bladder's position anterior to the uterus.*

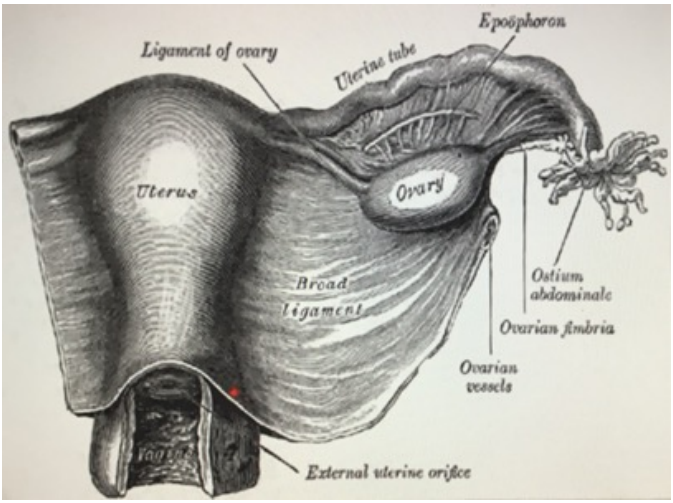


The uterus is composed of the cervix, the isthmus, the corpus and the fundus. Note that in the non-pregnant state the peritoneal reflection of the bladder occurs at the level of the uterine isthmus.

However, the utero-vesical fold of peritoneum, which lies between the bladder and the uterus, moves upwards and covers the uterine lower segment in the third trimester of pregnancy.
This fold may lie higher and may be adherent to the uterus and the bladder, in women who have had one or more previous Caesarean sections. It is very important to be aware of this when undertaking obstetric hysterectomy, repeat Caesarean section or repair of uterine rupture.

The broad ligament (Figure E11.3) contains the uterus, like a sheet over it, and forms an anterior and posterior covering. The triangular space along the lateral uterine wall lies between the leaves of the broad ligament.

Figure E11.3 *A posterior view showing the draping of the broad ligament over the uterus and stretching out to the pelvic wall*



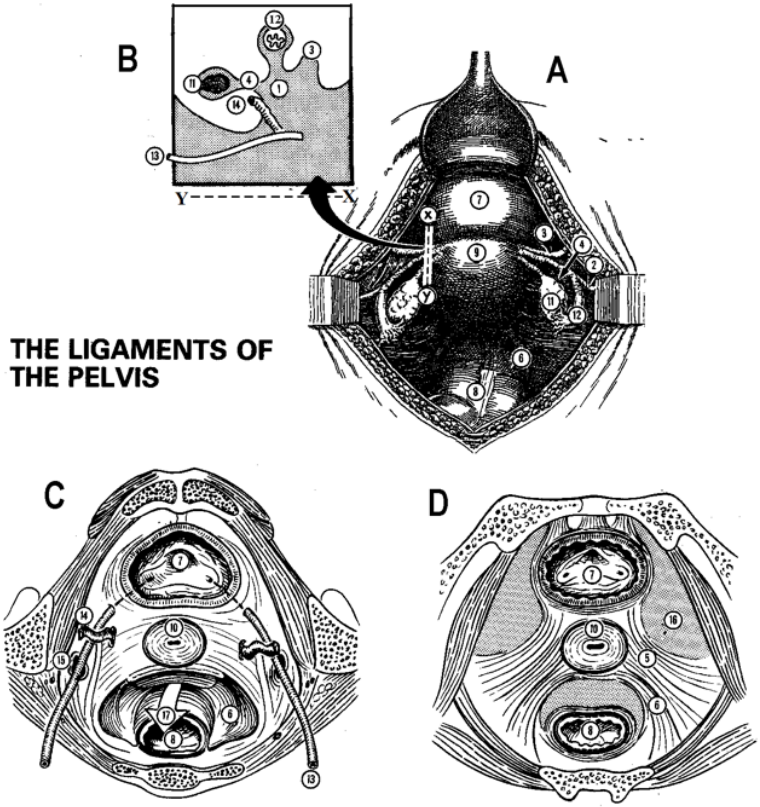
The rectum lies posterior to the uterus. The space between the rectum and uterus, which is covered in peritoneum, is known as the Pouch of Douglas. Adhesions in this area are less commonly encountered in obstetric surgery than are anterior adhesions. However, they may exist as a result of endometriosis, previous bowel surgery, or previous pelvic inflammatory disease.

For obstetricians and obstetric clinicians, a ‘ligament’ is a fold of peritoneum, or a local thickening of the pelvic connective tissue.
Knowing the positions and structure of ligaments is important when undertaking hysterectomy (Figure E11.3 and E11.4)

(1) The broad ligament is a fold of peritoneum running from the Fallopian tubes towards the floor of the pelvis. The ureter and the uterine artery lie in the base of the broad ligament; vessels run around its edge, and its middle is avascular.
(2) The infundibulo-pelvic ligaments are folds of tissue which run from the lateral ends of the fallopian tubes to the pelvic wall. Their importance is that the ovarian vessels run in them.

(3) The round ligaments are folds of peritoneum and fibrous connective tissue, which run from the uterus close to its junction with the tubes, antero-laterally towards the brim of the pelvis. They are really anterior folds or leaves in the broad ligaments, and they have a role in supporting the uterus.
(4) The ovarian ligaments support the ovaries and hang off the back of the broad ligaments.
(5) The cardinal (transverse cervical) ligaments are thickenings of the pelvic connective tissue which run laterally from the cervix to the sides of the pelvis.
(6) The utero-sacral ligaments run from the lower segment of the uterus to the sacrum on each side of the rectum. They are, in effect, the posterior edges of the cardinal ligaments.

Figure E11.4 *The ligaments of the pelvis*



A, View through a laparotomy, looking down into the pelvis with the bladder at the top of the illustration. B, a sagittal section of part of the pelvis along line YX. C, a section through the pelvis, parallel with the pelvic brim. (i.e. the pelvic inlet at the level of the sacral promontory and the symphysis). D, the main supporting ligaments of the pelvis viewed from above.

(1) the broad ligaments. (2) the infundibulo-pelvic ligaments. (3) the round ligaments. (4) the ovarian ligaments.

(5) the cardinal (transverse cervical) ligaments. (6) the utero-sacral ligaments. (7) the bladder. (8) the rectum. (9) the fundus of the uterus. (10) the cervix. (11) the ovaries. (12) the Fallopian tubes. (13) the ureters. (14) the uterine arteries. (15) the veins of the pelvis. (16) fat filling the odd spaces in the pelvic connective tissue. (17) the arrow shows how an opening can be made from the posterior fornix into the pouch of Douglas.

*A, after Young, J. A Textbook of Gynaecology, A&C Black, 5th ed 1939. C, after Last RJ. Anatomy, Regional and Applied.Churchill Livingstone 5th ed 1972 D, after Jeffcoate TNA. Principles of Gynaecology. Butterworths 3rd ed 1967***.**

It is most important to recognise, and avoid cutting, the ureters during pelvic surgery (Figures E11.5. E11.6 and E11.7). The uterine arteries lie adjacent to the lower uterine segment and the cervix, and they are very close to the ureters. It is important to be aware of this when undertaking obstetric hysterectomy.

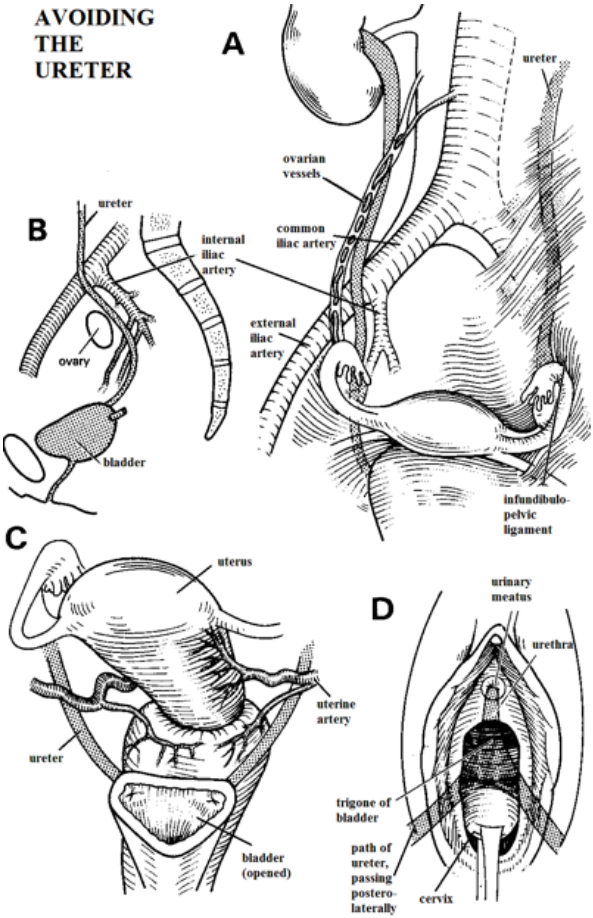


Figure E11.5 *avoiding the ureter*
A, notice how the ovarian vessels pass in front of the ureter. B, the ureter passes over the pelvic brim, (i.e. the pelvic inlet at the level of the promontory of the sacrum and the pubic symphysis), just after the common iliac artery has divided into its internal and external iliac branches. C, the ureter passes close round the vault of the vagina under the uterine artery (remember this by 'water under the bridge'). D, the relation of the urethra, the trigone of the bladder (a smooth surface delimited by the openings of both ureters and the urethra) and the ureters when you retract the cervix. After Garrey MM. Gynaecology Illustrated Churchill Livingstone, 1977, p.308-9.

Figure E11.6. *Posterior view of a pregnant pelvis showing sites for uterine and uterine-ovarian ligature of arteries in a case of a PPH.*

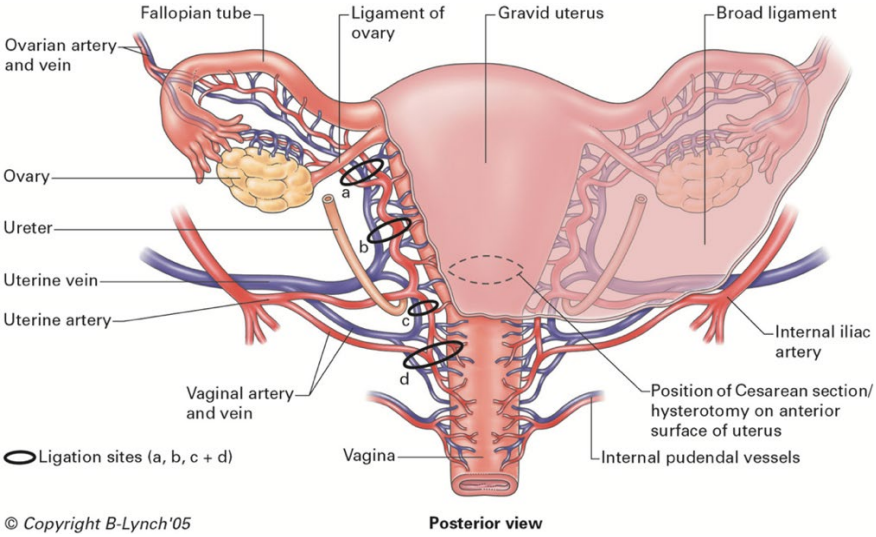
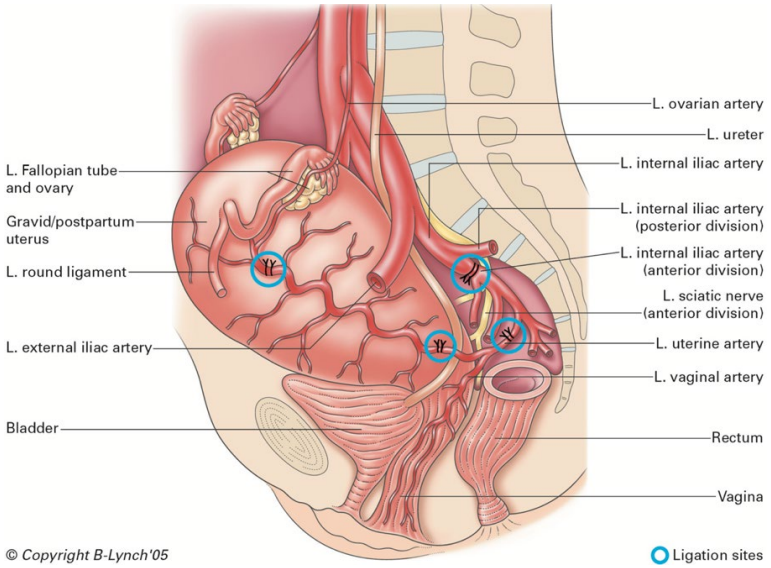


Figure E11.7 *Sagittal view of the vasculature of the pregnant uterus*



Technical aspects of obstetric hysterectomy

The surgical concerns are as follows:

1. The view of the operative field is often obscured by large volumes of blood, which may inhibit identification of the site of any uterine rupture.

2. The uterus is larger and more hypotonic than in the non-pregnant woman, and the tissues are likely to be more friable and oedematous, making suturing difficult.

3. The uterine and ovarian vessels are enlarged and distended.

4. Identification of the ureters may be compromised by the distorted anatomy as well as by the presence of blood, thereby making inadvertent ligation or transection of the ureters a particular hazard.

5. If the bladder has been damaged in the process of uterine rupture, it will require repair once the uterus has been removed.

6. Occasionally, uterine rupture may be amenable to repair by suturing, thereby conserving the uterus. Whilst the surgical risks associated with this procedure are less than with a hysterectomy, the woman will have a high risk of uterine rupture in subsequent pregnancies. She must be advised to undergo elective Caesarean section in her next pregnancy, preferably preceded by residence in a hospital or antenatal waiting home in the third trimester.

Total versus sub-total hysterectomy

Hysterectomy in the non-pregnant woman is generally carried out as an elective procedure, allowing time to consider and discuss the pros and cons of removal or conservation of the cervix.

This is clearly not the case with obstetric hysterectomy, which generally takes place as a life-saving procedure.

Whilst removal of the cervix virtually eliminates the risk of subsequent cervical carcinoma, and obviates the need for cervical screening, this is very much a secondary consideration at the time of emergency obstetric hysterectomy.

Subtotal hysterectomy, where the cervix is left in situ, is the method of choice at obstetric hysterectomy, for two reasons:

Firstly, it may be extremely difficult to distinguish the cervix from the lower uterine segment and the vagina, particularly at full cervical dilatation.

Secondly, the risk of ureteric damage is increased by attempts to remove the cervix, especially when the operative field is obscured by haemorrhage.

However, where cervical trauma, plus or minus upper vaginal trauma, occurs, perhaps as a result of Caesarean or operative vaginal delivery, removal of the cervix may be necessary in order to arrest the haemorrhage.

In all cases, the ovaries should be conserved wherever possible.

Pre-operative actions
Set up an IV infusion and have blood cross-matched (ideally fresh blood, and at least 4 units).

Broad spectrum triple IV antibiotics are essential and should be given when the decision for hysterectomy is made.

A urethral catheter must be in place. Compress the bladder supra-pubically to make sure it is empty, and leave the catheter in the bladder for continuous drainage.

Clean the vagina and cervix with aqueous iodine or chlorhexidine solution.

It may be easier to stand and operate from the patient's left side if you are right-handed.

Abdominal entry where hysterectomy is undertaken without prior Caesarean section

If there is uncontrollable haemorrhage **following vaginal delivery**, speed is essential.

If the indication is abdominal trauma, with the possibility of injury to abdominal organs including bowel, liver and spleen, then a lower midline incision is preferable, as it can be extended upwards in order to access the abdominal contents. An experienced surgeon should be present in any situation where bowel or bladder injury or involvement is suspected.

To open the abdomen:
1. Make a midline vertical incision below the umbilicus to the pubic hair, through the skin and to the level of the fascia;
2. Make a 2–3 cm vertical incision in the fascia;
3. Hold the fascial edge with forceps and lengthen the incision up and down using scissors;
4. Use fingers or scissors to separate the rectus muscles (abdominal wall muscles);
5. Use fingers to make an opening in the peritoneum near the umbilicus. Use scissors to lengthen the incision up and down in order to see the entire uterus.

Carefully, to prevent bladder injury, use scissors to separate layers and open the lower part of the peritoneum;

6. Place a bladder retractor over the pubic bone and consider placing self-retaining abdominal retractors.

If the indication for hysterectomy is uterine atony, or the presence of an abnormally invasive placenta, then a transverse curved suprapubic incision may be appropriate. However, in an emergency, especially in a low resource setting, a vertical incision is now favoured.

Make sure that the incision is long enough, and that you have divided the rectus sheath and muscles as far as the symphysis pubis. (An extra 1cm at the bottom is worth 5cm at the top).

Abdominal entry where hysterectomy is undertaken following Caesarean section

The abdomen may already have been opened for Caesarean section in which case the obstetric hysterectomy should be performed through that incision. However, if there needs to be better access, the suprapubic incision can be extended vertically.

Intra-abdominal procedures

1. There is a relationship between the duration of time that passes prior to deciding to perform an emergency hysterectomy, the amount of blood loss, and the likelihood of coagulopathy. As a result, severe hypovolemia, tissue hypoxia, hypothermia, and acidosis further compromise the patient's status. Timing is critical to an optimal outcome: hysterectomy should not be left until it is too late.

2. Where atony exists with an intact uterus, there will be little, if any, intra-abdominal bleeding encountered. However, where uterine rupture has occurred, or where there has been extensive tearing during Caesarean section, there will be large quantities of blood in the abdominal cavity, which may obscure the operative field.

3. After the fetus has been delivered, the uterus can be quickly closed with a running lock stitch of 0 absorbable suture such as Vicryl. Re-approximating the myometrium optimizes uterine contractility and decreases the occurrence of uterine atony.

4. If there is considerable bleeding from the placental site, the uterus can be packed with one or two laparotomy swabs before uterine closure; this may serve to tamponade the bleeding. Remember to document that these swabs are in situ; they will need to be removed when the patient’s condition has improved.

5. The placenta will generally have been delivered before a decision is made to carry out obstetric hysterectomy. However, if a morbidly adherent placenta is suspected, it should be left in situ, as attempting to remove it piecemeal will lead to rapid and intractable haemorrhage.

6. Careful use of suction should take place.

7. Red blood cell salvage, with subsequent auto-transfusion, should be utilised wherever feasible (see Section A+6). This is not available in most hospitals in Liberia at present.

8. Where there is ongoing major haemorrhage, especially with shock, the immediate priority is to arrest the haemorrhage, via obstetric hysterectomy. Clamping the uterine and ovarian vessels takes priority over actions such as suction or packing. Pedicles should be rapidly clamped and cut and sutured later.

9. Additional immediate manoeuvres to stop haemorrhage depend on the causes.

10. In cases of uterine rupture, Green-Armitage clamps or sponge forceps can be used to compress the bleeding edges of torn uterine muscle.

11. In cases of massive bleeding, it may be helpful temporarily to have an assistant press his/her fist over the aorta, until haemorrhage from the uterus is under control.

12. When the patient is haemodynamically stable, obtaining adequate exposure and careful uterine traction will minimize vascular or ureteric injury.

13. The skin incision may be extended if necessary.

14. The ureters are most closely approached and vulnerable at three points during the dissection in subtotal hysterectomy: the infundibulopelvic ligament ligation site (when adnexal structures are removed), the uterosacral ligament dissection, and the uterine vascular and cardinal ligament pedicles.

15. The most important principle in approaching the ureter in caesarean hysterectomy cases is direct visualization. Without direct visualization, the ureter, which can inadvertently be lifted into the operative field, can be ligated or transected.

16. The ureter is avoided at the level of the uterine artery and cardinal ligament pedicles by placing the clamps exactly against the lateral wall of the uterus and cervix. Never place additional clamps lateral to the uterine clamps or pedicles.

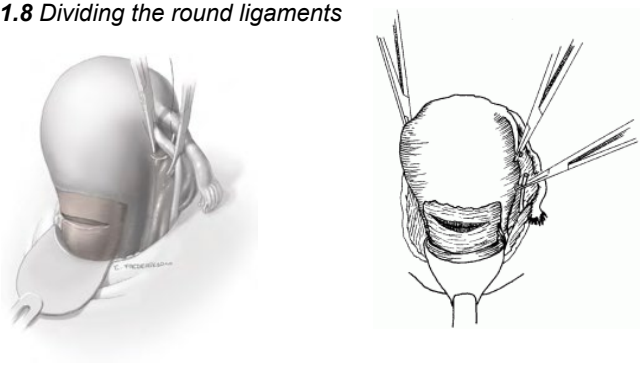
17. When the uterosacral ligament is divided as a separate pedicle, it must be carefully identified and accurately clamped and ligated without endangering the ureter, which passes just lateral to this dissection. This clamp must always be placed medially to the uterine pedicle or clamp.

Surgical technique A Based on latest WHO guideline

1. Lift the uterus out of the abdomen and gently pull to maintain traction.

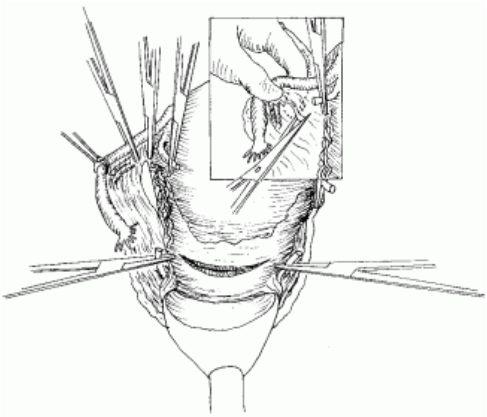
2. Doubly clamp (Kocher) and cut the round ligaments with scissors (Figure E11.8). Care should be taken to place the tips of the clamps in the avascular portion of the broad ligament to avoid lacerating the artery of the round ligament (Sampson's artery). Clamp and cut the pedicles, but ligate after the uterine arteries are secured, to save time.

Figure E11.8 *Dividing the round ligaments*



3. From the edge of the cut round ligament, put your hand behind the uterus and push a finger through the broad ligament under the tube and out through the divided round ligament. You now can surround, with your fingers, the fallopian tube and the ovarian vessels, and can clamp and divide them safely. Alternatively, use two fingers to push the posterior leaf of the broad ligament forward, just under the tube and ovary, near the uterine edge. Make a hole the size of a finger in the broad ligament, using scissors. Doubly clamp and cut the fallopian tube, the ovarian ligament and the broad ligament through the hole in the broad ligament (Figure E11.9).

Figure E11.9 *Dividing the tube and ovarian ligaments*



The posterior leaf of the broad ligament adjacent to the uterus is perforated just beneath the fallopian tube, utero-ovarian ligaments, and ovarian vessels. The utero-ovarian ligament and fallopian tube are clamped and cut bilaterally.

Long Spencer Wells clamps are placed on either side of the uterus, medial to the broad ligaments. Long straight clamps, such as Zeppelin or Rogers, are then placed at approximately 45 degrees to the uterus on either side, and the broad ligaments are incised, to create the ovarian pedicles. Later, after transfixing and tying these pedicles, independent ties should be used to ensure optimal haemostasis.

4. Open the anterior leaf of the broad ligament. Incise to:
- the point where the bladder peritoneum is reflected onto the lower uterine surface in the midline; or
- the incised peritoneum at a caesarean section.
The ureters are very close to the uterine vessels (Figures E11.5 to E11.7 earlier). The ureter must be identified and exposed to avoid injuring it during surgery or including it in a stitch.

5.Posteriorly, the broad ligament is incised laterally and parallel to the infundibulo-pelvic ligament to expose the retroperitoneum. The loose areolar tissue encountered in this space, which is more pronounced than usual because of the enlarged uterus, can be carefully dissected parallel to the course of the ureter. This allows visualization of the retroperitoneal space and the ureter throughout its course.
The utero-vesical fold is then accessed by placing the curved scissors under the visceral peritoneum medial to one of the ovarian pedicles, and developing that plane medially, towards the opposite side. The bladder must then be pushed well down,

starting centrally and working laterally to right and left, as this will help to ensure that the ureters are out of harm's way.

6. Using fingers or scissors, dissect the bladder downwards off the lower uterine segment. Direct the pressure downwards but inwards toward the cervix and the lower uterine segment.

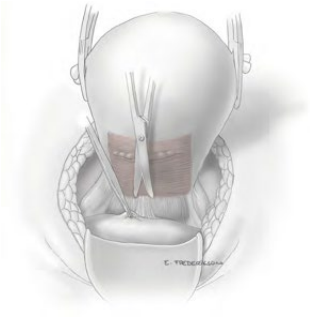


Figure E11.10 *The bladder is dissected from the lower uterine segment.*

Before approaching the uterine arteries, the bladder must be dissected free and displaced below the operative field. Because most patients undergoing cesarean hysterectomy have had previous surgery, significant adhesive disease is frequently encountered; as a result, sharp dissection is sometimes the technique of choice. It is extremely important to avoid lateral dissection into the highly vascular bladder pillars. It is also wise not to extend the dissection farther than is necessary to safely ligate the uterine arteries, because excessive dissection can cause additional bleeding and waste time.

7. Locate the uterine artery and vein on each side of the uterus. Feel for the junction of the uterus and cervix. (Figure E11.1 and E11.12)

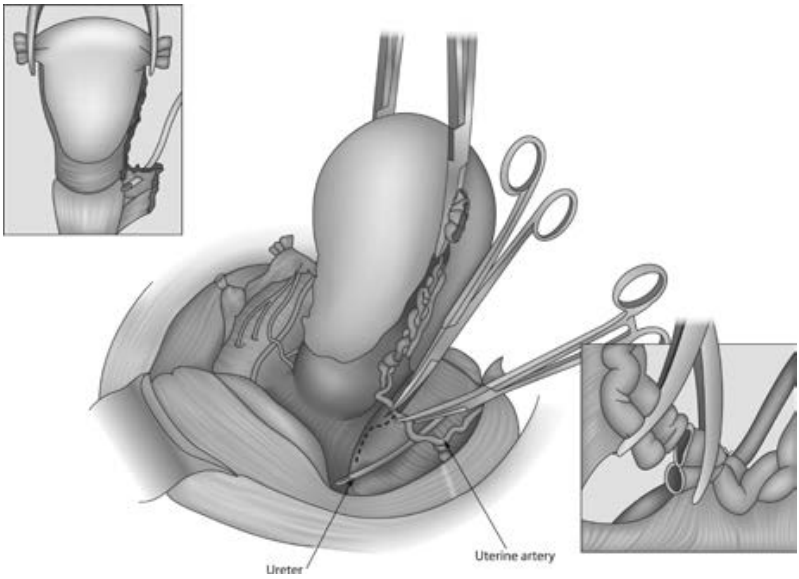
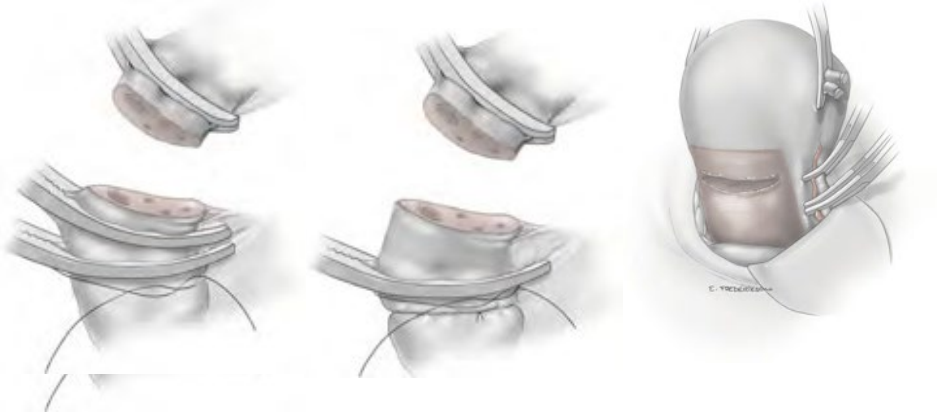


Figure E11.11 *Abdominal hysterectomy and the relationship of the uterine vessels. The ureters usually lay 2 cm lateral to the uterine artery but may be closer. Care must be taken during the ligation of the uterine arteries to avoid the ureters.* From Uptodate Abdominal Hysterectomy, 2011 Stovall TG, Mann

Figure E11.12 *The uterine artery and veins on either side are doubly clamped*



Clamps (such as Rogers or Zeppelin clamps) are then placed on either side of the uterus, keeping the tips of the clamps as near as possible to the uterus. After incising the uterine pedicles, they are sutured and tied, and independent ties are then placed in order to maximise haemostasis.

Doubly clamp across the uterine vessels at a 90-degree angle on each side of the cervix immediately adjacent to the uterus at the junction between the cervix and the uterus. The use of a second clamp on the uterine side reduces back-bleeding from the uterus, which can obstruct the operative field.

Care must be taken not to place lateral or downward traction on these clamps, which might tear friable tissues and cause bleeding that cannot be easily controlled. These clamps must be supported and not manipulated.

Cut and doubly ligate with 0 chromic catgut (or Vicryl) suture

Observe carefully for any further bleeding. **If the uterine arteries are ligated correctly,** bleeding should stop, and the uterus should look pale.

8. Return to the clamped pedicles of the round ligaments and tubo-ovarian ligaments (Figure E11.13) and ligate them with 0 chromic catgut (or Vicryl) suture. This may be done in a single bundle but may require multiple pedicles on each side if the bundle is too large to ligate safely.

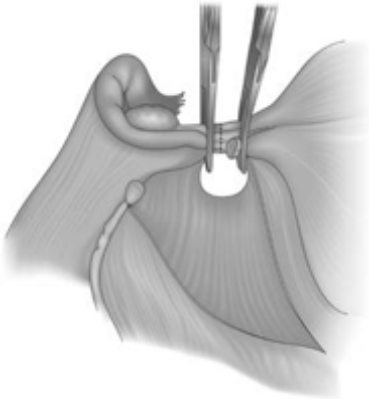


Figure E11.13 *Dividing the utero-ovarian pedicle.* Stovall TG, Mann WJ. Hysterectomy without oophorectomy.

9. Amputate the uterus above the level where the uterine arteries are ligated, using scissors.

Figure E11.14 *Amputation of the cervix (posterior view) The uterine arteries have been doubly clamped, and the third clamp is placed on the uterine vessels higher up to control back-bleeding.*
Inset, A scalpel cuts the uterus, separating the corpus from the cervix. The line of incision is between the upper clamp and the lower two clamps.

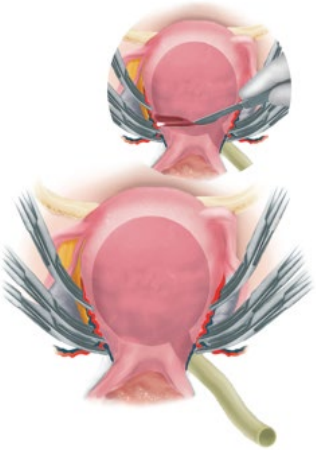


Figure E11.14 *Amputation of the cervix (posterior view)*

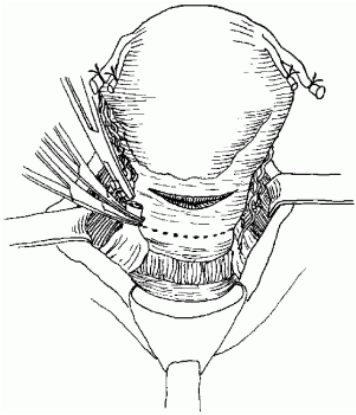


Figure E11.15 *Amputation of the cervix (anterior view)*

Amputation is achieved by cutting superiorly to the ligated uterine arteries while angling the scalpel blade or scissors medially and downward. This technique allows removal of an inverted cone of the cervix, which will facilitate approximation of the edges of the cervical stump regardless of the degree of dilation. Once amputated, the cervical stump can be approximated in an anterior-to-posterior fashion using interrupted figure-of-eight ligatures. Special care should be taken to avoid the bladder.

Close the cervical stump with interrupted 2-0 or 3-0 chromic catgut (or Vicryl) sutures. Three or four mattress sutures are then used to close over the defect, and further individual sutures may be required to bring about haemostasis from small vessels.
The body of the uterus is then detached, by incising just below the level of the uterine pedicles.

All pedicles must be carefully re-checked before closing the abdomen.

Use of a suction drain is optional, remembering that a drain does not aid haemostasis, but rather serves as an early warning sign of ongoing intra-abdominal haemorrhage.

Total blood loss should be assessed as accurately as possible, ideally by measurement of blood in the suction apparatus, and by weighing used swabs.

Once this has taken place, the abdominal contents should be inspected if suspicion of trauma exists, specifically where ongoing intra-abdominal bleeding is noted post-hysterectomy.

Carefully inspect the cervical stump, leaves of the broad ligament, and other pelvic floor structures, for any bleeding. Ensure that there is no bleeding. Remove clots using a sponge.

If a clotting disorder is suspected, place a drain through the abdominal wall. **Do not** place a drain through the cervical stump as this can cause postoperative infection.

In all cases, check for injury to the bladder. If a bladder injury is identified, repair the injury (see below).

Close the fascia with continuous 0 chromic catgut (or Vicryl) suture.

Note: There is no need to close the bladder peritoneum or the abdominal peritoneum.

If there are signs of infection, pack the subcutaneous tissue with gauze, and place loose 0 catgut (or Vicryl) sutures. Close the skin with a delayed closure after the infection has cleared.

If there are no signs of infection, close the skin with vertical mattress sutures of 3-0 nylon (or silk) and apply a sterile dressing.

Surgical technique B. Based on extracts from Michael Cotton et al's book (Primary Surgery Volume One: Non-Trauma (Second edition) See Figures E11.16 and E11.17 below

The great danger at hysterectomy is that you may damage the ureter by cutting, tying, or clamping it. The ureter is at risk at several stages:

(1) when you tie the ovarian vessels. So, lift these clear of the ureters beforehand.
(2) when clamping and tying the exposed broad ligament, especially if the ureter is displaced by a large uterine fibroid.
(3) during the control of unexpected bleeding where clamps and sutures might be placed blindly and too deep.

So, before you do anything in this region which might injure the ureters, feel for them carefully. You can roll a ureter between your finger and thumb, and when you pinch it, it vermiculates (moves like a worm).

Bleeding can be severe, especially from the uterine vessels. Even when you have divided them, you are still in a bloody triangle at the sides of the vaginal vault. If you are not careful, you can also cause a vesico-vaginal fistula. This will be much less likely if you carefully separate the bladder from the cervix.

Gentle continued traction is the secret of all pelvic surgery:
(1) It demonstrates the tissue planes.
(2) You are less likely to pick up structures that you do not want to cut.
(3) Vessels stand out more clearly.
(4) You are less likely to injure the bladder or the ureter
(5) You can find the relation of the bladder to the cervix and vagina more easily.

Clear the operative field. This is often the most difficult part of the operation. *Don't start removing any organs until you have cleared the site of operation*.

Carefully pack the bowel out of the way with large damp packs, attached to a cloth tape, to which a haemostat is fixed. Protect the wound edges with moist gauze. The operative field is exposed using appropriate retractors (preferably Doyen or Deaver).

If you restore the proper anatomy first by removing adhesions, you are far less likely later to damage ureters, bladder or bowel. **However, if massive bleeding is present, clamping the ovarian and uterine arteries as soon as possible takes priority.**

Clear any adherent bowel or omentum from the pelvis. Use blunt dissection to free any loose adhesions between the uterus and its surrounding structures: the sigmoid colon, the ovaries, or the walls of the pelvic cavity. The tubes and ovaries may be stuck down behind the broad ligaments; get your fingers under them and free them from below upwards. You may have to divide denser adhesions with scissors, or if you think they are likely to contain blood vessels, clamp, divide, and tie them. Divide any adhesions between the fundus of the bladder and the fundus of the uterus.

If you can exteriorize the uterus (deliver it out of the abdomen), especially if it is very big, this will help greatly.

The figures below (E11.16 and E11.17) summarise the procedure and are followed by some detailed accounts of individual actions.

N.B. The illustrations here assume you are standing on the patient's left, which most right-handed surgeons find easier. *After Parsons L, Ulfelder H. An Atlas of Pelvic Operations. WB Saunders 1968 p.21ff*

Put clamps on either side of the fundus of the uterus, (Figure. E11.16A) and over the fallopian tubes and round ligaments (Figure. E11.16B). Use them to exert traction, and control arterial bleeding.

Ask your assistant to pull on the clamps, so as to demonstrate the thin avascular part of the broad ligament more clearly. Push your finger through this thin part near the uterus, from behind forwards, to make a hole (Figure. E11.16B). Do the same on the other side.

Reflect the bladder. Incise the peritoneum on the front of the cervix, near to its vesico-cervical reflexion (Figure.E11.16C).

Dissect the bladder off the front of the cervix and upper vagina (Figure. E11.16D), until you can feel the tip of the cervix (Figure. E11.16F). This dissection is best done bluntly with your gloved finger or a gauze while your force is exerted in the direction of the uterus & cervix, *not the bladder*. If there was a previous Caesarean Section, you often need sharp dissection: so cut even into the cervix superficially, rather than into the bladder. Feel the cervix from in front and behind. Also separate the bladder from the underlying tissues laterally.

Find the ureters. They enter the pelvis at the bifurcation of the iliac vessels. Trace them distally to beyond the tip of the cervix; recognize them by their feel: they are firm to feel, they do not pulsate, and you can roll them between your finger and thumb (Figure E11.16).

CAUTION! *Ureters are apt to be easy to find when they are in no danger, and almost impossible to find when you need to find them!*

If you cannot find the ureters, these steps will protect them:

(1); Free the adnexa from adhesions before you remove them.
(2); Lift the infundibulo-pelvic ligament and find the ovarian vessels before you clamp them.
(3); Very carefully dissect the bladder away from the cervix, and the adjoining part of the broad ligament.
(4); Cut and mobilize downwards the posterior peritoneal leaf of the broad ligament from the posterior surface of the cervix and somewhat beyond, and a tiny bit laterally so that it is possible to apply a clamp from lateral just under the cervix at the last stage of the hysterectomy without having any peritoneum in the clamp.

In order now to retain the ovaries, apply a clamp across the Fallopian tube and its pedicle, 1cm lateral to the first clamp that you applied to these structures near the uterus (Figure. E11.16H). Divide the tissues between these clamps (Figure. E11.16I). Ease and squeeze and then remove the lateral clamp and tie its pedicle as above. Do the same thing on the other side, retaining the ovary.

Define, tie, and divide the lateral end of the round ligament. Do this by pushing your finger under it and tying it (Figure.E11.16J and E11.16K).

Find the uterine artery (Figure.E11.16K and E11.16L). Cut the posterior leaf of the broad ligament with the loose areolar tissue inside it, almost as far as the artery (Figure. E11.16K and E11.16L). If your assistant stretches the broad ligament well by pulling on the clamps, you may see the artery through the tissues you are going to cut. Repeat this on the other side.

Ask your assistant to lift up the uterus again (Figure.E11.16M). This will demonstrate the utero-sacral ligaments. Clamp, divide, and tie them (Figure. E11.16N).

Dissect the peritoneum off the back of the cervix (Figure.E11.16O), if it is not too adherent, otherwise leave it.

The uterus will now be much more mobile.

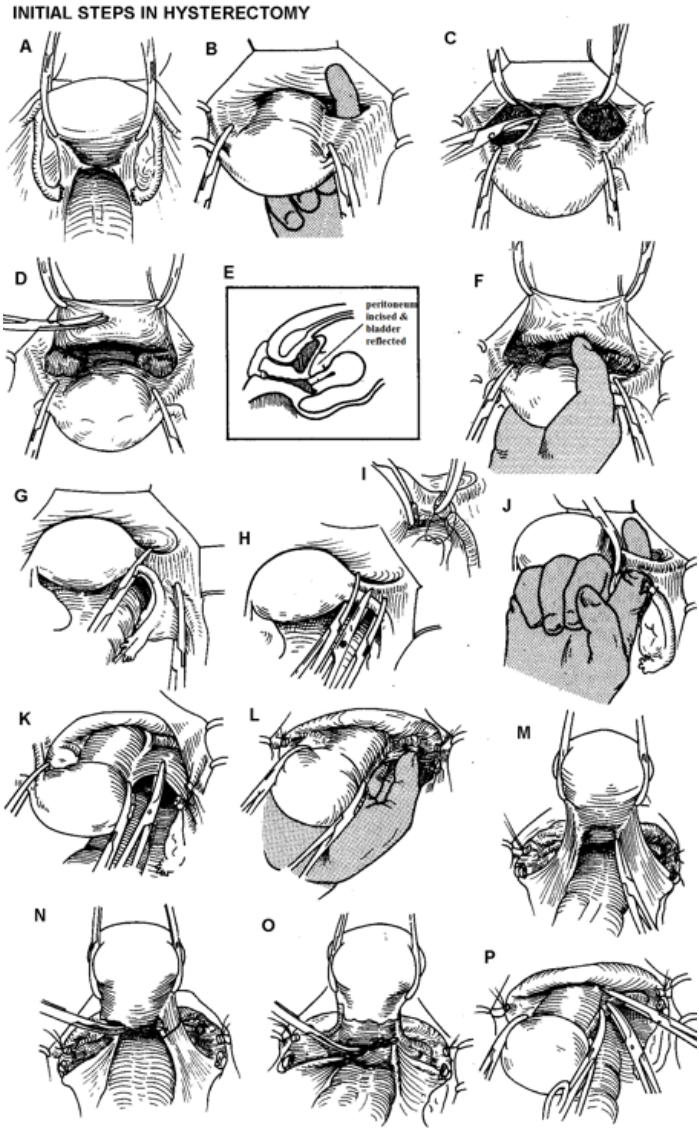
Feel for the uterine arteries again. There is no need to dissect them out. Next feel for the ureters on each side of the distal cervix. Again, identify them by their feel: firm cords which you can roll between your finger and thumb. Doubly clamp the pedicle containing the uterine artery (Figure.E11.16P), well away from the ureter, with the tip

of the clamp biting the side of the cervix and leaving little or no tissue on the uterine side.

Use scissors, or a knife. Cut as near, or even just in the uterus, as possible. If you do not use 2 clamps on each side, apply bilateral single clamps before you start cutting because the uterus will start bleeding on one side when the uterine artery on the other side is not clamped. Using, in this way, 2 clamps instead of 4 makes it possible to divide and clamp nearer to the uterus/cervix decreasing the risk to the ureters; there is also less clutter in the operative field.

Put the convex side of the clamp near the uterus so that it is easier to get the clamp very near it. If the bladder is well down and the posterior leaf of the broad ligament out of the way and the clamp (and suture) very near to the uterus, then the ureters should be out of harm's way. The clamp is then not on the slippery peritoneum. Sometimes it needs 2-3 steps to clamp the tissues on each side of the uterus. Place the suture 1mm medial and 1mm distal from the point of the clamp while laterally, tie it c.1cm under the clamp. This will prevent oozing later.

Figure E11.16 *Initial steps in obstetric hysterectomy* A, put clamps on either side of the fundus. B, put clamps on the tubes & round ligament and make a hole in the broad ligament with your finger. C, reflect the bladder. D,E, incise the peritoneum in front of the cervix. F, feel for the tip of the cervix. G, clamp the ovarian pedicle laterally if you are removing the ovary or, H, clamp it medially if you are retaining the ovary. I divide and tie the stumps. J,K, isolate and tie the round ligaments. L, find the uterine arteries and cut the posterior leaf of the broad ligament almost as far as the artery. M, lift up the uterus. N, divide and tie the utero-sacral ligaments. O, reflect the peritoneum off the back of the cervix. P, doubly clamp the uterine arteries.



Complete the task of pushing the bladder down the cervix, if you have not already done so (Figure.E11.16A). Blunt dissection is usually enough.

Now proceed with a subtotal hysterectomy.

Subtotal hysterectomy

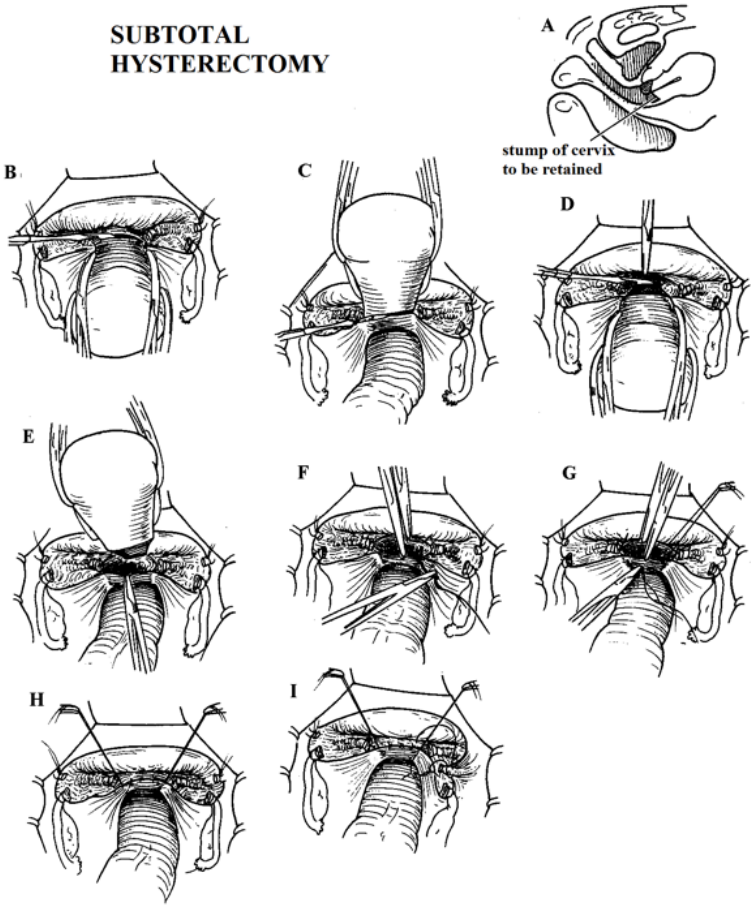
If you have placed 2 clamps for the uterine vessels with their points 1·5-3cm above the distal end of the cervix on the lateral uterine wall, release each slightly in turn, squeeze again and tie them individually after the ligating needle has gone *through* the uterus just under the point of the clamp. In this way, you will be sure to have tied all the vessels lateral to the uterine part you are going to remove.

When you are sure you have reflected the bladder adequately (Figure.E11.17A), pull on the clamps attached to the uterus and incise the anterior wall of the cervix, above the reflexion of the bladder and the stump of the uterine vessel (Figure.E11.17B). Then draw the uterus sharply forwards towards the symphysis and incise the posterior wall of the cervix (Figure.E11.17C). Place a clamp on its anterior incised edge (Figure. E11.17D).

Place a clamp on the posterior cut edge of the cervix (Figure.E11.17E), so that you can maintain traction. Bring the two cut edges of the cervix together to control bleeding. Use a cutting Mayo half-circle needle and place the first stitch in the edge of the cervix, close to the point where you tied the uterine arteries. Control bleeding by placing the sutures through the posterior peritoneal reflection, deep into the muscle of both lips (Figure.E11.17 F, G and H). Suture the round ligaments to the cervix if you can do this easily (Figure.E11.17 I).

Surgical techniques C. Based on additional information from GLOWM A Comprehensive Textbook of Postpartum Hemorrhage 2nd Edition
Baskett TF Peripartum hysterectomy Chapter 55. Edited by Sir Sabaratnam Arulkumaran, Mahantesh Karoshi, Louis G. Keith, Andre B. Lalonde and Christopher B-Lynch

Figure E11.17 *Undertaking a subtotal hysterectomy. A, the part of the uterus to be retained. B, C, incise the anterior and posterior walls of the cervix. D, E, grasp the cervix stump and make a cone-shaped cut. F, G, H, close the cervix and control bleeding by placing sutures through the posterior peritoneal reflection deep into both lips of the cone. I, suture the round ligaments to the cervix.*
After Parsons L, Ulfelder H, An Atlas of Pelvic Operations, WB Saunders 1968 p.45,47



D. Situations where there is massive continuing PPH:

Immediate urgent management to stop further haemorrhage

The structures of the adnexa (the appendages to the uterus) on each side are pulled laterally by an assistant, and the surgeon applies straight clamps adjacent to the top sides of the uterus to include the round ligament, the Fallopian tube and the utero-ovarian ligament. This serves to control the collateral blood flow to the uterus from the ovarian arteries and help stop haemorrhage from these vessels.

Using transillumination (if available), the avascular spaces in the broad ligament, roughly opposite the level of a transverse lower segment Caesarean incision, should be identified and a sterile urinary catheter passed through on each side to encircle the lower uterine segment just above the cervix. Making sure this catheter does not include either of the ureters, the catheter should be twisted tightly and closed around the lower uterine segment with a clamp, thereby compressing the uterine arteries.

These two manoeuvres, if properly applied, should occlude the main collateral ovarian and uterine artery supply to the uterus and help to make the remainder of the operation as described below easier and less urgent.

E. Other advice on obstetric hysterectomy

The vascular pedicles are thick and oedematous and must be double clamped. Remove the proximal clamp first and apply a free tie, and then replace the distal clamp with a transfixing suture. The proximal free tie should ensure that there is no hematoma formation in the base of the pedicle.

The ureters should be avoided by placing all clamps medial to those used to secure the uterine arteries.

It may be difficult to identify the cervix, particularly when the hysterectomy is being performed at full cervical dilatation. If a uterine incision has been made, a finger can be placed through this and hooked up to identify the cervical rim. It is safest to enter the vagina posteriorly, identify the rim of the cervix and then proceed anteriorly.

The bladder is particularly vulnerable in patients previously delivered by Caesarean section, as it may be adherent to the lower uterine segment and cervix. It may therefore be useful to check the integrity of the bladder intra-operatively. This can be done by installing through the urinary catheter 200 ml of sterile normal saline (mixed ideally with 2-3 drops of methylene blue). After repair of any bladder injury, this can be repeated to check its integrity.

Tears in the bladder should be repaired with two layers of 3/0 polyglactin (Vicryl) or equivalent suture. Otherwise, No. 1 polyglactin (Vicryl) or equivalent is used throughout the procedure.

Within the context of the emergency situation and the available resources, it is best to diagnose and deal with any bladder or ureteric injury at the time of the hysterectomy. If lower urinary tract injuries are not diagnosed until the postoperative period, clinical morbidity is increased, and diagnostic and surgical management is more complex.
Following hysterectomy, traumatized tissues at the base of the pelvis may continue to bleed despite ligation of obvious bleeding pedicles. This bleeding is usually, but not always, associated with DIC. In these instances, the application of a pelvic pressure pack can be lifesaving and provide haemostasis, either permanent or temporary, until haematological stability using fresh blood or ideally platelets and clotting factors is/are given IV. Tranexamic acid may also be helpful.

The pelvis should be irrigated and suctioned, and blood-soaked packs should be removed. Each vascular pedicle should be checked for haemostasis, as should the dissection sites. The abdomen is closed using any standard technique, after ensuring good haemostasis. No drains are necessary, unless there is concern for ongoing bleeding or persistent bladder leak.

Perioperative antibiotic prophylaxis should be continued for 24–48 hours.

F. Difficulties with hysterectomy

1. Bleeding

Emergency caesarean hysterectomy presents special bleeding problems. Coagulopathies may be present when the patient is first encountered, or may develop as the case progresses. There are often large hematomas in the broad ligament and other retroperitoneal spaces that distort anatomic relations and defy attempts at direct clamping and suturing. It is often possible to find a free dissecting space near the lateral pelvic wall where the uterine vessels can be ligated near their origin from the internal iliac artery or, failing this, the internal iliac (hypogastric) artery itself can be isolated and ligated.

In extreme emergencies, the aorta may be compressed for a time to stop copious bleeding while the field is cleared for a more direct attack on the bleeding problem.

The use of surgical packs is a frequently overlooked adjunct in obtaining hemostasis. Temporary packing of a bleeding area can offer time, similar to that of compressing the aorta, and allow blood component replacement to catch up with a possible coagulopathy.

Bleeding in the deep pelvis may persist following hysterectomy. Coagulation status must be assessed with laboratory testing and, if abnormal, managed with transfusion of blood products, patient warming, and correction of acidaemia and hypocalcaemia. Whole blood clotting time WBCT is a useful measure of coagulation (see Section A+11)

- *If laboratory clotting tests are not available, transfer 2 mL of venous blood into a small dry clean plain glass test tube (approximately 10 mm x 75 mm).*
- *Hold the tube in your closed fist to keep it warm (+ 37°C).*
- *After 4 minutes, tip the tube slowly to see if a clot is forming. Then tip it again every minute until the blood clots and the tube can be turned upside down.*
- *Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down indicates a blood clotting disorder (coagulopathy)*

Surgical haemostasis may be achieved by placing running and figure-of-eight absorbable sutures in bleeding areas. If this does not control bleeding, haemostatic agents (if available in Liberia) and pelvic packing are the next steps.

If there is bleeding at the end of the operation, it is important to tie off any bleeding vessels. Pressure (for at least five minutes) will help settle small vessel bleeding. Packing the pelvis with warm packs may help; remember that they will need removal once the patient is stable. Do not close the abdomen until haemostasis is secured.

2. ***Risk of DVT and pulmonary embolus.*** Women undergoing peripartum hysterectomy are at moderate risk or high risk of postoperative thromboembolic disease, depending on individual risk factors. (See Section A+15).

3. ***Bladder and ureter injury.*** The process of uterine rupture may directly injure the bladder and/or ureters. The surgeon must look for these, as well as inadvertent surgical injuries. It is usually the unrecognized bladder injury that results in vesico-vaginal fistula; the properly repaired bladder usually heals without difficulty. A urinary catheter must be left in situ for 10 days, to aid bladder healing.

4. **If you cannot find the ureter**, but must proceed with the operation, keep extremely close to the uterus. You will nearly always be safe there. Perform a subtotal hysterectomy only.

5. **If you divide the ureter** and recognize that you have done so, repair the ureter with continuous 3/0 or 4/0 absorbable over a fine feeding tube which you have inserted into the proximal and distal ends of the divided ureter. If you can perform a cystoscopy, you will be able to withdraw the feeding tube after

10days. If not, make a small cystostomy and find the distal end of the tube: *do not pull on it!* Attach its distal end through the eye of a Foley catheter that you have placed in the bladder. You can then remove the feeding tube simply by removing the catheter. Otherwise, fix the feeding tube in place in the proximal ureter, and lead the other end of the tube out of the abdomen through a separate stab incision, and allow urine to collect in a sealed bag. This will preserve kidney function till you can refer the patient for ureteric re-implantation later. Place a tube drain into the abdomen.

6. **If you open the bladder**, repair it in at least 2 layers with long-acting absorbable sutures. Leave a catheter in for 10days. The tear is likely to heal uneventfully.

7. **If you have injured the colon**, CALL FOR SURGICAL HELP. The tear will be repaired in 2 layers. Fashion a de-functioning colostomy if there is severe soiling, or if there is severe scarring, and you are uncertain of the reliability of your closure.

8. **If there is postoperative retention of urine**, it is likely to be due to *detrusor* failure, and may be difficult to treat. First of all, make sure urine is being produced. Try 4 weeks of catheter drainage and urethral dilatation. If this fails, teach intermittent self-catheterization, which is effective and safe. Use a clean but not sterile simple plastic catheter, which the patient can use for at least a week. *A retentive bladder is much more comfortable than a leaky one, and easier to manage.*

Repair of bladder injury (WHO)

1. Identify the extent of the injury by grasping each edge of the tear with a clamp and gently stretching. Determine if the injury is close to the bladder trigone (ureters and urethra).
2. Dissect the bladder off the lower uterine segment with fine scissors or with a sponge on a clamp.
3. Free a 2 cm circle of bladder tissue around the tear.
4. Repair the tear in two layers with continuous 3-0 chromic catgut (or Vicryl) suture.
5. Suture the bladder mucosa (thin inner layer) and bladder muscle (outer layer);
6. Invert (fold) the outer layer over the first layer of suture and place another layer of suture;
7. Ensure that sutures do not enter the trigone area.
8. Test the repair for leaks:

- Fill the bladder with sterile saline through the catheter;
- If leaks are present, remove the suture, repair and test again.

If it is **not certain that the repair is well away from the ureters and urethra**, complete the repair and refer the woman to a higher-level facility for an intravenous pyelogram (if possible).

Keep the bladder catheter in place for 10 days, and until urine is clear. Continue IV fluids to ensure flushing of the bladder.

Anaesthetic concerns

The need for this major intervention may arise very suddenly, allowing little time to assess and investigate the patient's underlying condition.

Resuscitation must take place in tandem with transfer to the operating theatre and provision of anaesthesia (usually General Anaesthesia).

Rapid sequence induction (RSI) of anaesthesia always carries excess risks in pregnancy, notably acid aspiration and failed intubation. The risks are heightened by the emergency nature of obstetric hysterectomy. Expired carbon dioxide monitoring is important in ensuring that endotracheal intubation has been achieved (rather than oesophageal). If there is time, an antacid orally before anaesthetic can reduce the severity of aspiration pneumonia.

The patient will generally have lost a large volume of blood by the time the decision is made to remove the uterus, and she is often shocked. Disseminated intravascular coagulation (DIC) may then supervene. Fresh blood transfusion is always advisable, but especially so in this situation.

There may be associated dehydration, plus or minus sepsis, as a result of prolonged labour.

There may be co-existing medical or obstetric conditions, for example pre-eclampsia, which add significantly to the risks.

Post-operative management

It is crucial for the woman to receive post-operative care in a high-dependency environment for at least the first 48 hours. Regular observation of respiratory rate, blood pressure, pulse rate and volume, oxygen saturation, temperature and conscious level should take place, as well as monitoring of urine output.

If there are no signs of infection, remove the abdominal drain after 48 hours.

If there are signs of infection or the woman currently has fever, give a combination of antibiotics until she is fever-free for 48 hours:

- ampicillin 2 g IV every 6 hours;
- PLUS gentamicin 5 mg/kg body weight IV every 24 hours;
- PLUS metronidazole 500 mg IV every 8 hours.

Consider Ceftriaxone.

Give appropriate analgesic drugs (IV paracetamol and IV morphine).

Diet — Clear liquids are ordered after surgery, and diet is introduced with patient appetite and tolerance of oral intake. Nausea, anorexia, abdominal distention, or vomiting are signs of paralytic ileus. Mild symptoms can be managed with restriction of oral intake and intravenous fluids, while more severe vomiting should be evaluated radiographically. Confirmed ileus or partial obstruction should be treated with nasogastric suction, along with intravenous fluid and electrolyte repletion.

Breast-feeding — Hysterectomy is not a contraindication to breastfeeding. Patients admitted to the intensive care unit may use a breast pump once they are extubated and stabilized. Early pumping is encouraged when the newborn is admitted to the neonatal intensive care unit. Breast milk output should be considered in the patient's fluid management, although this is usually not a concern by the time her milk supply develops. In the setting of a physically or psychologically difficult recovery, patients who are unwilling or unable to breastfeed should be supported.

Sheehan syndrome (pituitary infarction due to extreme hypovolaemia) should be considered in women who fail to lactate postpartum, or who develop other manifestations of hypopituitarism.

After the operation, it is painful to bear down to defaecate; so, make sure your patient is not constipated, and if so prescribe laxatives, perhaps in advance if they have such a tendency.

Fetal/neonatal considerations

Where obstetric hysterectomy is carried out for uterine rupture, the perinatal mortality is extremely high, as a result of extrusion of the fetus into the abdominal cavity, with disruption of blood supply.

Where post-partum haemorrhage necessitating surgery is due to uterine atony, the perinatal outcome will be unaffected. However, consideration must be given to ensuring appropriate neonatal care and infant feeding, which the mother may be unable to provide while recovering from surgery.

Family aspects

The loss of the uterus may be perceived as a tragedy to the woman and her family, as it prevents further childbearing.

This fact must be borne in mind when engaging with the woman and her family members, and they should be given the opportunity to express their thoughts and feelings in a supportive and respectful environment.

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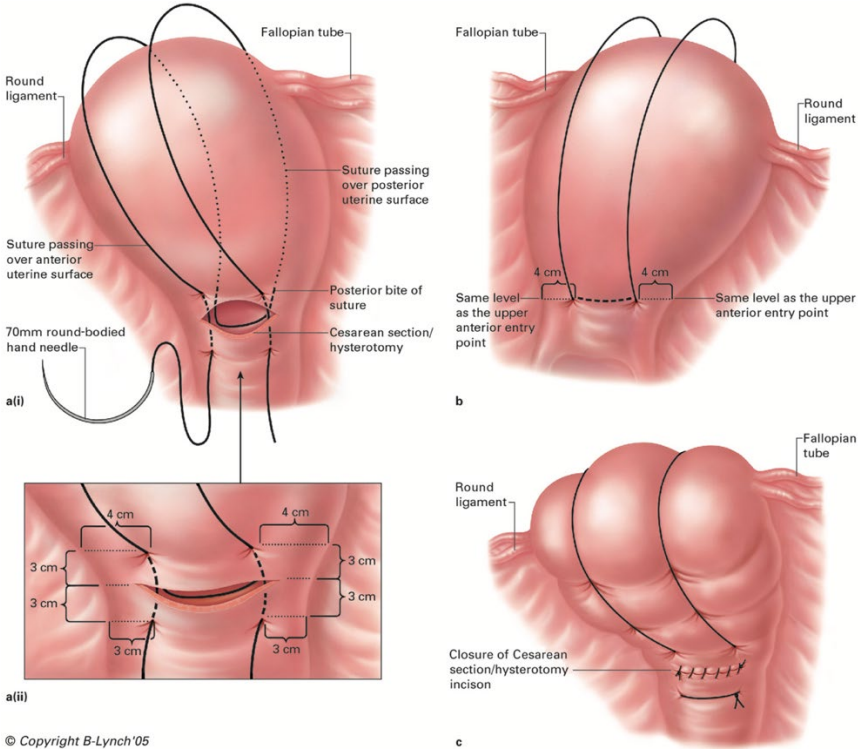
Section E12. The B-Lynch suture compression technique

This procedure may be used in the management of postpartum haemorrhage due to an atonic uterus. It can be extremely valuable, and sometimes life-saving, if the condom catheter tamponade is not successful.

The aim is to exert continuous vertical pressure on the atonic uterus, thereby providing compression to the innumerable small blood vessels which run through the uterine musculature, bringing about cessation of haemorrhage.

Please see this link for details on the procedure:
https://www.youtube.com/watch?v=CaDZYstixeY

1. The B-Lynch suture.
See Figures E12 1a (i and ii), E12 1b and E12 1c.



Ideally, the woman should be placed in the Lloyd-Davies position, to allow an assistant to stand between the woman's legs to assess the bleeding. A second assistant stands opposite the surgeon. A laparotomy incision is required, to gain access to the uterus. The wound from a recent caesarean section or hysterotomy may be used. It is necessary to exteriorize the uterus (seeking permsission from the Nurse Anaesthetist in advance, as it can cause bradycardia due to vagal stimulation). A lower segment transverse incision is made, or the recent lower segment caesarean section (LSCS) wound is opened by removing the sutures which were used to close it. The cavity is checked for retained placental fragments and/or membranes.

The potential for efficacy of the B-Lynch suture may be assessed as follows:
After exteriorizing the uterus, the surgeon pushes the bladder well down, and performs bimanual compression. This is carried out by placing one hand anterior to the uterus, with the fingers just below the bladder reflection, and the other hand posterior to the uterus, with the fingers at the level of the cervix. If the bimanual compression is effective, the assistant who is standing between the patient's legs will notice a significant reduction in vaginal blood loss. There is therefore a good chance that application of the B-Lynch suture will be effective in stopping the bleeding, as it delivers compression equivalent to sustained bimanual compression.

A B-Lynch suture may be applied in the presence of coagulopathy, as it will address the blood loss through uterine atony. However, it is not a substitute for the medical treatment of coagulopathy, which should take place along with the operative intervention. In low-resource settings, the best approach is to provide a **transfusion of freshly donated blood.**

Suture application
Provided that the test criteria for the B-Lynch suture placement are met, the uterus remains exteriorized until application of the suture is complete. The surgical assistant takes over in performing compression and maintains it with two hands during the placement of the suture by the surgeon.

(1) *First stitch relative to the low transverse CS/hysterotomy wound*.
With the bladder displaced inferiorly, the first stitch is placed 3 cm below the CS/hysterotomy incision on the patient's left side, and threaded through the uterine cavity to emerge 3 cm above the upper incision margin, approximately 4 cm from the lateral border of the uterus (Figure E12 1a(i)).

(2) *The fundus.*
*T*he suture is now carried over the top of the uterus and to the posterior side. Once situated over the fundus, the suture should be more or less vertical and lie

about 4 cm from the cornu. It does not tend to slip laterally toward the broad ligament because the uterus has been compressed and the suture milked through, ensuring that proper placement is achieved and maintained (Figure E12 1a(ii).

(3) *The posterior wall.*
The location on the posterior uterus where the suture is placed through the uterine wall is actually easy to surface mark posteriorly. It is on the horizontal plane at the level of fundus and onto the anterior right side of the uterus. The needle re-enters the cavity exactly in the same way as it did on the left side, that is 3 cm above the upper incision and 4 cm from the lateral side of the uterus through the upper incision margin, into the uterine cavity and then out again through 3 cm below the lower incision margin (Figure E12 1a(ii)).

(4) Role of the assistant.
As the operation proceeds, the assistant continues to compress the uterus as the suture is fed through the posterior wall into the cavity. This will enable progressive tension to be maintained as the suture begins to surround the uterus. Compression by the assistant will also help to pull the suture material through to achieve maximum compression, without breaking it, at the end of the procedure. Furthermore, it will prevent suture slipping and uterine trauma. The suture now lies horizontally on the cavity side of the posterior uterine wall.

(5) *The fundus.*
As the needle pierces the uterine cavity side of the posterior wall, it is placed over the posterior wall, bringing the suture over the top of the insertion of uterosacral ligament (Figure E12 1b).

(6) *The later role of the assistant.*
The assistant maintains the compression as the suture material is milked through from its different portals to ensure uniform tension and no slipping. The two ends of the suture are put under tension and a double throw knot is placed for security to maintain tension after the lower segment incision has been closed by either the one- or two-layer method.

(7) *Relation to the hysterotomy incision.*
The tension on the two ends of the suture material can be maintained while the lower segment incision is closed, or the knot can be tied first, followed by closure of the lower segment (Figure E12 1c).
If the latter option is chosen, it is essential that the corners of the hysterotomy incision be identified, and stay sutures placed before the knot is tied. This ensures that, when the lower segment is closed, the angles of the incision do not escape it.

Either procedure works equally well. It is important to identify the corners of the uterine incision to make sure no bleeding points remain unsecured, particularly when most of these patients are hypotensive with low pulse pressure at the time of the B-Lynch suture application.

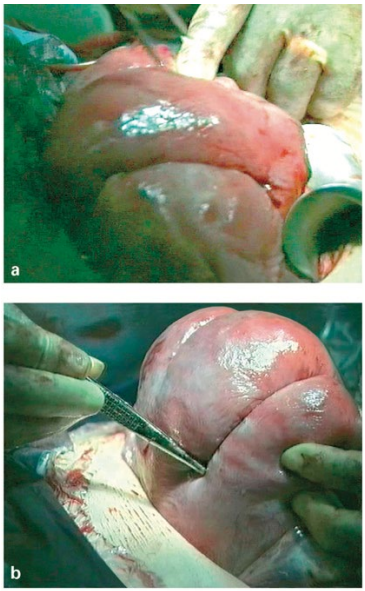


Figure E12.2 *Appearance of compressed uterus after B-Lynch sutures*

(8) *Post-application and hysterotomy closure*

It is probable that the maximum effect of suture tension lasts for only about 24–48 h. Because the uterus undergoes its primary involutionary process in the first week after vaginal or Caesarean section delivery, the suture may have lost some tensile strength, but haemostasis would have been achieved by that time.

There is no need for delay in closing the abdomen after the application of the suture. The assistant standing between the patient's legs swabs the vagina again and can confirm that the bleeding has been controlled.

Application for massive PPH after normal vaginal delivery

If laparotomy is required for the management of atonic postpartum haemorrhage, hysterotomy is necessary to apply the B-Lynch suture. Hysterotomy will also allow exploration of the uterine cavity, exclusion of retained products of conception, evacuation of large blood clots and diagnosis of abnormal placentation.

For B-Lynch suture application or any modification of it (see below) to be effective, confirmation that the uterine cavity is completely empty is essential. Furthermore,

hysterotomy ensures that the correct application of the suture provides maximum and even distribution of the compressive effect during and after application of the B-Lynch suture (Figures E12.2). Also, it avoids blind application of the suture and the possibility of obliteration of the cervical and/or uterine cavities, that may lead to clot retention, infected debris, pyometra, sepsis and morbidity.

Application for abnormal placentation

The B-Lynch suture may be beneficial in cases of placenta accreta, percreta and increta. In a patient with placenta praevia, where the lower segment tends not to contract down well after delivery of the placenta, a figure- of-eight or transverse compression suture to the lower anterior or posterior compartment or both, is applied to control bleeding. If this is not completely successful, then, in addition, the longitudinal Brace suture component may be applied for further/complete haemostasis. (See video for details: https://www.youtube.com/watch?v=CaDZYstixeY

The B-Lynch surgical technique: clinical points

1. An absorbable suture, such as monocryl No.1 mounted on 90-cm curved Ethigard blunt needle (codeW3709) (Ethicon, Somerville, NJ) may be used. Other **absorbable** sutures can be used, according to the surgeon's preference. A good length of suture material is essential
2. The uterine cavity is checked, explored and evacuated
3. Sutures maintain even and adequate tension without uterine trauma
4. Ensuring that the cervix is open allows free drainage of blood, debris and inflammatory material
5. Transverse compression suture applied to the lower segment for abnormal placentation effectively controls bleeding
6. Simple, effective and not expensive
7. Fertility preserved
8. Mortality avoided
9. World-wide application and successful reports (> 1300) .(B-Lynch, personal data base, christopherbl@aol.com)
10. Potential for prophylactic application at caesarean section when signs of imminent postpartum haemorrhage develop, e.g. placenta accreta, or where blood transfusion is declined, e.g. placenta previa surgery in a Jehovah's Witness

The Hayman uterine compression suture is a variant on the B-Lynch suture

Clinical points

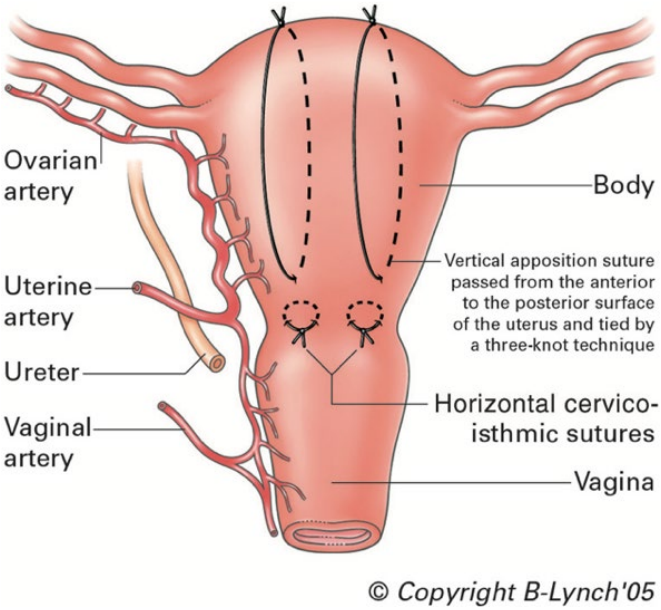
1. Lower uterine segment or uterine cavity not opened
2. Uterine cavity not explored under direct vision
3. Probably quicker to apply
4. No feed-back data on fertility outcome

5. Morbidity feed-back data limited
6. Unequal tension leads to segmented ischemia secondary to slippage of suture – 'shouldering' with venous obstruction

Transverse lower segment compression sutures

In the case of postpartum haemorrhage from placenta accreta, percreta or increta, transverse lower segment compression sutures on each side (horizontal sutures at the cervico-isthmus) are effective: see video:
https://www.youtube.com/watch?v=CaDZYstixeY

Figure E12.3 *Showing the Hayman and horizontal cervico-isthmic sutures*



Complications of brace sutures

1. **Uterine necrosis**
   Modifications to the original technique have been reported, where multiple sutures and square sutures are placed instead of the single brace. Clearly, isolating portions of uterus increases the risk of necrosis and this complication has been reported in association with these adapted procedures.

2. **Bowel obstruction**
   As the uterus involutes, the loops of thread loosen and there is the potential for bowel herniation through the loose loops of suture material which can cause bowel obstruction. The original technique described using chromic catgut, but as this is no longer available, longer acting materials are being used. Vicryl or Monocryl are reasonable substitutesas they are rapidly absorbing, but **long-acting or non-absorbable material such as PDS and nylon must not be used.**

3. **Adhesion formation is more likely when multiple sutures are used.**

Section E 13. Emergency vascular access in pregnancy

External jugular vein cannulation (Figure E13.1)

Procedure

1 Place patient in a 15–30-degree head-down position (or with padding under the shoulders so that the head hangs lower than the shoulders).

2 Turn the head away from the site of puncture.

3 Clean the skin over the appropriate side of the neck.

4 Identify the external jugular vein, which can be seen passing over the sternocleidomastoid muscle at the junction of its middle and lower thirds.

5 Have an assistant place their finger at the lower end of the visible part of the vein just above the clavicle. This stabilises it and compresses it so that it remains distended.

6. If the patient can undertake a valsalva manoeuvre this can help distend the vein

7 Puncture the skin and enter the vein pointing in the direction of the clavicle.

8 When free flow of blood is obtained, ensure that no air bubbles are present in the tubing, and then attach a giving set.

9 Tape the cannula securely in position. One of the most important points is to ensure that the cannula is properly secured in the vein by high-quality fixation. It is easily removed, so use plenty of tape!

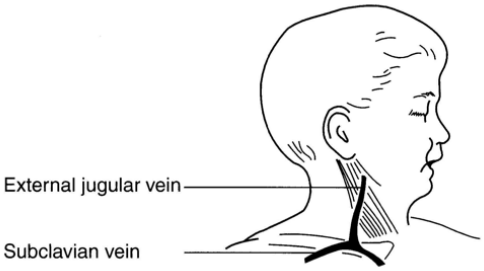


Figure E.13.1 *Position of external jugular vein*

Be aware that there is a higher risk of air embolism than with peripheral venous cannulation.

If infusion through a peripheral vein or external jugular vein is not possible, and it is essential to give IV fluids to keep the patient alive:

- set up an intra-osseous infusion
- or use a central vein
- or perform a venous cut-down.

All of these procedures are described below.

Central venous cannulation

This should not be used routinely, only be performed when IV access is urgent, and only by those who have been trained in the technique (usually a nurse anaesthetist). Remove the cannula from a central vein as soon as possible (i.e. when IV fluids or drugs are no longer essential, or when a peripheral vein can be cannulated successfully).

The aims of central venous cannulation are as follows:

- to obtain venous access when peripheral cannulation is not possible (however, in an emergency, intra- osseous cannulation is faster and easier)
- to monitor central venous pressure
- to obtain prolonged vascular access
- to obtain large-bore vascular access
- to administer certain drugs
- during resuscitation.

Procedure

Several routes are possible, but the most widely used in pregnancy is the internal jugular approach.

The following equipment is needed:

- sterile pack
- sterile Seldinger wires
- cannula: single 16- to 22G cannula
- single, double or triple lumen if available
- syringe and Ringer-lactate or Hartmann's solution or saline
- suture and tape for fixing
- local anaesthetic with fine 25G needles
- Sterilise the skin and maintain sterile technique.

Two insertion techniques are available, namely:

- the same as in peripheral cannulation
- the Seldinger technique (wire)

Ideally an ultrasound probe can help identify the vein and ensure the cannula when inserted is in the correct position in the lumen of the vein.

Seldinger method

1. Identify the vein with cannula on syringe (same approach as for peripheral cannulation); there must be good flow.
2. Stop and pass the cannula over the needle.
3. Disconnect the syringe.
4. Pass the wire through the cannula to three-quarters the length of wire (if there is any resistance, stop, withdraw the wire with needle, and start again).
5. Holding the wire firmly, withdraw the needle over the wire.
6. Pass the dilator over the wire (it is sometimes necessary to make a small cut at the skin) and, holding the wire firmly, withdraw the dilator.

7 Pass the cannula/catheter filled with Ringer-lactate or Hartmann's solution or 0.9% saline over the wire (passage of the cannula should be smooth, meeting no resistance).
8 Hold the cannula, and withdraw the wire (gently if it sticks, do not force it).
9 Confirm correct placement by aspiration of blood.
10 Suture and fix with antiseptic ointment over the entry site.
11 Confirm the position with an X-ray.

Internal jugular vein cannulation

Use a head-down position as this increases vein distension and reduces the risk of air embolism.

Procedure

1 Place the patient in a 30-degree head-down position with lateral tilt if more than 24 weeks pregnant and turn the head to the left-hand side for the right-sided approach, which avoids the lymphatic duct. Place a towel or roll under the shoulders to extend the neck.
2 Clean the skin and drape with towels, exposing the neck to the clavicle.
3 Identify the apex of the triangle formed by the two heads of the sternocleidomastoid and clavicle and infiltrate local anaesthetic (if conscious). Alternatively, identify carotid pulsation medial to the sternomastoid at the level of the lower border of the thyroid cartilage, and the vein (usually) just lateral to this. Aim the needle at 30 degrees to the skin and towards the ipsilateral nipple. Estimate the length of catheter from the point of skin entry to the nipple.
4 Direct the needle at 30 degrees to the skin, pointing towards the right nipple, and puncture the skin at the apex of the triangle.
5 Holding this position, advance the needle, aspirating all the time. If blood 'flashes back', stop advancing and remove the syringe from the needle. (If you do not cannulate the vein, withdraw the needle, but not out of the skin, and advance again slightly more laterally.)
6 Feed the Seldinger guide wire through the needle, always having control of one end of the wire.
7 Withdraw the needle over the guide wire and then feed the catheter over the wire into the superior vena cava.
8 Withdraw the wire, aspirate for blood and attach the infusion set. Do not leave the catheter open, as this may lead to an air embolism.
9 Suture the catheter in place and obtain a chest X-ray (if possible) to check for a pneumothorax and the position of the catheter tip, which should be in the superior vena cava (SVC), ideally at the junction of the SVC and the right atrium, but not in the right atrium.

Complications

- arterial puncture

- nerve damage
- pneumothorax
- extravasation-administered fluids/drugs
- septicaemia if the procedure is not sterile or if the cannula is in place for more than 5 days.

Intra-osseous needle insertion

Intra-osseous infusion is a safe, simple and reliable method of giving fluid and drugs in an emergency when venous access is not possible (e.g. in shock).

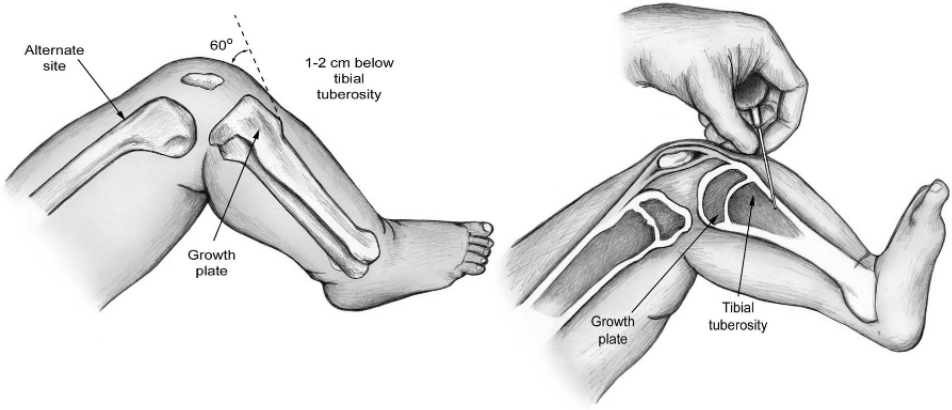
Standard intraosseous needle insertion

Intra-osseous needles (15- to 18-gauge)

If a purpose-made intra-osseous needle is not available, a number of alternatives can be used, including bone-marrow needles, short lumbar puncture needles or a large-caliber vene-puncture needle. The disadvantage of vene-puncture needles is that they may carry a fragment of bone into the marrow. This is not dangerous, but it may block the needle. Also, the bevel of these needles is long, and extravasation of fluid is more likely than with a purpose-made intra-osseous needle.

The site for needle insertion is in the middle of the antero-medial surface of the tibia, at the junction of the upper and middle third, to avoid damaging the epiphyseal plate (which is higher in the tibia), 2–3 cm below the tibial tuberosity. An alternative site for needle insertion is the distal femur, 2 cm above the lateral condyle.

Figure E13.2 *Site for standard IO needle insertion*



Other equipment needed

This includes the following:

1. a sterile 2-mL syringe containing 1–2% lignocaine to be used whenever the patient is conscious (otherwise the procedure will be very painful)
2. two sterile 5-mL syringes
3. sterile 20- or 50-mL syringes and ideally a three-way tap.

Procedure

1. Place padding under the patient's knee so that it is bent at 30° from the straight (180°) position, with the heel resting on the table.
2. Locate the correct position (described above and shown in Figure E13.2).
3. Wash your hands and put on sterile gloves. (To avoid osteomyelitis, the procedure must involve strict asepsis using an antiseptic solution and sterile gauze to clean the site, with the operator wearing sterile gloves.) Clean the skin over and surrounding the site with an antiseptic solution.
4. Infiltrate with lidocaine down to the periosteum if the patient is conscious.
5. Ask an assistant to stabilise the proximal tibia by grasping the thigh and knee above and lateral to the cannulation site, with the fingers and thumb wrapped around the knee but not directly behind the insertion site.
6. Insert the needle at a 90° angle with the bevel pointing towards the foot. Advance the needle slowly using a gentle but firm twisting or drilling motion.
7. Stop advancing the needle when you feel a sudden decrease in resistance or when you can aspirate blood. The needle should now be fixed in the bone and stand up by itself.
8. Remove the stylet.
9. Aspirate the marrow contents (which look like blood), using the 5-mL syringe, to confirm that the needle is in the marrow cavity and to provide bone marrow/blood for the following tests when appropriate: blood glucose, haemoglobin, group and cross-matching, blood culture and urea and electrolytes.
10. Hb, glucose and electrolyte measurements may not be accurate after infusions have been previously given through the needle.
11. Note that failure to aspirate bone-marrow contents does not mean that the needle is not correctly placed.
12. Attach the second 5-mL syringe filled with Ringer-lactate or Hartmann's solution or 0.9% saline. Stabilise the needle and slowly inject 3 mL while palpating the area for any leakage under the skin. If no infiltration is seen, start the infusion.
13. Attach the 50-mL syringe, usually containing Ringer-lactate/Hartmann's or 0.9% saline, but compatible blood or 10% glucose can be used if hypoglycaemia is suspected and push in the infusion fluid in boluses.

It is not possible to infuse fluid through the intra-osseous needle using a standard IV giving set. The fluid has to be pushed in under light pressure, and if large volumes are needed (e.g. when giving boluses of fluid to treat shock) then 20-mL or 50-mL syringes should be used.

14. Check that the calf does not swell during the injections of fluid.
15. Secure IV cannula access as soon as possible.
16. When the needle has been removed, cover with a sterile dressing.
17. Do not place distal to a major fracture or where there is infection.
18. Give prophylactic antibiotics after the immediate emergency has been managed.
19. All drugs and fluids that are given IV (including 10% glucose) can be given into the bone marrow, and they will reach the heart and general circulation as fast as if they had been given through a central vein.
20. Remove the intra-osseous needle as soon as venous access is available. In any case, it should not be in place for more than 8 hours.

Complications

These include the following:

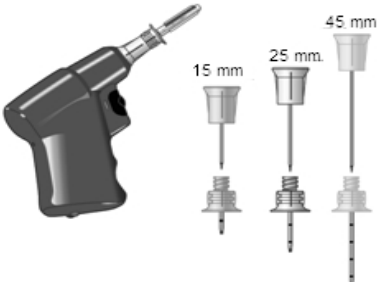
- dislodgement
- misplacement (penetration through posterior cortex, failure to penetrate cortex), resulting in:
  - haematoma
  - tissue necrosis
  - compartment syndrome
- skin infection
- osteomyelitis
- tibial fracture in babies.

Battery-powered intra-osseous drill device

The EZ-IO drill is a powered device that enables rapid insertion of an intra-osseous needle. Unfortunately, the disposable needles are extremely and prohibitively expensive for low resource settings.

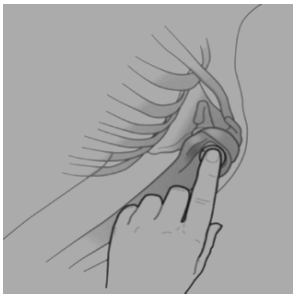
Various sizes of needle are available (*see* Figure E13.3) for different-sized patients.

***Figure E13.3**. EZ-IO power drill and needles*



The landmarks are as before, using the upper end of the tibia. In pregnancy the upper outer aspect of the humerus is a better site (see Figure E13.4)

***Figure E13.4**. Site for EZ-IO needle in the proximal humerus in pregnancy*



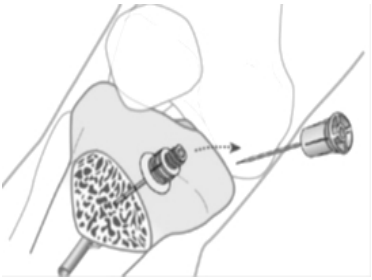
The procedure is less painful for the conscious patient due to its rapidity, the drilling effect and the sharpness of the needles. The EZ-IO needles are available in two sizes, for patients under 40 kg and over 40 kg.

The procedure for insertion is as follows:

1 Take universal precautions for sterile procedure. Clean the site.
2 Choose an appropriate size of needle and attach it to the drill. It will fix magnetically.
3 Remove the safety cap from the needle.
4 If the patient is conscious, control their movement during insertion.
5 Hold the drill and needle at 90° to the skin surface and push through the skin without drilling, until bone is felt. Ensure that at least 5 mm of the needle is visible at this point.
6 Squeeze the drill button and drill continuously, applying gentle steady downward pressure until there is sudden loss of resistance – there is a palpable 'give' as the needle breaches the cortex. Release the trigger and stop insertion at this point.
7 If the driver stalls and will not penetrate the bone you may be applying too much downward pressure.

8 If the driver fails (this is rare) remove it, grasp the needle kit by hand and twist it into the bone marrow.
9 Remove the drill and unscrew the trochar.
10 Aspirate the bone marrow if possible directly from the needle.
11 Attach the pre-prepared connection tube containing sterile Ringer-lactate or Hartmann's solution or 0.9% saline before any infusion is given. Do not attach a syringe directly to the EZ-IO catheter hub except when drawing blood with the needle set stabilised by hand (sterile).
12 Proceed with the required therapy. It should be noted that rapid infusion of fluid may be painful for the conscious patient.
13 Apply a sterile dressing.
14 When removing the catheter, attach a Luer lock syringe, and continuously rotate it clockwise while slowly and gently applying traction to the catheter. Do not rock or bend the catheter during removal.
15 Do not leave the catheter in place for more than 24 hours.

***Figure E13.5**. EZ-IO needle in place, with stylet removed.*



Cut-down venous cannulation

Indication

Continuous IV access is needed where percutaneous attempts have failed. In the emergency situation, intra-osseous access, if available, is faster and easier. Cut-down is less appropriate if speed is essential.

Preparation of kit

The following equipment is needed:

- skin prep (iodine, alcohol)
- scalpel
- suture
- IV cannula
- local anaesthetic
- curved artery forceps
- syringe and hypodermic needle
- sterile drapes.

Procedure

Long saphenous vein:

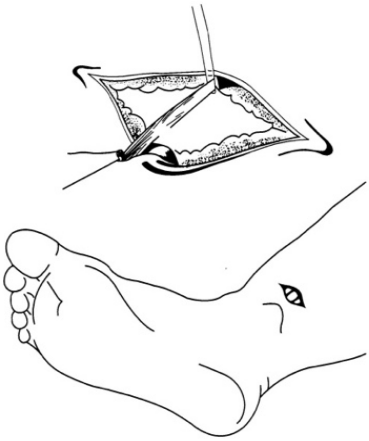
1. Immobilise the lower leg and clean the skin, as described above. Identify the long saphenous vein, which lies 1-2 finger breadths (in pregnancy) superior and anterior to the medial malleolus.
2. Clean the skin and drape with sterile towels.
3. Infiltrate the skin with 1% lignocaine using a fine 24- to 25G needle and make an incision through the skin perpendicular to the long axis of the vein. Bluntly dissect the subcutaneous tissue with haemostat forceps.
4. Identify and free a 1–2 cm section of vein. Pass a proximal and distal ligature.
5. Tie off * the distal end of the vein, keeping the ties as long as possible for traction.
6. Make a small hole in the upper part of the exposed vein, gently dilate the opening with the tip of a closed haemostat and insert the cannula (without the needle/trocar in it) into this, while holding the distal tie to stabilise the position of the vein.
7. Secure the cannula in place with the upper ligature.
8. Attach a syringe filled with Ringer-lactate or Hartmann's solution or saline and ensure that the fluid flows freely up the vein. If it does not, check that the cannula is in the vein or try withdrawing it slightly to improve the flow.
9. Tie the distal ligature* around the catheter, and then close the skin incision with interrupted sutures.
10. Place antiseptic ointment (e.g. iodine) over the wound, and suture or tape the catheter to the skin (ensure that local anaesthetic is used at the suture site if the patient is conscious). Cover with sterile dressing.
11. **It is also possible to dispense with the proximal and distal ligatures and simply penetrate the vein directly with a plastic over-the-needle cannula as you would if penetrating the skin externally. Once in the vein, remove the inner needle and secure in position.**

Complications

These include the following:

1. haemorrhage or haematoma
2. perforation of the posterior wall of the vein
3. nerve transection
4. phlebitis
5. venous thrombosis.

Figure E13.6. *Cut-down incision showing vein and position of cut-down on long saphenous vein at ankle.*



Section E14. Insertion of an orogastric or nasogastric tube

The nasogastric tube is used to feed any patient who is unable to take food by mouth.

Preparation of kit

The following equipment is needed:

1. nasogastric tube
2. lubricant
3. pH indicator paper or litmus paper
4. syringe
5. stethoscope
6. adhesive tape.

Procedure

1. Place the patient supine with their head in the 'sniffing' position.
2. Measure the length of the tube from the nose via the earlobe to the mid-point between the xiphoid and the umbilicus. Mark the tube at this point with indelible pen.
3. Feed the tube lubricated with KY Jelly or saline through either the nose or the mouth directly backwards. Try to advance the tube as the patient swallows.
4. Check the position of the tube by very gently aspirating 0.5 mL of stomach contents using a small (2- or 5-mL) syringe and checking the change in the pH indicator paper (the pH should be 5.5 or less, or the litmus paper should change colour from blue to pink), or flush the tube with 2–3 mL of air and listen over the stomach area with the stethoscope. If in doubt, X-ray the chest and/or abdomen if available.
5. If there is any doubt about the location of the tube, withdraw it and start again. Withdraw immediately if the patient starts coughing, as the tube may then be in the airway.
6. Secure the tube by taping it to the cheek and record the length of tube outside the nose or mouth.
7. When the tube is in place, fix a 50-mL syringe (without the plunger) to the end of the tube, and pour food or fluid into the syringe, allowing it to flow by gravity.
8. The nasal route is more comfortable and secure.

Never pass a nasogastric tube in a head-injured patient. An orogastric tube is safe. If there is a base-of-skull fracture, a nasal tube could be pushed into brain tissue.

Figure E14.1. *Inserting a nasogastric tub*
(a) The distance from the nose to the ear and then to the epigastrium is measured.
(b) The tube is then inserted to the measured distance.