ESS & EMCH Course

ESSENTIAL SURGICAL SKILLS WITH SPECIAL EMPHASIS ON EMERGENCY MATERNAL & CHILD HEALTH

ESS & EMCH

The Practical Approach to Emergencies in the Pregnant Mother, Newborn infant and Child

PROVIDER MANUAL

PROVIDER MANUAL FOR THE EMERGENCY CARE OF CRITICALLY ILL AND INJURED INFANTS, CHILDREN AND PREGANT MOTHERS

ESS & EMCH

Essential Surgical Skills with special emphasis on Emergency Maternal and Child Health

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The material in this manual was derived from a number of different sources. Throughout it has been made as compatible as possible with published advice from the World Health Organisation. The following were major sources of the material:

Initiative for maternal mortality programme assessment. IMMPACT www.who.int/reproductive-health/impac/

The International Federation of Infection Control www.ifac.narod.ru

Primary Mothercare Ed. Maurice King

The Resuscitation Council (UK) and Richmond S (ed). Resuscitation at birth. The Newborn Life Support (NLS) Provider Course Manual The Resuscitation Council (UK) 2001 London.

CD Rom of APLS (emergency care of babies and children). The CD Rom includes 120 videos and more than 400 X-rays and other clinical pictures. Published BMJ Books April 2003.

CD Rom of obstetric and neonatal emergency care (still under preparation)

International Child Health Care: a practical manual for the hospital care of children worldwide. Published BMJ Books November 2001.

Pocket Emergency Paediatric Care - A Practical Guide to the Diagnosis and Management of Paediatric Emergencies in hospitals and other healthcare facilities worldwide. British Medical Journal Books. 2003

A manual for the control of pain in children. Royal College of Paediatrics and Child Health UK 1990

Advanced Paediatric Life Support: The Practical Approach, BMJ Books.

Managing Obstetric Emergencies & Trauma: The Practical Approach, RCOG Publications

A Pocket Guide to Teaching, BMJ Books

Cardiopulmonary resuscitation. Irfan Mirza

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In the manual reference to the corresponding sections of 4 WHO publications are included. These are:

1. Surgical Care at the District Hospital. WHO 2003 and the Integrated Management for Emergency and essential Surgical Care (IMEESC) Tool. Department of Essential Health Technologies, World Health Organization, 20 Avenue Appia, 1211, Geneva 27,Switzerland Fax: 41 22 791 4836 Internet: www.who.int/surgery
Labelled in blue and with prefix "IMEESC"

2. Integrated Management of Pregnancy and Childbirth. Managing Newborn Problems: a guide for doctors, nurses and midwives. WHO 2003 ISBN 92 4 154622 0
Labelled in pink with prefix "WHO Newborn"

3. Integrated Management of Pregnancy and Childbirth. Managing Complications in Pregnancy and Childbirth: a guide for midwives and doctors. WHO 2005 ISBN 92 4 154587 9 **Labelled in red with prefix "WHO pregnancy"**

Contents

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12	Management of Paediatric Emergencies Recognition seriously ill child: rapid assessment ABCD Infant or child with breathing difficulties Upper airway obstruction Croup Epiglottitis Anaphylaxis Wheeze Bronchiolitis Asthma Lower respiratory tract infection Infant or child with shock Dehydration Gastroenteritis Diabetic ketoacidosis Septicaemia Dengue haemorrhagic fever Cardiogenic Cardiac arrhythmias Infant or child with acute renal failure Infant or child in coma Meningitis Malaria Infant or child with convulsions Infant or child with severe malnutrition

Introduction to the ESS-EMCH manual

Every effort has been made to ensure that the medical advice given in this manual on Emergency Maternal and Child Healthcare reflects the best available evidence and that the drug dosages are accurate. However, the authors and publishers (Childhealth Advocacy International-CAI) cannot be responsible for any clinical problems that may result from any errors of fact or advice given in this publication. Always check drug doses before administration.

We have done all we can to make the information available here compatible with advice given by the World Health Organization in its publications relating to maternal and child healthcare. When there are differences between our recommendations and those of WHO we provide the readers with both versions.

We invite readers to make comments or suggestions on the material presented here. We promise to look carefully at these and to modify the manual accordingly if the evidence behind the suggestions is considered to be convincing. Please send suggestions and comments to the following email address: davids@doctors.org.uk

We will update the sections of this manual on-line when new information becomes available. The header for each section shows the date on which it was last modified.

Finally, we are providing this material free of charge to those healthcare workers based in disadvantaged countries. We hope that you find it helpful. For those who download and use this manual in well resourced countries we would ask that you consider making a donation to the work of our two aid agencies. Please contact the address below if you wish to donate.

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SECTION 1: Infection prevention (IMEESC 2.1 and WHO pregnancy C-17)

General issues

- minimize the risk of transmitting hepatitis, HIV-AIDS and other serious infections to the patients and to all staff
- every person (patient or staff) must be considered potentially infectious
- wear gloves before touching anything wet—broken skin, mucous membranes, blood or other body fluids (secretions or excretions)
- use barriers (protective goggles, face masks or aprons) if splashes and spills of any body fluids (secretions or excretions) are anticipated
- use safe work practices such as not recapping or bending needles, proper instrument processing and proper disposal of medical waste.

Hand washing

For staff, visitors and patients this is the most important factor in preventing cross-infection

- supplies of clean water, soap or disinfectant, individual towels for drying (paper or cloth) are needed
- all jewellery (except wedding rings) should be removed

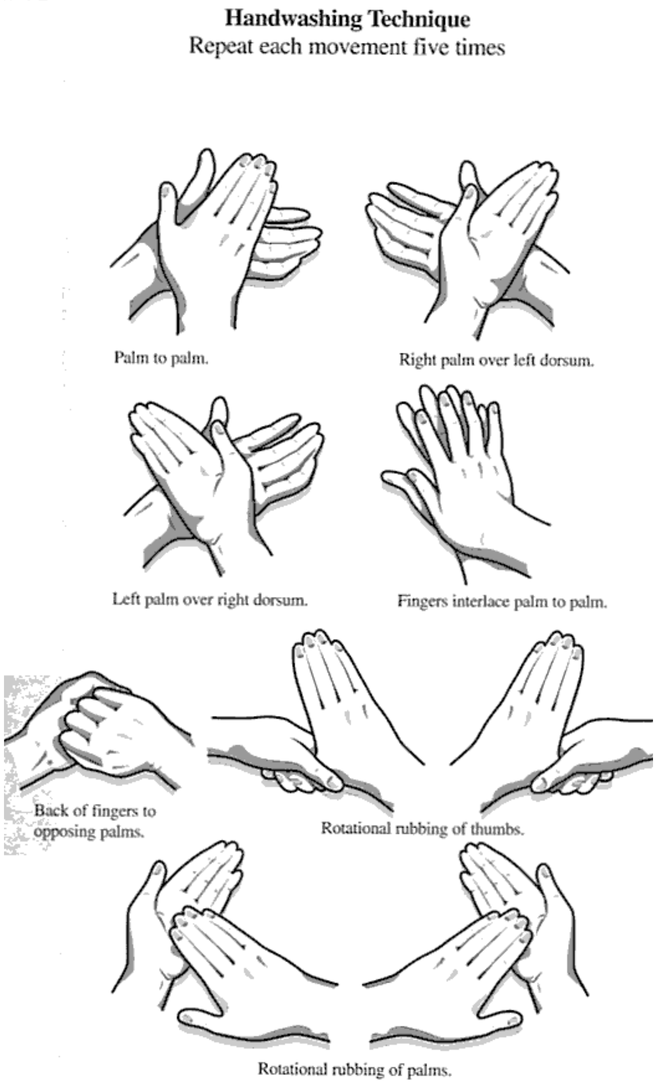
For all methods – technique is as in Figure below

Methods of hand washing

- Social Hand washing
    - Use plain soap and water
    - Wash all surfaces of hands vigorously for at least 10 seconds

- Hygienic hand washing
    - Use disinfectant and water eg. 4% chlorhexidine/detergent solution or alcohol solution eg. 70% alcohol with emollient
    - If using disinfectant and water – wash hands for 10-15 seconds
    - If using alcohol solution – apply at least 3mls and rub until dry
    - Alcohol is effective when no water and/or towels available

- Surgical hand washing
    - As for hygienic hand washing
    - Time of scrub – 2-3 minutes
    - Area – include wrist and forearms
    - Volume – 2 applications of 5mls each rubbed until dry
    - Sterile nail brushes (if available) – to clean fingernails only and only for first scrub of the day
    - Sterile towels to dry hands



Gloves

NOT A SUBSTITUTE FOR HAND WASHING

A glove does not provide complete protection against the spread of infection. During surgery, for example, 20-30% of gloves are punctured. However, the use of gloves is essential to reduce the spread of microorganisms, and protect patients and staff from infection.

There are various types of sterile packages. For some sterility of the outer surface of the sterile content is lost the moment pack is opened. Such articles are suitable for use in the ward (e. g., disposable syringes packed in plastic sleeves, feeding tubes, Foley's catheter) but these are not suitable for handing over to someone working the operation field.

Cautions

- Do not use the same gloves – between patients
  between dirty and clean procedures in the same patient
- Wash hands after removing gloves and before wearing sterile gloves

The type of gloves used for different procedures is shown in Table 1 below

Table 1: Glove and gown requirements for common procedures

PROCEDURES	Preferred Gloves	Gown
Blood drawing, starting IV infusion, airway procedures	Exam *	None
Pelvic examination	Exam	None
Manual vacuum aspiration, colpotomy, repair of cervical or perineal tears	High-level disinfected surgical **	None
Laparotomy, major surgery e.g. CS, manual removal of placenta, childbirth, dilatation and curettage, invasive procedures such as central venous line insertion, repair of ruptured uterus, salpingectomy, bimanual compression of uterus, manual removal of placenta, correcting uterine inversion, instrumental delivery	Sterile surgical**	Clean, high-level disinfected or sterile
Handling and cleaning instruments	Utility ***	None
Handling contaminated waste	Utility	None
Cleaning blood or body fluid spills	Utility	None

Gloves and gowns are not required to be worn to check blood pressure or temperature, or to give injections.

* Exam gloves are single-use disposable latex gloves. If gloves are reusable, they should be decontaminated, cleaned and either sterilized or high-level disinfected before use.

** Surgical gloves are latex gloves that are sized to fit the hand.

*** Utility gloves are thick household gloves.

When putting on sterile gloves, it is essential that the external surface of the gloves is not touched by the operator's hands.

Barriers – protective gowns, aprons, goggles, face masks

Gowns

- Use clean gown for all major procedures (see table above)
- Gloves should be put over gown so gloves are not contaminated
- Keep gloved hands above waist level and do not touch gown with gloves

Aprons

- Minimises cross-infection and protects uniforms
- Wear clean apron during childbirth

Goggles

Wear eye-shield or glasses when operating or helping at operations or in childbirth

Sharps

- Use sharps "bin" with container made from tin or strong plastic which needles cannot penetrate to scratch someone. Only fill to ¾ full, then tape over lid for security
- Never put plastic cover back on used needle
- Never bend or break needles before disposal
- Burn used needles so they cannot be re-used
- Make sure contaminated disposable syringes are disposed of safely and ***not*** on a rubbish tip
- For surgical needles – use needle-holders wherever possible
- Put all sharp instruments into a receiver – ***Do not pass hand to hand***
- Tell other workers before passing sharps

Decontamination of equipment and the environment

Clean bucket containing clean squares of cloth and below it dirty bucket to receive cloths after hand washing

Decontamination removes or destroys microorganisms to make an object safe. It includes cleaning, disinfection and sterilisation.

Cleaning

Cleaning removes foreign material (eg. soil, organic matter, micro-organisms) from an object. Cleaning does not remove these things completely: rather only the load is reduced.

Disinfection

Disinfection educes the number of microorganisms (but not bacterial spores from objects or skin) to a level which is not harmful to health.

High level disinfection

This is used to kill mycobacterium tuberculosis and enteroviruses as well as bacteria, fungi and some other viruses.

Sterilisation

This destroys all microorganisms including bacterial spores. The level of decontamination should be such that there is no risk of infection when using equipment.

To prevent infection during obstetric procedures

Wash hands with soap and water.
Put gloves on. The type will depend on the procedure (see table 1 **"Glove and gown requirements for common procedures"**).
Wash area with soap and water (for vaginal/cervical procedures wash lower abdomen and perineum).

For vaginal and cervical procedures

Use high-level disinfected or sterile instruments.

Apply antiseptic solution 3 times to vagina and cervix, using ring forceps and cotton or gauze swabs.

For lower abdominal procedures eg. symphysiotomy

Use high-level disinfected or sterile ring forceps and cotton or gauze swabs.

Apply antiseptic solution 3 times to the area – begin at centre and work outward in circular motion. **NEVER** go back to the middle of a prepared area with the same swab.

Prevention of post-operative wound infections

Surgical categories

Prophylactic antibiotics are required for
- Dirty operations eg those involving the bowel
- Clean operations with a high risk of infection eg any caesarean section, especially if there is prolonged rupture of the membranes

For these situations a relevant antibiotic should be given at the beginning of the procedure, followed by no more than two doses afterwards.

Recent evidence promotes a single dose of first generation cephalosporin or ampicillin to reduce the 8% risk of endometriosis, or urinary or wound infection after Caesarian Section.

Skin Care

Remove hair with clippers if needed. Shaving is only safe if it does not leave cuts in the skin.

To disinfect the skin use alcohol solutions with disinfectants eg. chlorhexidine or iodine and apply with friction over a wide area for 3-4 minutes. Allow area to dry before starting the procedure.

Section 1

Self Assess (1)

1. ***Hand-washing is not necessary between the examination of different patients*** True/False
2. ***It is not necessary to wash your hands if you wear gloves?*** True/False
3. ***For standard pelvic examinations the following gloves should be used:***
   (a) Sterile surgical
   (b) Utility
   (c) High level disinfected surgical
   (d) Examination – single use disposable
4. ***After using a syringe and needle put the plastic cover back on the needle before disposal.*** True/False

ANSWERS:

1. **False**
2. **False**
3. **(d)**
4. **False**

SECTION 2: Principles of managing emergencies (IMEESC 10.2, 3.2 and 16.3 and WHO pregnancy C15 and C3)

Approach to emergencies

Training

Members of the clinical team must know their roles and ideally will have trained together in:

- Clinical situations and their diagnoses and treatments. Practice drills can be very useful
- 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.

Initial management

- Stay calm.
- **Do not leave the patient unattended.**
- Have one person in charge to avoid confusion.
- **SHOUT FOR HELP.** Have one person go for help and another to get emergency equipment and supplies for example oxygen cylinder, emergency kit.
- Assess **Airway, Breathing, Circulation** and **Disability.**
- If patient is conscious, ask what happened and what symptoms he/she has.

Triage *Seeing the sickest first*

Rapid initial assessment

When a woman of childbearing age, baby or child presents with a problem, rapidly assess and determine how urgently the patient should be seen. This requires the ability to recognise patients who need urgent treatment, and to act quickly and appropriately.

This can be done by:

• training all staff—including clerks, guards, door-keepers or switchboard operators— to get help when a patient arrives as an emergency.

• practicing clinical and emergency drills with staff.

• ensuring that access is not blocked, door keys are available, equipment is in working order (requires daily checks and logbooks) and staff are properly trained to use it.

• having protocols (and knowing how to use them) to recognize a genuine emergency and know how to react immediately.

- having pathways of emergency care laminated and on the walls in areas where emergencies are managed

• clearly identifying which patient in the waiting room needs urgent attention from the health worker and should therefore pass to the front of the queue: that is symptoms/signs noted in **Table** 2 for pregnant women or symptoms/signs outlined in **Table** 3 for babies and children

• agreeing on schemes by which patients with emergencies can be exempted from payment, at least temporarily (local insurance schemes, health committee emergency funds).

Table 2 Rapid initial assessment of a mother who may be pregnant

Assess	Danger signs	Consider
Airway and breathing	**LOOK FOR** • cyanosis (blueness) • respiratory distress **EXAMINE:** • skin: pallor • lungs: wheezing or creps	• severe asthma • pneumonia • heart failure • severe anaemia • malaria • diabetic ketoacidosis • anaphylaxis • pulmonary embolus • amniotic fluid embolus See **Difficulty in breathing**
Circulation (signs of shock)	**EXAMINE:** • skin: cool and clammy • pulse: fast (110 or more) and weak (pulse may be bounding in septic shock) • blood pressure: low (systolic less than 90 mm Hg) • urine output absent	• Haemorrhage-revealed or concealed • Severe gastroenteritis • Septicaemia • Anaphylaxis • Trauma See: **Shock** and trauma
Vaginal bleeding (early or late pregnancy or after childbirth)	**ASK IF:** • pregnant, length of gestation • recently given birth • placenta delivered **EXAMINE:** • vulva: amount of bleeding, placenta retained, obvious tears • uterus: atony • bladder: full **DO NOT DO A VAGINAL EXAM IF THERE IS A RISK OF PLACENTA PRAEVIA**	• abortion • ectopic pregnancy • molar pregnancy See **Vaginal bleeding in early pregancy** abruptio placentae placenta praevia ruptured uterus See **Vaginal bleeding in later pregnancy and labour** • atonic uterus • tears of cervix and vagina • retained placenta • inverted uterus See **Vaginal bleeding after childbirth**
Unconscious or convulsing	**ASK IF:** • pregnant, length of gestation **EXAMINE:**	• Eclampsia • Malaria • Epilepsy • Tetanus

Assess	**Danger signs**	**Consider**
	• blood pressure: high (diastolic 90 mm Hg or more) • temperature: 38°C or more (may be normal in eclampsia)	• Meningitis • Poisoning See **Convulsions or loss of consciousness**
Dangerous fever	**ASK IF:** • weak, lethargic • frequent, painful urination **EXAMINE:** • temperature: 38°C or more • unconscious • neck: stiffness • lungs: shallow breathing, consolidation • abdomen: severe tenderness • vulva: purulent discharge • breasts: tender	• Septicaemia • urinary tract infection • malaria See **Fever during pregnancy and labour** • metritis • pelvic abscess • peritonitis • breast infection See **Fever after childbirth** • complications of abortion See **Vaginal bleeding in early pregnancy** • pneumonia See **Difficulty in breathing**
Severe abdominal pain	**ASK IF** • pregnant, length of gestation **EXAMINE** • blood pressure: low (systolic less than 90 mm Hg) • pulse: fast (110 or more) • temperature: 38°C or more • uterus: state of pregnancy	• ovarian cyst • appendicitis • ectopic pregnancy See **Abdominal pain in early pregnancy** • possible term or preterm labour • amnionitis • abruptio placenta • ruptured uterus See **Abdominal pain in later pregnancy and after childbirth**

The mother also needs **prompt attention** if she has any of the following signs:

• BLEEDING with palpable contractions;
• ruptured membranes;
• pallor;
• weakness;
• fainting;
• severe headaches;
• blurred vision;
• vomiting;
• fever;
• respiratory distress. The mother should be sent to the front of the queue and promptly treated.

Triage of Children

Emergency Triage Assessment and Treatment (ETAT)

Triage is the process of rapidly screening sick children and infants when they first arrive at the health facility and placing them in one of 3 groups:

- **Emergency signs- patients** who require immediate treatment to avert death. This group includes those with IMCI "Danger signs"
- **Priority signs -patients** who should be given priority within the queue so that they can be assessed and treated without delay
- **Non-urgent cases-patients** who have neither emergency or priority signs

Check for Neck / Head Trauma before treating child – do not move neck if cervical spine injury is possible

EMERGENCY SIGNS

Always assess in the following order

- **Airway**
- **Breathing**
- **Circulation**
- **Disability**

If any emergency signs present:

- give treatment(s)
- call for help
- take blood for emergency laboratory investigations (Blood glucose, Malaria screen, Hb, Blood culture if possible etc)

TABLE 3 Rapid initial assessment of a child

Assess	Emergency signs	Treatment
1. AIRWAY AND BREATHING	Obstructed breathing **or** Central Cyanosis **or** Severe Respiratory Distress **or** Oxygen Saturations <92% if available	IF FOREIGN BODY ASPIRATION *See BLS Choking Protocol* IF NO FOREIGN BODY ASPIRATION Manage airway ie: Head tilt/chin lift unless neck trauma (jaw thrust) Neutral position (infant); Sniffing (child) Oro-pharyngeal airway Give Oxygen Ensure Child is warm

2. **CIRCULATION**	Cold Hands with Capillary Refill Time longer than 3 seconds AND Weak and fast pulse Low Blood pressure Check state of nutrition	Stop any bleeding Give Oxygen Ensure child is not hypothermic **IF NOT SEVERLY MALNOURISHED** Insert IV and begin giving fluids rapidly (20mls/kg) If not able to gain peripheral access use intraosseous or other method IF SEVERLY MALNOURISHED (visible severe wasting especially buttocks and bilateral pedal oedema) **If lethargic or unconscious** Give IV glucose (5mls/kg 10% glucose) Insert IV line and give fluids (15mls/kg over 1 hour – 0.9% Saline and 5% Dextrose wait 2 hrs for response) **If not lethargic or unconscious** Give Glucose orally or per NG tube Proceed immediately to full assessment and treatment
3. **DISABILITY**	Coma (**U** on AVPU) Convulsing (now)	Manage airway IF CONVULSING Give diazepam or other appropriate anticonvulsant IF UNCONSCIOUS If trauma suspected stabilise neck If trauma not suspected position child in left lateral position Give IV 5ml/Kg 10% glucose Make sure child is warm
4. **HYDRATION** (child with diarrhea-)	**Diarrhea plus any 2 of:** • Lethargy • Sunken eyes • Very Slow capillary refill (skin pinch) (>3 secs) **IMCI "Danger signs" of:** Vomiting continuously Unable to drink	**IF NO SEVERE MALNUTRITION** Insert IV line and begin giving fluids rapidly – according to WHO Plan C **IF SEVERE MALNUTRITION** Do not insert IV Proceed immediately to full assessment and treatment

PRIORITY SIGNS - these children need prompt assessment and treatment

- Visible severe wasting
- Oedema of both feet
- Severe palmar pallor
- Any sick young infant (<2 months of age)
- Lethargy
- Continually irritable and restless
- Major burn
- Any Respiratory Distress
- An Urgent Referral Note from another facility

Note: If a child has trauma or other surgical problems, get surgical help – follow trauma guidelines.

NON-URGENT CASES – proceed with assessment and further treatment according to the child's priority

Triage decision making

Triage decisions are based on

- Initial assessment for emergency signs
  - ABCD and hydration
- Reassessment
  - Looking for priority signs
  - If patients condition changes

Triage categories change with the patient's condition. Patients should be reassessed and their triage category changed if necessary. Categories can be classed as:

1. Immediate
2. Very urgent
3. Urgent
4. Standard

Life threat	Threat to vital functions (ABC) means that the patient is in the **immediate** group. Thus the presence of an insecure airway, inspiratory or expiratory stridor, absent or inadequate breathing and with a rapid weak pulse are significant.
Pain	Pain is a major factor in determining priority. Patients with severe pain should be allocated to the **very urgent** category, those with moderate pain to the **urgent** category, and those with a lesser degree of pain to the **standard** category.
Haemorrhage	Haemorrhage is a feature of many presentations, particularly those during pregnancy or following trauma. For example, 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 be treated **very urgently**.
Conscious level	Unresponsive patients must be an **immediate** priority, those who respond to voice or pain only are categorized as **very urgent**, and those with a history of unconsciousness should be allocated to the **urgent** category. Those fitting are **immediate**.
Temperature	Fever > 38.5°C or < 35°C are always seen **very urgently**.

Section 2 – Self Assess (1)

1) In the initial management of an emergency the following are true:
(a) do not leave patient alone
(b) assess Airway, Breathing, Circulation and Disability
(c) have a number of different persons in charge

2) In undertaking triage in pregnancy:
(a) do ABC first
(b) Vaginal bleeding is important
(c) Cyanosis is a danger sign
(d) Vomiting is a danger sign

3) In undertaking triage in children (ETAT)
(a) Obstructed breathing is a priority not an emergency sign
(b) The presence of severe malnutrition is important in determining treatment
(c) Severe dehydration is an emergency sign

ANSWERS
1) a b 2) a b c 3) b c

SECTION 3: Drug and fluid administration (IMEESC 13.3 and 13.4 and WHO Pregnancy S-55, C-23 and C-34)

Fluid requirements

Dehydration: see Sections 9 and 12

Oral fluid requirements: see Sections 9 and 12

Fluid replacement

Oral rehydration solutions – used in gastro-enteritis to maintain electrolyte balance. Prepare by adding **1 sachet to 7 oz (210 ml)** clean water. **One ounce = 30ml**

Importance of enteral fluids:

- Best method of maintaining caloric intake is through enteral feeding
- If patient is unable to drink then pass gastric tube.
- When commencing feed fill syringe to required amount with feed, draw plunger back as far as possible and then attach syringe to tube. Kink tube and remove plunger. Allow feed to pass into stomach using gravity.
- Observe patient's colour and respiratory rate for any signs of aspiration.

- Breast milk is the best food for infants. It is always available at the correct temperature, no preparation is required and no sterilising equipment involved.
  - If the infant is too ill to suck and is fed through a gastric tube, encourage mother to express milk into sterile receptacle. To encourage release of milk and ease of expression encourage mother to express whilst holding the baby. Store excess milk in a freezer. Defrost the quantity needed for 4 hours of feeding at a time.

IV fluids

IV fluids must only be used when essential and enteral feeds not available or absorbed.
Always check before use: seal is not broken, expiry date, solution is clear and free of visible particles
Dextrose/glucose solutions unless in 0.9% or 0.45% saline are not appropriate for replacing fluid losses
Never infuse plain water IV: causes haemolysis and will be fatal

Always specify concentrations of dextrose and saline solutions to be infused.

Maintenance requirement of electrolytes:

Sodium (Na^+)	3-4 mmol/kg/24 hour in child	150mmol/24hour in mother
Potassium (K^+)	2-3 mmol/kg/24 hour in child	100 mmol/24hour in mother

Crystalloids containing a similar concentration of sodium to plasma (0.9% saline or Hartmann's) are used to replace vascular compartment losses. When infused IV only ¼ remains inside the vascular compartment, the rest passes into the extra-cellular space.

All fluids should be prepared and given using an aseptic technique. It is important to observe cannula site (directly by removing dressing) for redness and swelling before each IV injection.

Observe patient for pain or discomfort at drip site. If any signs of inflammation, stop fluids, reassess need for continuing IV fluid drugs and resite cannula.

Record fluid intake/hour on a fluid balance chart.

Fluids can be calculated in drops/minute as follows: (standard giving sets) 20 drops = 1ml and ml/hour divided by 3 = drops/minute.

Ensure that site is kept clean

Flush cannula with 0.9% saline 4-hourly if continuous fluids are not being given

Section 3 **Self assess 1**

1) ***Enteral fluids are preferred whenever tolerated to IV fluids for the following reasons***
   (a) safer
   (b) can contain more calories
2) ***When giving IV fluids the following are true***
   (a) sterile water is one of the fluids that can be given IV in shock
   (b) the daily requirement of sodium in a child is 3 - 4 mmol/kg/24 hours
   (c) a septic technique is not necessary when placing IV cannula
   (d) 0.9% saline contains a similar concentration of sodium to that in plasma and can be used to replace vascular losses

ANSWERS

1) a b 2) b d [a) sterile water is fatal if given IV, c) strict asepsis is essential]

Prescribing practice and minimising drug errors

Introduction - general

- oral administration is safer and less expensive, if tolerated
- the following antibiotics are as effective orally as IV:
  - amoxycillin, ampicillin, chloramphenicol, ciprofloxacin, co-trimoxazole, erythromycin, flucloxacillin, fluconazole, metronidazole, sodium fusidate,
- if a drug is given down an oro/nasogastric tube, flush through
- rectal drugs are less reliably absorbed than oral drugs
- liquid formulations are better than suppositories for rectal treatment in infants

Prescribing

- use block capitals
- use approved names
- dosages should be in grams (g) milligrams (mg) or micrograms **ALWAYS WRITE MICROGRAMS IN FULL**
- volumes should be in milliliters (ml)
- avoid decimal places when possible (eg write 500mg not 0.5g) if used, prefaced by a zero (eg write 0.5ml not .5ml)
- write times using 24 hour clock

- routes of administration can be abbreviated to: IV (intravenous), IM (intramuscular), PO (orally), SC (subcutaneous) NEB (nebuliser), PR (rectally)
- 'as required' prescriptions must be specific as to how much, how often and for what purpose (indicate maximum 24 hour dose)
- 'stop dates' for short course treatments should be recorded when first prescribed

Measuring Drugs

- multiple sampling from drug vials risks introducing infection: they do not contain preservatives or antiseptic
- dilute drugs so that volumes can accurately be measured eg do not use doses <0.1ml for a 1 ml syringe
- do not forget to consider the dead space in the hub of the syringe for small volumes
- for dilutions >10 fold, use a small syringe to inject the active drug connected by a sterile 3 way tap to a larger syringe and then add diluent to the large syringe to reach desired volume

Delivery

- MUST BE GIVEN IN AN ASEPTIC MANNER
- give IV drugs slowly in all cases
- after injection into line (eg through a 3 way tap), use the usual rate of the IV infusion to drive the drug slowly into the patient
- if there is no background infusion, give sufficient follow-up (flush) of 0.9% saline or 5% dextrose to clear the drug from the cannula or T piece
- repeat flushes of 0.9% saline can result in excess sodium intake in infants - use 0.45% saline if possible
- flush over 2 minutes to avoid sudden surge of drug (remember the hub)

Infusions

- MUST BE GIVEN IN AN ASEPTIC MANNER
- adjust total 24 hour IV fluid intake
- never put more drug or background IV into syringe or burette than is needed over a defined period of time
- check and chart rate of infusion and confirm this by examining amount left every hour
- Use cannula NOT butterfly needles for infusions if available
- DO NOT mix incompatible fluids IV

- do not add drugs to any line containing blood or blood products
- infusions of glucose >10%, and adrenaline, can cause problems if outside the vein
- most IV drugs can be given into an infusion containing 0.9% saline or up to 10% glucose (exceptions include phenytoin and erythromycin)
- if using only one line wait 10 minutes between each drug infused, or separate by 1 ml of 0.9% saline or sterile water

Safe IV infusions where no burettes are available

Mark the infusion bottle with tape for each hour of fluid to be given and label each hour.

Or

Empty until only the necessary amount of fluid to be given is left in bottle

Intravenous Lines

Placement

- always place cannula aseptically and keep the site clean
- use **sterile** bungs, NOT syringes, for closing off cannula/butterfly needles between IV injections

Care

- change giving sets every 3 or 4 days
- change the giving set after blood transfusion, or if a column of blood has entered the infusion tubing from the vein (site of potential bacterial colonization)
- always inspect the cannula tip before and whilst injecting any drug IV - never give a drug into a drip that has started to tissue - severe scarring can occur, for example from calcium solutions.
- always use luer lock connections to minimize extravasations

Sampling

- clear the dead space first (by 3x its volume)
- glucose levels cannot be accurately measured from any line through which a glucose solution is infused
- blood cultures should always be taken from a separate, fresh, venous needle or stab sample
- after sampling, flush the line - beware that repeat flushes of 0.9% saline can result in excess sodium intake in infants

Complications

- infection
    - local infection can become systemic, especially in neonates or the immunosuppressed (eg HIV)
    - if there is erythema in tissue, remove the cannula
    - if lymphangitis is present, remove cannula, take a blood culture from a separate vein and start IV antibiotics
- air embolism
    - umbilical or other central venous lines are particularly high risk
    - another source of air embolus is through the giving set, especially when pumps are used
    - 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
    - in neonates this can occur from the umbilical stump

- all connections must be luer locked
- the connections to the cannula and its entry must be visualized at all times

Minimising Errors with IV infusions

- prescribe or change infusion rates as infrequently as possible
- have the minimum number of IV infusions running at the same time
- use a burette in which no more than the prescribed volume is present (especially in infants and young children, or with drugs like quinine)
- record hourly the amount given (from burette, syringe or infusion bag) and the amount left
- check the infusion site hourly to ensure fluid outside the vein has not occurred
- ensure that flushes are only used when essential and are given slowly over at least 2 minutes
- be careful with potassium solutions given IV (use enteral route when possible)
- check and double check the following:
    - is it the right drug? Check ampoule as well as box
    - is it the right concentration?
    - is shelf life within expiry date?
    - has it been constituted and diluted correctly?
    - is it for the right patient?
    - is the dose right (2 health workers ideally to check the prescription chart)
    - is it the correct syringe? (deal with one patient at a time)
    - is the IV line patent?
    - is a separate flush needed? If so has the flush been checked?
    - are sharps disposed of (including glass ampoules)?
    - has it been signed off as completed (ideally countersigned)?
    - If not received is reason given?

Intramuscular injections

- IM injections are unsafe in shock, especially with opiates
  eg a high dose can be released once recovery of the circulation occurs
- to avoid nerve damage, only the anterior aspect of the quadriceps muscle in the thigh is safe in infants
- alternate between legs if multiple injections are needed
- do not give IM injections if a bleeding tendency is present
- draw back the plunger to ensure that the needle is not in a vein before injecting (especially adrenaline or lidocaine)

In very poorly resourced situations the IM route might be preferred because the drug might reach the patient sooner than if the patient had to wait in a queue to have an IV sited. It also

- requires less nursing time
- less expensive: venous cannula are often in short supply
- as effective as IV injections in many situations

Section 3 **Self assess 2**

1) *When prescribing drugs the following statements are true*
   a) IV administration is safer and less expensive
   b) Flucloxacillin is as effective orally as IV
   c) if given down a nasogastric tube drugs do not need flushing in
   d) are more reliably absorbed rectally than orally

2) *For safe prescribing the following statements are true*
   a) use decimal places
   b) IM means intramuscularly
   c) Micrograms should be spelt in full
   d) Stop dates should be included when first prescribed

ANSWERS

1) b 2) b c d

Section 3 **Self Assess 3**

1) *When preparing for IV or IM injections of drugs the following statements are true*
   a) multiple sampling from a drug vial is good practice
   b) asepsis is essential
   c) give drugs rapidly IV
   d) there is no need to flush in drugs IV if there is a background infusion

2) *When an IV infusion is being given the following statements are true*
   a) never put more drug into syringe or burette than is needed over a defined time period
   b) glucose solution > 10% are safe if they go outside the vein
   c) change giving set after blood transfusion or if column of blood has entered IV tubing from vein

ANSWERS

1) b d 2) a c

Section 3 **Self Assess 4**

1) *To minimise errors with IV infusion the following statements are true*
   a) use a burette in which no more than prescribed volume is present especially if drug is dangerous e.g. quinine
   b) be very careful with potassium solution which should ideally be given orally
   c) change the infusion rates frequently

2) *Regarding IM injections the following statements are true*
   a) IM opiates are safe to give in shock
   b) must not be given if a bleeding tendency is present
   c) if essential to draw back on the plunger to ensure needle is not in vein

ANSWERS

1) a b 2) b c

Blood and blood transfusion and techniques to avoid transfusion wherever possible.
(IMEESC 12.3, 14.7, 13.4 and 13.8 and WHO Pregnancy C-23 and C-34)

Blood must be stored safely, or a bank of adequately screened donors be available 24 hours a day, especially for obstetric emergencies or major trauma.

If giving a blood transfusion, care must be taken to ensure the blood is compatible with the recipient, is infection free and is given safely.

Normal Hb (after the neonatal period) is around 12G/dl.

The WHO defines anaemia as any Hb below 11G/dl but in pregnancy haemodilution means that a figure of <10g/dl is more appropriate.

Severe anaemia in a child is Hb 5G/dl or less. Hb 5G/dl is the widely accepted level at which transfusion might be indicated and < 4G/dl if severe malnutrition. In a pregnant woman, transfusion may be considered at a Hb level of 6 – 7 G/dL taking into account other factors.

Factors other than the Hb level must be taken into account when considering transfusion:

- What is the heart rate? If rapid this will favour the decision to transfuse
- What is the respiration rate? If rapid this will favour the decision to transfuse
- Is a patient grunting? If so this will favour the decision to transfuse
- Is the patient already in circulatory collapse (shock)? ***Transfusion is very urgent***

Some patients will not show any of these features, and it might then be justifiable to delay transfusion and use haematinics – iron and folic acid. Some patients may show the above features and have a Hb of more than 5G. It will also be necessary to transfuse such patients.

Who needs blood?

- Mothers with obstetric emergencies eg APH, PPH
- Children with severe malaria. Usually under 2 years old
- Patients involved in major trauma or surgery
- Children with severe burns

A child's body contains 80ml blood for every kg body weight; hence a 3 year old weighing 12kg will have 960ml blood.

A pregnant mother's body contains 100ml/Kg of blood.

Administration

During initial transfusion give 20ml/kg body weight in a child; i.e. increase the blood volume by 25% (in severe malnutrition give 15ml/Kg and watch carefully for heart failure) and in the **pregnant mother give 2 units (1000 ml) with frusemide 40mg IV after each 500ml.**

The transfusion should ideally take 4 hours except in cases of shock when blood must be given as quickly as possible. Each unit of blood transfused should never take longer than 6 hours. Blood left out of the fridge longer than 6 hours should be discarded.

A trained person must monitor the patient as frequently as possible during a transfusion (T,P,R,BP, urine output)

Blood should be warm before it is infused. This can be achieved by passing the coiled delivery tube through a bowl of lukewarm water by the patient's side (be careful of the risk from electricity at this time) or by warming the transfusion pack under a relative's clothes.

For blood there are 20 drops per ml; in changing ml per hour into drops per minute you divide by 3.

Eg a 10kg child require 10 x 20ml blood for transfusion = 200ml

200ml in 4 hours = 50ml per hour

50ml per hour divided by 3 = 17 drops per minute

Any rate between 16-18 drops per minute would be acceptable for this transfusion

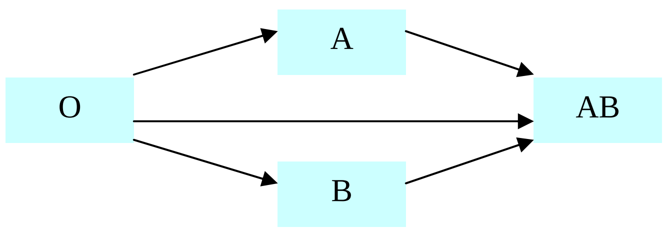
Special issues when transfusing children

If the drip goes at the correct rate throughout the transfusion, you can use the **time** to know when the right amount of blood has been delivered. Eg, the 10kg child with a 500ml bag of blood up, will require only 200ml of it. If you run your transfusion at 16-18 drops per minute as calculated above, you know that the 200ml will have gone through in 4 hours. So, if your transfusion started at 2.00pm, and your drip rate stays at 16-18 drops per minute – your 200ml will have gone in at 6.00pm. **This is more accurate than guessing the amount remaining in the bag.**

The volume delivered can also be derived by weighing the infusion bag and giving set using scales from which the bag/giving set is suspended.

Blood Groups

There are 4 major blood groups - A, B, AB and O. To avoid ABO incompatibility, the blood group of the donor and the receiver must be known. Blood can only be donated in the direction of the arrows:



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 is also categorized according to its rhesus status. Therefore:

Rhesus negative donors can give to rhesus +ve and –ve patients

Rhesus positive donors can only give to rhesus +ve patients

(just thought that needed clarifying)

Rh negative → Rh positive and Rh negative

Rh positive → Rh positive ONLY

Blood O negative is the universal donor blood

If blood group unknown and blood is required before a cross-match can be performed, give O Rhesus negative blood if available.

Is the blood safe?

When possible and regionally appropriate, HIV, syphilis, Hepatitis B and C, malaria and Chagas disease should be screened for. It may be appropriate to give prophylactic anti malarial drugs.

Major transfusion reactions (signs of which include fever > 38 degrees C or anaphylaxis)

Take down blood <u>and the giving set</u> and replace with IV 0.9% saline.

Give treatment as for anaphylaxis: IM **adrenaline**, IV hydrocortisone, promethazine or chlorphenamine

Record ID of blood given

Send specimens of venous blood and samples of the transfused blood to the lab. Take blood cultures if risk of contaminated transfusion.

<u>**Section 3**</u> <u>**Self Assess 5**</u>

1) ***Severe anaemia as defined by WHO and the level at which transfusion is widely accepted is:***
   a) Hb < 5g/dl
   b) Hb < 8g/dl
   c) Hb < 10g/dl
2) ***Total blood volume in a child is:***
   a) 40 ml/kg body weight
   b) 60 ml/kg body weight
   c) 80 ml/kg body weight
3) ***Initial transfusion of blood in an un-shocked child is:***
   a) 20 ml/kg over 8 hours
   b) 40 ml/kg over 4 hours
   c) 20 ml/kg over 4 hours

<u>**ANSWERS**</u>

1) a 2) c 3) c

<u>Section 3</u> **<u>Self Assess 6</u>**

1) Which of the following is true:

a) O rhesus –ve blood can be given to all patients in an emergency when there is no time for X match
b) Patients of blood group AB rhesus –ve are able to receive in an emergency all types of blood

2) If a major transfusion reaction occurs:

a) take down the blood bag, leave the giving set as it is and transfuse IV 0.9% saline
b) take down the bag and replace the giving set with a new one and transfuse IV 0.9% saline
c) leave the blood going but give IV hydrocortisone and an antihistamine

<u>ANSWERS</u>

1) a 2) b

SECTION 4: Pain management, sedation and local and general anaesthesia (IMEESC 3.1, 3.2, 14.7, 3.5, 14.4 to 14.7 and 3.9 and WHO Pregnancy C-43, C-46 and C-58)

Babies and children are often under-treated for pain because of:

- fear of the harmful side effects
- failure to accept that children feel pain like adults
- a child's fear of receiving IM injections

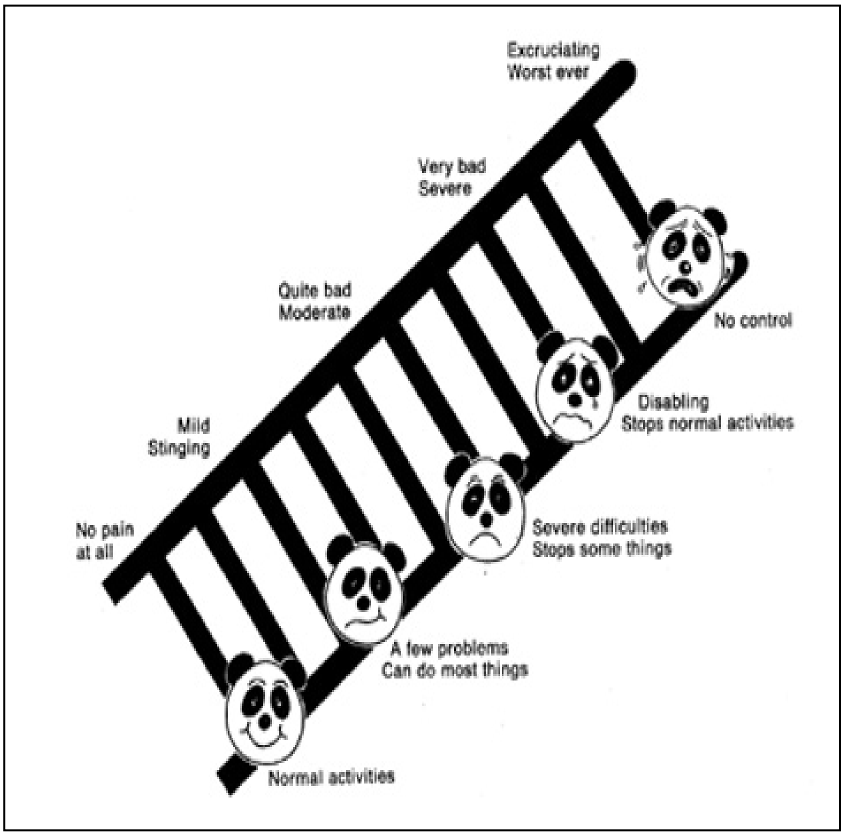
Recognition of Pain

- description from the patient (self-reporting)
- behavioral changes, eg crying, guarding of the injured part, facial grimacing
- physiological changes, eg vasoconstriction, tachycardia, tachypnoea
- expectation of pain because of the pathophysiology involved, eg obstructed labour, placental abruption, fracture, burn or other significant trauma

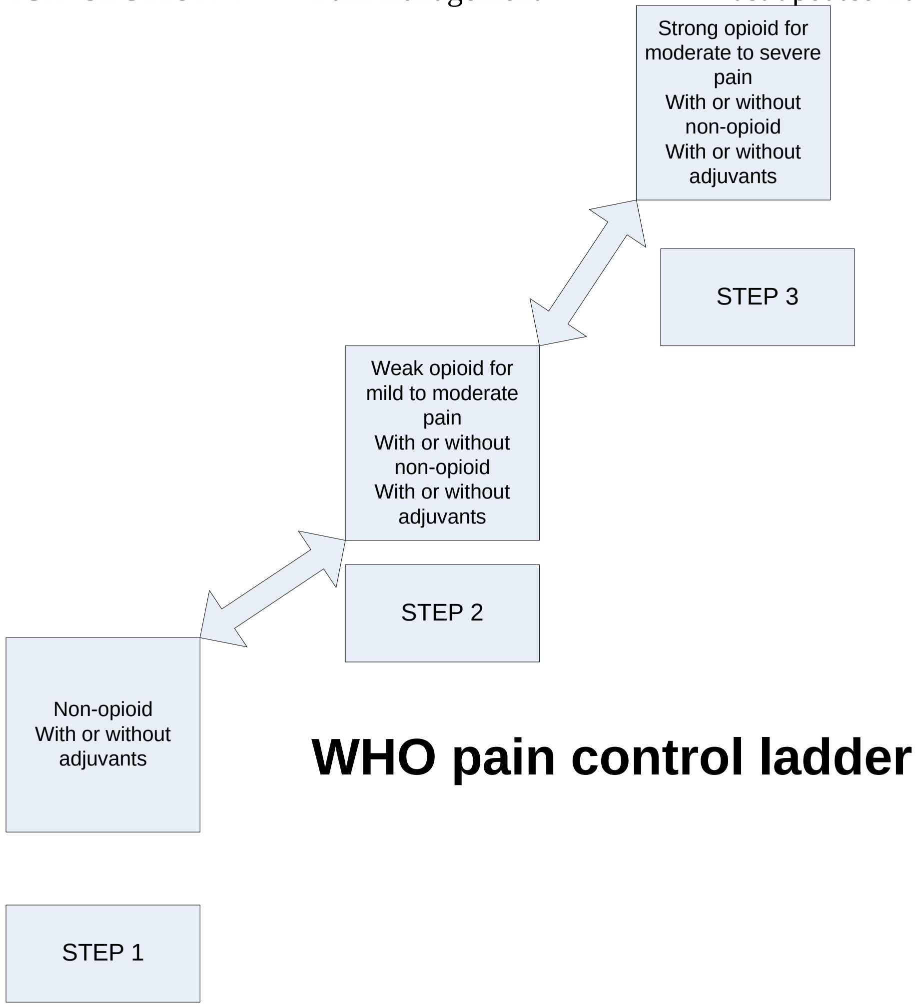
Assessment of pain

- to establish the degree of pain experienced
- to help select the right level of pain relief
- to give an indication of success of pain management

The following are 2 commonly used pain scales:



Face scales for pain assessment – children from 4 to 8 years



*** An adjuvant is another drug (eg steroid or anxiolytic) or type of treatment (eg TENS or radiotherapy) which can relieve pain*

Pain Management - Non-drug Treatment

Distraction – toys, play, allow parents to be present for painful procedures

Pain management - Drug Treatment

Local anaesthetics - infiltrated

Lidocaine 0.5 to 2%

- used for rapid and intense sensory nerve block
- onset of action is within 2 minutes MUST NOT DO PROCEDURE UNTIL TAKES EFFECT
- effective for up to 2 hours
- maximum dose given locally 3 mg/kg (7mg/Kg with 1 in 200,000 adrenaline)
- safest is to use 0.5%
- 3mg/kg of 1%, up to a maximum of 200mg not more than 4 hourly, nothing about increased dose with adrenaline

Preparation of lidocaine 0.5% solution

Combine:

- **lidocaine 1%, 1 part**
- **normal saline or sterile distilled water, 1 part.**

DO NOT use local anaesthetic containing adrenaline in areas served by an end artery, eg finger, toe, penis. Tissue necrosis will occur.

If the **procedure requires a small surface to be anaesthetized** or in the mother **requires less than 40 mL of 0.5% lidocaine**: adrenaline is not necessary.

Advantages of adding adrenaline:

- less blood loss

- longer effect of anaesthetic (usually 1–2 hours);

- less risk of toxicity because of slower absorption into the general circulation.

The concentration of adrenaline to use is 1:200 000 (5 micrograms/mL). In children maximum dose of adrenaline is 5 micrograms/kg.

Note: It is critical to measure adrenaline carefully and accurately using a 1 ml syringe. Mixtures must be prepared observing strict infection prevention practices.

Table 4 Formulas for preparing 0.5% lidocaine solutions containing 1 in 200 000 adrenaline

Desired Amount of Local Anaesthetic Needed	0.9% Saline	Lidocaine 1%	Adrenaline 1:1 000
20 mL	10 mL	10 mL	0.1 mL
40 mL	20 mL	20 mL	0.2 mL
100 mL	50 mL	50 mL	0.5 mL
200 mL	100 mL	100 mL	1.0 mL

COMPLICATIONS OF LOCAL ANAESTHESIA (IMEESC 14.4 and WHO Pregnancy C-38)

Prevention of complications

- If **more than 40 mL of 0.5% lidocaine is to be used**, add adrenaline as above. Procedures that may require more than 40 mL of 0.5% lidocaine are Caesarean Section or 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:

  - moving needle technique (preferred for tissue infiltration): the needle is constantly in motion while injecting, this makes it impossible for a substantial amount of solution to enter a vessel
  - plunger withdrawal technique (preferred when considerable amounts are injected into one site): the syringe plunger is withdrawn before injecting, if blood appears the needle is repositioned and attempted again
  - syringe withdrawal technique: the needle is inserted and the anaesthetic is injected as the syringe is being withdrawn.

Symptoms and signs of lidocaine allergy and toxicity

Allergy: Shock, redness of skin, skin rash/hives, bronchospasm, vomiting, serum sickness

Management of lidocaine allergy

See anaphylaxis section

Management of lidocaine toxicity

Mild Toxicity	Severe Toxicity	Life-Threatening Toxicity (very rare)
• Numbness of lips and tongue • Metallic taste in mouth •Dizziness/lightheadedness • 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 skills should be present
- can be absorbed through mucous membranes in sufficient concentration to be toxic

Immediately stop injecting and prepare to treat severe and life-threatening side effects.

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. Continue the procedure if possible.

Adrenaline Toxicity

Results from excessive amounts or inadvertent IV administration and results in:

- restlessness
- sweating
- hypertension
- cerebral haemorrhage
- rapid heart rate
- cardiac arrest

Bupivicaine 0.25%

- used for longer lasting local anaesthesia
- onset of action is up to 30 minutes
- effective up to 8 hours
- maximum dosage is 2 mg/kg (in mothers pre-pregnant weight)

For uses of other preparations of Bupivicaine –see anaesthetic section

Non-Opiate Analgesics

Paracetamol

- the most widely used analgesic and anti-pyretic
- does not cause respiratory depression
- dangerous in overdose

Non-steroidal anti-inflammatory drugs (NSAID)

- anti-inflammatory, anti-pyretic drug with moderate analgesic properties
- less well tolerated than Paracetamol causing gastric irritation, platelet disorders and bronchospasm
- should be avoided with gastric ulceration, platelet abnormalities, and significant asthma
- especially useful for post-traumatic pain because of anti-inflammatory effect
- given by mouth or by rectal administration (for example diclofenac)

Caution: use in 3rd trimester of pregnancy may close the ductus arteriosus and predispose to pulmonary hypertension of the newborn. It may also delay the onset and progress of labour

Opiate Analgesics

Morphine

- in appropriate dose, analgesia occurs without loss of consciousness

- in single doses has minimal haemodynamic effect in a supine patient with normal circulating volume
- in hypovolaemic patients it will contribute to hypotension
  - monitor cardiovascular status
  - have IV fluid bolus of 0.9% saline ready (20ml/kg in a child and 500ml to 1 litre in a mother)
- opiates produce a dose-dependent depression of ventilation and decreased respiratory rate.
- Patients who have received opiates need observation and/or monitoring of respiratory rate and sedation
  - do not discharge home until the opiate's effects are significantly reduced
- nausea and vomiting seen in adults and children
- better controlled IV than IM—if giving IV, give small dose initially and repeat every 3-5 minutes until patient is comfortable. Individuals vary widely as to the doses needed to provide pain relief
- dangerous in situations of raised intracranial pressure without means to provide respiratory support
- in mothers can produce respiratory depression in the neonate

Codeine

- oral codeine, usually with paracetamol, for moderate pain
- less potent opiate than morphine and has fewer effects on the central nervous system
- Avoid in first trimester of pregnancy (facial abnormalities)
- **codeine must not be given IV as it causes profound hypotension.**
- Do not give codeine and morphine together as codeine will reduce the effect of morphine

Naloxone

Naloxone is an opiate antagonist which reverses sedative, respiratory depressive, and analgesic effects of morphine and codeine

Sedative Drugs

- may be useful with analgesics when undertaking lengthy or repeated procedures. The aim of sedation is to make the procedure more comfortable while maintaining verbal contact with the patient.
- start with small dose IV, wait 2-3 minutes, observe response and repeat if necessary
- relieve anxiety and not pain
- when given to mother can result in floppy babies
- may reduce a patient's ability to communicate discomfort and therefore should NOT be given without concomitant analgesia
- side effects include hyper-excitability or prolonged sedation, delaying discharge after procedure

Midazolam

- is an amnesic and sedative drug
- can be given orally, intra-nasally, or IV

- has an onset time of action of 15 minutes if given orally or intra-nasally
- duration of action is about an hour after oral or intranasal use
- can cause respiratory depression
- needs monitoring of respiratory rate and depth, and pulse oximetry

Diazepam

An anxiolytic, amnesic and sedative drug also used to stop convulsions

- half the sedative potency of midazolam
- can be given orally (15 minutes to onset of action), IV or rectally (few minutes to absorption)
- can cause respiratory depression

Other agents useful for inducing Light Sedation in children

Promethazine hydrochloride (Phenergan): 0.5mg/kg Deep IM or IV, or 1 to 2 mg/kg orally – to maximum of 50mg
Chloral hydrate
single doses up to a maximum of 50mg/kg or total 1gm rectally
25-50mg/kg (max 1g), oral or rectal, 45-60 minutes before procedure
Can give 100mg/kg (max. 2g) with respiratory monitor

Can be used in conjunction with Trimeprazine at 2mg/Kg. In children over 2 years, max 60mg 1-2 hours before procedure

Minimum facilities and skills required to prescribe sedation

Anyone giving sedation, particularly when given IV, could inadvertently produce anaesthesia and must be able to deal with the following possible consequences:

- support respiration
- manage upper airway obstruction – have resuscitation equipment available
- use suction appropriately
- intubate if necessary and available

Patients needing sedation should have oral intake restricted as for anaesthesia.

Some patients are more vulnerable to effects of sedation, particularly those with problems with respiration or the upper airway. If not possible to avoid sedation, give smaller dose than expected for weight.

Procedures:

- are often painful, undignified or both. Ideally should be undertaken in a treatment room so that other patients are not frightened and so that the patient's bed-space is a safe place where such events will not happen.
- often have to be repeated. Therefore provide optimal treatment on first occasion in order to minimise a dread of future procedures
- fear is often the major emotion to address: explain each step
- pharmacological and non pharmacological methods should be used

- for major procedures requiring powerful analgesia/sedation, 2 people should be present, one to undertake the procedure and the other to administer analgesia, sedation and ensure the airway is maintained. These include chest drain insertion and repeated lumbar puncture

For venous cannulation, size appropriate catheters must be available. It is not, for example, appropriate to have to use an 18 or 20 gauge cannula in a neonate.

Give analgesics or sedatives at an appropriate time before the procedure (30 minutes before for IM and 60 minutes before for oral medication but this varies with drug used) so that maximum relief will be provided during the procedure.

Check the level of anaesthesia by pinching the area with forceps. If the patient feels the pinch, wait 2 minutes and then retest.

Wait a few seconds after performing each step or task for the patient to prepare for the next one.

Handle tissue gently and avoid undue retraction, pulling or pressure.

Talk with the patient throughout the procedure.

Post operative pain management

Provide analgesia before pain becomes established.

Use safe and effective doses of opioids along with regular paracetamol and non-steroidals to reduce the amount of opioid required.

Avoid IM injections if possible.

Give analgesia - check response - reassess

Most at risk of poor pain control are children with limited/absent verbal ability.

If pain seems out of proportion to surgical trauma consider complication and re-assessment by surgeons.

If asleep, assume pain is acceptable -don't wake up to make assessment but check regularly to ensure still asleep. If awake and lying quietly do not assume comfortable without enquiring.

Analgesia / anti-emetics during labour

- morphine 10mg IM or 2.5- 5mg IV or pethidine 50- 100 mg IM or 25-50mg IV
- promethazine 25-50 mg IM or IV, max 100mg if vomiting occurs-although some antiemetics better if given before vomiting starts

Barbiturates and sedatives should not be used to relieve anxiety in labour.

Special issues regarding pain in the newborn infant

Neonates (premature and full term) react to, and certainly feel, pain.

Infants can easily be forced to put up with suffering.

Small doses should be measured and given with an oral syringe.

Local anaesthetics must be used when they would be used in an older child undergoing the same procedure.

Pain control during procedures in neonates

Breast feeding during procedures may be helpful.

In all cases comfort and containment (swaddling) should be provided by a parent or a nurse.

Table 5 - analgesic drug doses

Analgesic		
Morphine IV	**Pain Severity**	Moderate - severe
	Dose **No standard dose of IV morphine** **Give repeated small doses until pain is relieved**	Mother:- 10mg diluted to 10mls – give 2mg (2mls) every 5 mins until pain relieved Over 1 year: -200 micrograms/kg – diluted to 10mls – give 2mls every 5 mins until comfortable 1-12 months 100-200 micrograms/kg – diluted to 10mls – give 1-2mls every 5 mins until comfortable Neonate - 50-100 micrograms/kg - diluted to 1ml in 1ml syringe – give 0.2mls boluses every 5 mins with dextrose 10% flush between each bolus
	Frequency of dose	4-6hrly
	Common side effects	Respiratory depression, hypotension
	Comments	Monitor - respiration - SaO2 - ECG (ideally)

Analgesic		
Pethidine IV or IM	**Pain Severity**	Moderate - severe
	Dose	Mother:-1mg/Kg (maximum dose 100mg) – if given IV – dilute to 10mls and give 2 mls every 5 mins until pain relieved Obstetric/acute pain-50-100mg IM, max 400mg/24hrs, then 1-3 hrly Acute pain IV 25-50mg, repeat after 4 hours
	Frequency of dose	3 hourly
	Common side effects	Respiratory depression, hypotension
	Comments	Monitor - respiration - SaO2 - ECG (ideally)

Analgesic		
	Pain Severity	Moderate

Morphine oral	**Dose**	Mother:- 10-20mg Over 1 year: - 400 micrograms/kg Under 1 year: - 200 micrograms/kg
	Frequency of dose	4 hourly
	Common side effects	Constipation
	Comments	Observe respiration

Analgesic		
Codeine ORAL/IM	**Pain Severity**	Mild -moderate
	Dose	Mother:- 30-60mg Child: 0.5-1mg/kg po or im, same dose for neonates
	Frequency of doses	4 hours, max 240mg/24hrs for mothers, max 3mg/kg/24hrs for children
	Common side effects	Constipation
	Comments	Care if < 1 year DO NOT GIVE IV

Analgesic		
Paracetamol oral	**Pain Severity**	Mild
	Dose	Mother:- 500 mg to 1 gram 6 hourly Over 3 months: - 20mg/kg orally or rectally Under 3 months 15mg/kg PO/PR 4-6 hourly max 60mg/kg/day
	Frequency of dose	4-6hrly, max 4g/24hrs for mother, max 80 mg/kg/24hrs for children
	Common side effects	
	Comments	Avoid in liver impairment

Analgesic		
	Pain Severity	Mild - moderate
	Dose	**NOT IN PREGNANCY** Child:- 5mg/kg up to 30mg/kg/day in 3-4 divided doses
	Frequency of dose	6-8 hourly
	Common side effects	Avoid in asthmatics

	Comments	Not recommended for patients <10kg

Analgesic		
Diclofenac - Oral or rectal	**Pain Severity**	Moderate
	Dose	Child over 6 months:- 1mg/kg orally or rectally max 150mg/day
	Frequency of dose	8hr
	Common side effects	**Avoid in asthmatics and NOT IN PREGNANCY**
	Comments	Not for patients under the age of 1yr

Specific Clinical Situations

Severe Pain

- severe pain is likely in obstetric emergencies post operatively post operatively, major trauma, significant burns, displaced or comminuted fractures
- give IV morphine as described above
- a further dose can be given after 5-10 minutes if sufficient analgesia is not achieved
- monitor ABC (HR, RR, chest wall expansions, BP, SaO_2)
- have IV 0.9 saline replacement available (20ml/Kg in a child and 500ml to 1 litre in a mother)

Head Injuries

- an analgesic dose does not necessarily cause sedation
- if the patient is conscious and in pain, the presence of a potential deteriorating head injury is NOT a contraindication to giving morphine but give maximum dose of 100 micrograms/Kg in a child or 5mg in a mother
- if the patient's conscious level does deteriorate, then assess ABC. If hypoventilation occurs, ventilate with bag-valve-mask
- if necessary, a dose of naloxone will help distinguish whether reduced conscious level is due to morphine or increasing intracranial pressure but will reverse analgesia

Venepuncture and Cannulation

The following local anaesthetics can be used prior to venepuncture and cannulation:

- an ice cube inside the finger of a plastic glove placed over the vein to be cannulated
- local anaesthetic infiltration (1% lidocaine) using a fine gauge needle

In some circumstances the urgency of the situation will not allow use of local anaesthetic.

SECTION 4 QUIZ 1

1. **Regarding the WHO pain ladder the following statements are true**
    - a. comprises 2 steps
    - b. step 2 involves combing a strong opioid with or without a non opioid and with or without adjuvants
    - c. is applicable to children and mothers

2. **When giving lidocaine 0.5 to 2% the following statements are true**
    - a. onset is 2 minutes and effectiveness for 2 hours
    - b. maximum dose is 3 mg/kg
    - c. a concentration of adrenaline of 5 micrograms/ml can be added (1 in 200,000)

3. **The following are signs of lidocaine toxicity**
    - a. numbness lips and tongue
    - b. rapid breathing
    - c. tonic clonic convulsions

ANSWERS:

1. c 2. abc 3. ac

SECTION 4 QUIZ 2

1. CONCERNING NSAIDS **the following statements are true**
    - a. should not be given if peptic ulcer or platelet abnormalities
    - b. can be given orally and rectally
    - c. can be safely used in the 3rd trimester of pregnancy

2. CONCERNING OPIATES **the following statements are true**
    - a) it is dangerous to give codeine IV
    - b) it is appropriate to give codeine and morphine together
    - c) are potentially dangerous in raised intracranial pressure
    - d) given IV can drop the blood pressure

ANSWERS:

1. ab (dangerous to fetus in last trimester) 2. acd

Anaesthetic issues (see IMEESC Best Practice Protocols and WHO Pregnancy C37-C-46)

The limiting step is often the availability of "trained anesthetic doctors" - and woman and babies die because of it. Specially trained nurses can safely give adequate anesthesia in many situations.

Anaesthesia for Obstetric patients

Remember there are two patients – mother and baby. The condition of the mother affects the condition of the baby.

ALL pregnant mothers must be put in the left lateral tilt position to avoid aorto-caval compression and supine hypotension.

Maintaining adequate oxygenation and resuscitation of the mother is the best initial way of treating and preventing fetal distress

Potential areas for problems:

Risks to the mother:

Hypoxaemia:
Pregnant women are at risk of hypoxia. They use oxygen faster than non pregnant women, and because of the pregnancy it is more difficult for them to breathe deeply. Pulse oximetry is useful.

Hypovolaemia
Risk in hot season, pre eclampsia, APH, starvation during prolonged labour etc.

Acid regurgitation
The pregnancy pushes the stomach upwards and the gut empties slower, so all pregnant women are at risk. Can result in aspiration pneumonitis. Give 30ml sodium citrate or other appropriate antacid to all women, before Caesarean section.

Risks to the fetus:
Hypoxaemia
Acidosis
Due to reduced placental perfusion. Maternal BP is maintained at the expense of placental flow; so by the time the maternal blood pressure has dropped the baby may already be distressed.

Risks to both
Supine hypotensive syndrome

Problems with surgery:
Blood loss especially in placenta praevia, previous section etc.

Problems with drugs:

Ketamine - causes increase in BP. Should not be given to women with hypertension, but can be used in resuscitation of women with hypovolaemia. Also causes uterine contraction - may be a problem in fetal distress or where extraction of the baby may be a problem - eg. transverse lie. Narcotics and sedatives cross the placenta, so ideally should not be given until the cord is clamped.

Problems with equipment:

Make sure all resuscitation equipment is available and working: bag-valve-mask, airway equipment, oxygen, IV fluids, suction, SaO2, BP.

Preoperative preparation:

Explain to the patient the type of anaesthesia.
Do not give pre op sedative, as it may reduce the baby's respiration and conscious level at birth.
Give antacid (sodium citrate 30mls) immediately prior to anaesthesia.

Spinal (sub-arachnoid) anaesthesia in the pregnant mother

A spinal injection gives a dense block of rapid (within 5-15mins) onset that lasts for about 2 hours and can be ideal for Caesarean Section.

Its downside is that it causes vasodilatation with consequent hypotension. This can be prevented with fluid loading before spinal insertion and treated with IV fluid boluses and ephedrine.
A spinal should not be used if a patient has hypovolaemia, eg due to bleeding or shocked eg due to sepsis or ruptured uterus.

Indications for spinal anaesthesia

Caesarean section: Laparotomy (not optimal): Evacuation of residual products of conception:

Manual removal of placenta: Repair of third and fourth degree tears.

Precautions

Correct hypovolaemia first.

Be aware of the possible subsequent development of a coagulation disorder, for example with severe pre-eclampsia, eclampsia or placental abruption.

Contraindications

No experience of spinal anaesthesia or inadequate resuscitation facilities.

Uncorrected hypovolaemia.

Coagulopathy – eg. if spontaneous bruising.

Fixed cardiac output eg aortic valve stenosis.

Allergy to local anaesthetics.

Localised infection.

Procedure

- Ensure large bore IV cannula (14 or 16G) and IV infusion running.
- Infuse 500 – 1000 ml of IV fluids (normal saline or Ringer's Lactate) to preload mother and avoid hypotension. Also ensure atropine 0.6mg and ephedrine 30 or 50mg diluted to 10ml with 0.9% saline immediately available.
- Check the blood pressure.
- **Sterility is critical. Use antiseptic skin solution to clean the patient's back over a wide area. Use sterile gloves and ideally a sterile apron. Do not touch the point or shaft of the spinal needle with your hand. Hold the needle only by its hub.**
- Prepare the spinal anaesthetic – Bupivicaine 0.5% heavy – 2 to 2.5ml.
- Inject 1% lidocaine solution using a fine 25G needle to anaesthetise the skin over the site – L3/4 or L4/5. Do not use a space above L2/3 because the spinal cord ends at around L1/2.
- Introduce the finest spinal needle available (24G) via an introducer needle in the midline through the anaesthetised skin, at a right angle to the skin in the vertical plane. Fine spinal needles greatly reduce the risk of post dural puncture headache.
- If the **needle hits bone** it may not be in the midline. Withdraw the needle and reinsert it, directing it slightly upwards while aiming in the direction of the umbilicus. It is important to have 2 correct planes ie. midline and also not too near to the spinous processes above or below.
- Advance the spinal needle towards the sub-arachnoid space. A loss of resistance may be felt as the needle pierces the ligamentum flavum.
- Once the needle is through the ligamentum flavum, push the needle slowly through the dura. You may feel another slight loss of resistance as the dura is pierced.
- Remove the stylet. Cerebrospinal fluid (CSF) should flow out of the needle.
- If **CSF does not come out,** reinsert the stylet and rotate the needle gently. Remove the stylet to see if fluid is flowing out. If you continue to fail, try another space.
- Once CS flows out of the needle inject 2 to 2.5ml of the above local anaesthetic solution.

Never proceed with the injection if the patient complains of pain on injection

Lie the mother on her back**. Have the operating table tilted at least 15 degrees to the left or place a pillow or folded linen under her right lower back to decrease supine hypotensive syndrome.**

Recheck the blood pressure every 5 minutes after the spinal is inserted until the end of the procedure. A fall in blood pressure is likely. If there is significant hypotension ie systolic BP <100mmHg or >20% fall, or if the mother has nausea or vomiting.

- Give the IV infusion as fast as possible.
- Give ephedrine in 3-6mg increments until there is a response.
- Give high flow oxygen via face mask.

After the spinal injection wait 5 minutes and then pinch the skin with forceps. There should be no pain with the pinch up to the level of the nipples. If the pinch hurts wait 5 minutes, then retest the level of the spinal block.

After surgery the mother does not have to lie flat, but may not be able to move her legs for 2 – 4 hours. The first time she mobilises after a spinal she should be accompanied in case she has residual weakness.

Complications of spinal anaesthesia

1. Hypotension
2. Sensory block – full bladder, unnoticed by patient
3. Headache can occur following a spinal, but uncommon if small gauge spinal needles are used

Headache occurs because of a leak of CSF, which causes traction on intracranial structures.

A typical headache is frontal and/or occipital and worse on sitting or standing, better when lying down. It can be immediate or delayed.

Management: analgesia as per WHO pain ladder (page xx)

Keep patient well hydrated4. Spread of local anaesthetic

When using “heavy” (ie hyperbaric – heavier than CSF) Bupivicaine as is used for spinals, the position of the patient affects where the local anaesthetic lies and can be used to influence the height of the block. All patients should have their head raised on a pillow to prevent high spread of the anaesthetic. The position of the block can be brought higher by placing the table head down. Gravity can be made to influence the level of the block for up to 20 minutes after the injection.

If there is bradycardia, tingling or weakness in the hands, or difficulty breathing, the block is likely to be high. Give atropine 0.6mg in the mother if bradycardic, increase the IV infusion rate and give ephedrine. An ampoule of ephedrine may be put into the IV infusion.

Intracranial spread can rarely also occur. It produces loss of consciousness and apnoea = Total spinal block.

Management of spinal blocks which are too high or total

Call for help

Airway

Assess and maintain patency

Give oxygen 15L/min via facemask: pulse oximetry – should be already attached

Breathing

Assess and give chest inflations with bag mask valve if there is apnoea or inadequate breathing

Ideally protect airway by intubation if patient is unconscious (P or U on AVPU)

Circulation

High or total spinal blocks can cause cardiac arrest.

Assess pulse and BP

Chest compressions if cardiac arrest or inadequate central pulse (BP may be unrecordable)

Tilt to left if not already

Treat hypotension with IV 0.9% saline and ephedrine

Treat bradycardia <50/min in the mother with atropine 0.6 mg IV, repeated after 3 minutes as necessary

Check fetal heart and consider timing and method of delivery.

Consider and exclude other causes of unconsciousness eg. eclampsia, hypoglycaemia, epilepsy, opioid drugs, intracranial bleed.

Keep chart of pulse, BP, respiratory rate, SaO_2, FH and treatments given.

5. Anaphylaxis: see Section 9 for management

Ketamine in pregnancy

Ketamine causes a trance-like state. It is a unique drug causing sleep, analgesia and short term memory loss (amnesia). The patient is unconscious, pain-free and has no memory of the time under anaesthesia. The pharyngeal and laryngeal reflexes are active but are not completely normal. Therefore it is important that the patient is **starved** and anaesthetised on a **tipping table** with a **sucker** available. It is *relatively* safe (no anaesthesia is 100% safe), acts very *quickly*, and can be given IV or IM.

Contraindications

High BP/PIH/Eclampsia/Heart disease.

Effects:
Ketamine causes sympathetic nervous system stimulation. The additional use of diazepam will reduce the amount of sympathetic stimulation.
Ketamine also raises intracranial pressure which makes it unsuitable for patients with Eclampsia.

Central nervous system:
The effects start 1- 5 minutes after IV injection. It produces a "dissociative state". The eyes may remain open and may make quick side – to –side movements (nystagmus), and the patient may move during surgery. The patient can be quite agitated, crying and distressed on waking up. This can be helped with diazepam (see below) as part of the premedication.
Causes an increase in intracranial pressure.

Cardiovascular system:
Ketamine causes mild stimulation of the CVS – BP rises by about 25% and heart rate increases by 20%. This increases the workload of the heart. Premedication with diazepam (see below) can reduce the rise in BP. A further small dose of diazepam can be given IV if BP rises too high. It is not ideal to give to mothers with PIH because of the rise in blood pressure.

Respiratory system
If given rapidly IV it can stop the patient breathing for up to a minute. Ventilate the patient until the effect wears off. If given slowly the breathing rate may increase. The airway is usually maintained, but still needs to be watched closely. The oxygen saturation may decrease so give oxygen. Ketamine causes bronchodilatation so can be useful in asthmatic patients.
Laryngeal spasm may occur (rarely), and may be caused by secretions or blood falling onto the vocal cords.
Salivation is increased.

Muscle
Tone is increased. This makes it an unsuitable drug for major abdominal surgery where abdominal relaxation is necessary, but is usually not a problem for Caesarean section. Some body movements can occur.

Uterus and placenta

May increase the tone of the uterus. Crosses the placenta easily so the fetus gets ketamine. At doses of >2mg/kg this may cause respiratory depression in the baby. Don't give phenergan or diazepam until after the baby is delivered.

Premedication before Ketamine

Atropine 10-20micrograms/kg (max 600micrograms) IM 30 mins before or IV at induction of anaesthetic.
Diazepam 100micrograms/kg (maximum 10mg in a mother) can be given IV at time of induction to prevent hallucinations (for Caesarean section, give diazepam **after** the baby is delivered).

Give oxygen at 6–8 L per minute by mask or nasal cannulae.

Administration:

Start an IV infusion and ensure reliable IV cannula is in place.

Ketamine may be given IM, IV or by infusion.

Most patients will require 5–10 mg/kg body weight IM. Surgical anaesthesia is reached within 10 minutes and lasts up to 30 minutes.

Alternatively, give 2 mg/kg body weight IV slowly over 2 minutes (in which case the action lasts for only 15 minutes).

Infusion of ketamine is described below. This is suitable for Caesarean section.

When additional pain relief is needed, give ketamine 1 mg/kg body weight IV.

Ketamine anaesthesia should not be used in women with elevated blood pressure, pre-eclampsia, eclampsia or heart disease.

In doses of **250-500micrograms/kg IV** ketamine is a good analgesic.
1-2mg/kg IV or 5-10mg/kg IM is anaesthetic.

KETAMINE INFUSION

- Check vital signs (pulse, blood pressure, respiration, temperature)
- Induction of anaesthesia is achieved by slowly administering ketamine 2 mg/kg body weight IV slowly over 2 minutes. For short procedures lasting less than 15 minutes, this will provide adequate anaesthesia.
- If there are signs of airway obstruction insert an oro-pharyngeal airway
- Ideally, oxygen at 2L/min should be given, but if limited supply, give oxygen if SaO_2 <95%
- For longer procedures, infuse ketamine 200 mg in 100ml 5% dextrose at 2 mg per minute (i.e. 20 drops per minute). May need more or less. Stop the infusion 10 minutes before the end of the operation. If the patient needs a blood transfusion put it through another drip.

  Advantages are:-
  1) gives more control than an IM or IV bolus
  2) uses less ketamine than IM dose
  3) is simple and fast and safe
  4) makes anaesthesia and recovery quick

- Check the level of anaesthesia before proceeding with the surgery. Pinch the incision site with forceps. If the **mother feels the pinch** wait 2 minutes and then retest.

Monitor vital signs (pulse, blood pressure, respiration) every 5 minutes during the procedure.

POST-PROCEDURE CARE

Discontinue ketamine infusion and administer a postoperative analgesic suited to the type of surgery performed.

Takes about 2 hours to wake up. Needs to be in a quiet area. Let her wake up naturally.

Maintain observations every 30 minutes until the mother is fully awake; ketamine anaesthesia may take up to 60 minutes to wear off.

Local Anaesthesia

In extreme situations Caesarean Section can be undertaken under infiltration with local anesthetic. – This is not ideal but can be helpful in an extremely ill patient – for example unconscious and eclamptic - where GA/intubation is not available and ketamine/spinal inadvisable.

SECTION 4 QUIZ 3

1) When giving anaesthesia in pregnancy the following statements are true
   a) left lateral tilt is needed after 22 weeks gestation
   b) acid regurgitation is no more frequent than in the non-pregnant
   c) the mother is susceptible to hypoxaemia

2) Regarding spinal anaesthesia in pregnancy the following statements are true
   a) should not be given if mother has a low blood pressure
   b) can be given if there is a blood clotting disorder
   c) may result in a high spinal block with apnoea or inadequate breathing

3) Regarding ketamine in pregnancy the following statements are true
   a) is contraindicated if there is pre-eclampsia or eclampsia
   b) is contraindicated if hypovolaemia is present
   c) is indicated if heart disease is present

ANSWERS:
1. ac 2. ac 3. a

SECTION 5: Transport of ill patients (see IMEESC Best Practice Protocol and WHO Pregnancy C-80)

Not only between hospitals, but also within the same hospital. All must be approached with the same care.

With pregnancy related emergencies remember there are two patients: mother and baby.

Preparation and planning are essential. All transfers carry potential risks.

The patient must be in the best possible condition before transfer or transport - **no patient should be stabilised 'on the way'.**

Think ahead
Plan ahead
Anticipate problems
Be prepared

All resuscitation, emergency treatment and stabilisation must be performed before moving the patient.

Transfers of sick patients should be carried out by health workers trained in transport.

Never assume that ambulances, if available, will have equipment.

The basic principles of transport are ongoing ABCD

- Have enough oxygen
- Have enough blankets
- Have glucose for giving IV or via gastric tube

SECTION 6: Basic Life Support (IMEESC 13.1 and 13.5)

Introduction

Basic Life Support is a technique that can be employed by a single rescuer to support respiratory and circulatory functions of a collapsed patient using no equipment.

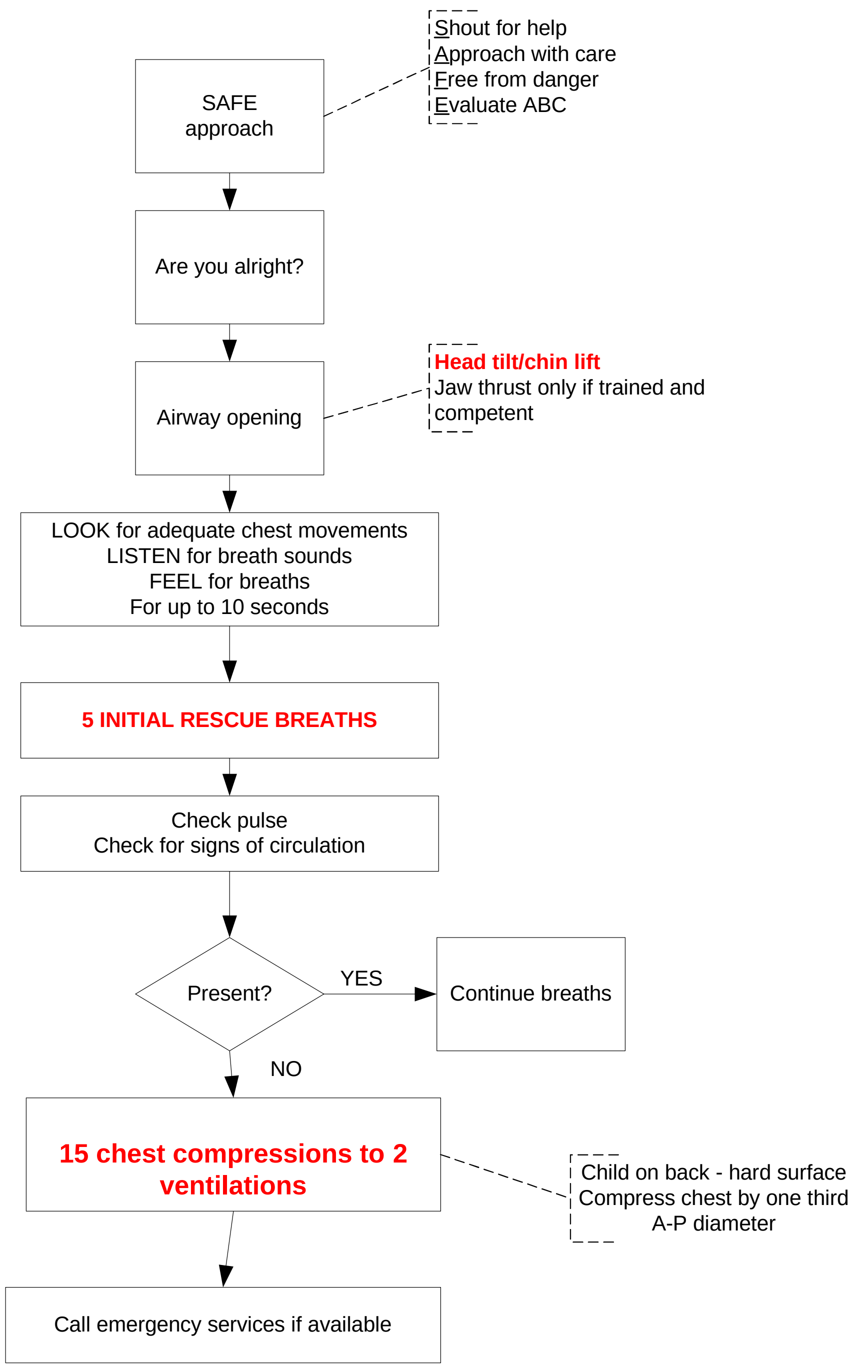
Children are classified into 2 groups:

- Infants (<1 year)
- Children between 1 year and puberty

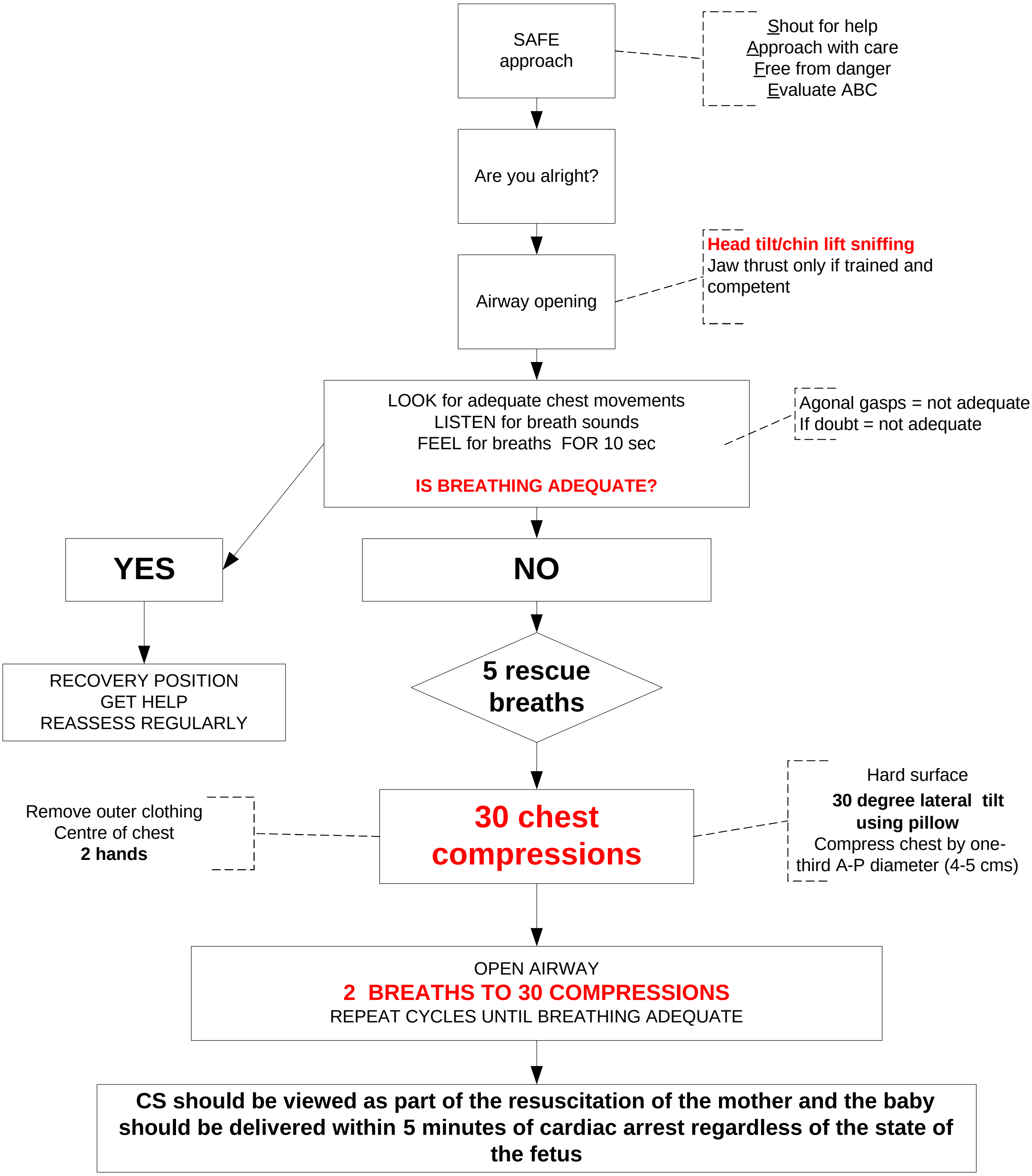
Adults and post-pubertal children are treated differently and there are special issues regarding pregnancy.

In infants and children hypoxia is the major cause of cardio-respiratory arrest, and therefore oxygen delivery rather than defibrillation is the critical treatment.

Pathway of Care: Basic Life Support infant and child in cardio-respiratory arrest

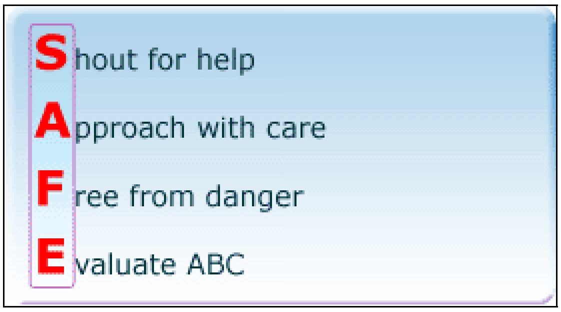


Pathway of Care: Basic Life Support in pregnancy



The Safe Approach

Additional help should be summoned. It is essential the rescuer does not become the second victim. Remove the patient from continuing danger.



When more than one rescuer is present one starts BLS. The second person activates the Emergency Medical Services (EMS) system then returns to assist in the BLS effort.

For infants and pre-pubertal children where there is only one rescuer, and no help has arrived, after 1 minute of CPR the rescuer must activate the EMS system themselves. In the case of a baby or small child the rescuer will probably be able to carry the victim to a telephone whilst continuing CPR.

In pregnancy a single rescuer should seek help as soon as there is evidence that the patient is not breathing adequately.

Are you alright?

An initial simple assessment of responsiveness consists of asking the patient '*Are you alright?* and gently shaking him/her by the shoulder. Infants may make some noise or open their eyes.

In cases associated with trauma, or possible trauma, the cervical spine should be immobilised during this procedure by placing one hand firmly on the forehead while one of the patient's shoulders are shaken.

Airway opening actions (A)

An obstructed airway may be the primary problem and correction of the obstruction can result in recovery without further intervention. A conscious child or mother, however, will often find his/her best position to maintain an airway and should not be forced to adopt a position that makes obstruction worse or upsets the patient. If unconscious the recovery position, or if pregnant the left lateral position, must be adopted.

Diagram demonstrating recovery
p
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n

the semi-prone or recovery position

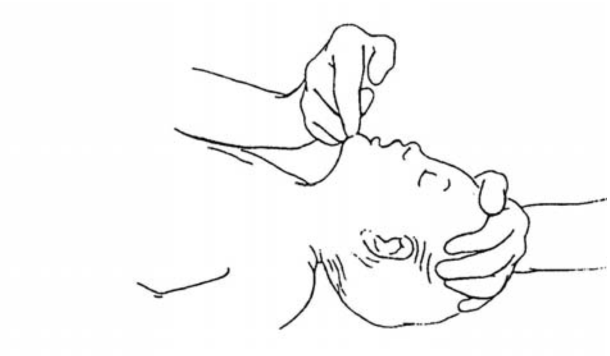
The Resuscitation Council (UK) recommends this sequence of actions to place a victim in the **recovery position**:

- *Remove the victim's spectacles-if present.*
- *Kneel beside the victim and make sure that both her legs are straight.*
- *Place the arm nearest to you out at right angles to her body, elbow bent with the hand palm uppermost.*
- *Bring the far arm across the chest, and hold the back of the hand against the victim's cheek nearest to you.*
- *With your other hand, grasp the far leg just above the knee and pull it up, keeping the foot on the ground.*
- *Keeping her hand pressed against her cheek, pull on the far leg to roll the victim towards you onto her side.*
- *Adjust the upper leg so that both the hip and knee are bent at right angles.*
- *Tilt the head back to make sure the airway remains open.*
- *Adjust the hand under the cheek, if necessary, to keep the head tilted.*
- *Check breathing regularly.*

If the victim has to be kept in the recovery position for ***more than 30 minutes*** *turn to the opposite side to relieve the pressure on the lower arm.*

Airway opening actions (A)

If the patient is not breathing, it may be because the airway is blocked by the tongue falling back obstructing the pharynx. Attempt to open the airway using **head tilt/chin lift maneuver.** The rescuer placing his/her nearest hand on the patient's forehead does this, and applying pressure to tilt the head back gently. The correct positions are **neutral in the infant (0 – 1 year)** or **"sniffing" (nose up in the air)** in the child and pregnant mother.

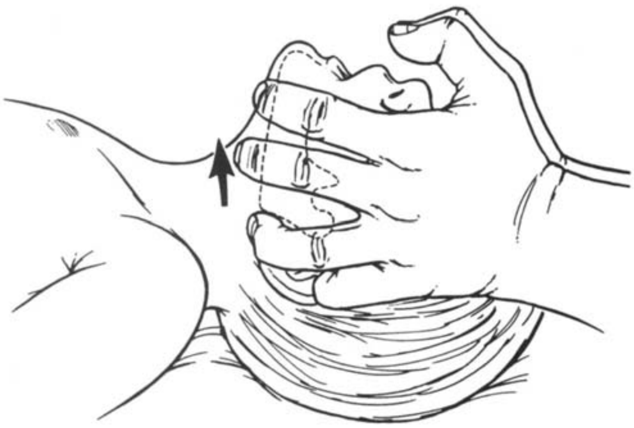


HEAD TILT CHIN LIFT
INFANT = NEUTRAL
POSITION

HEAD TILT CHIN LIFT CHILD OR PREGNANT PATIENT = SNIFFING POSITION

The fingers of the other hand should then be placed under the chin and the chin 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.

If the head tilt / chin lift is not possible, or is contraindicated (possible cervical spine injury), then the **jaw thrust** maneuver can be performed.



JAW THRUST

This is achieved by placing two or three fingers under the angle of the mandible bilaterally, and lifting the jaw upward. This is the safest maneuver where there is a history of trauma as head tilt / chin lift may exacerbate cervical spine injury. Jaw thrust requires training and experience and if the rescuer is not confident then he/she should move to next step.

(A) Airway opening actions

Patency of the airway should then be assessed by :

LOOK	for adequate chest movements
LISTEN	for breath sounds
FEEL	for breaths

This is best achieved by the rescuer placing his/her face above the patient's, with the ear over the nose, the cheek over the mouth, and the eyes looking along the line of the chest.
If there is anything obvious in the mouth and it is easy to reach remove it.

Do NOT perform a blind finger sweep of the mouth

This can damage the soft palate and foreign bodies may be forced further down the airway becoming lodged below the vocal cords.

The pregnant patient has a serious risk of regurgitation and aspiration if the airway is not opened, maintained and protected.

The causes of airway problems include:

- Head injury with decreased level of consciousness
- Other causes of decreased level of consciousness which include: hypoxaemia, hypovolaemia, cerebral malaria, meningitis, eclampsia and poisoning
- Injuries to the face and neck

Airway problems may be immediate, delayed or deteriorate with time. Careful monitoring of a patient with an airway problem, or with a condition which may deteriorate and cause an airway problem (e.g. facial burns), must be carefully managed. An airway that has been cleared may obstruct again if the patient's level of consciousness decreases, if there is further bleeding into the airway or if there is increased swelling in and around the airway. Airway obstruction must be suspected when breath sounds are absent or noisy or if the patient is cyanosed.

(B) Breathing Actions (B) in the Infant, pre-pubertal child or pregnant mother

If airway opening techniques do not result in the resumption of adequate breathing within 10 seconds, and a self inflating bag/mask system is not available then exhaled air resuscitation which should be commenced.

Definition of adequate breathing A victim may be barely breathing, or taking infrequent, noisy, agonal gasps. Do not confuse this with normal breathing.

If in doubt about the adequacy of breathing, 5 initial rescue breaths should be given. While the airway is held open, the rescuer breathes in and seals his/her mouth around the patient's mouth or mouth and nose (infant). If the mouth alone is used then the nose should be pinched using thumb and index finger of the hand maintaining head tilt. Slow exhalation, 1-2 seconds, by the rescuer should result in the patient's chest rising.

Mouth to mouth and nose neutral position infant

Mouth to mouth with nose pinched in sniffing airway position (child and in pregnancy)

As children and mothers vary in size, only general guidance can be given regarding the volume and pressure of inflation (see the box).

General guidance for exhaled air resuscitation

- The chest should be seen to rise
- Inflation pressure may be higher because the airway is small
- Slow breaths at the lowest pressure reduce gastric distension
- Firm, gentle pressure on the cricoid cartilage may reduce gastric insufflation

If the chest does not rise then the airway is not clear. The usual cause is failure to apply correctly the airway opening techniques previously discussed. The first step to try is to readjust 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 whilst 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.

C Circulation actions in the infant and pre-pubertal child

Check pulse and state of circulation (take no more than 10 seconds)

Once the initial 5 breaths have been given circulation should be assessed.

Inadequacy of circulation is indicated b y the absence of a central pulse for up to 10 seconds **or** *in babies and young children only* by the presence of a pulse at an insufficient rate (less than 60 beats/minute) or by the absence of other signs of circulation, i.e. no breaths or cough in response to rescue breaths and no spontaneous movement. In children the carotid pulse in the neck can be palpated. Infants, however, generally have a short fat neck so the carotid pulse may be difficult to identify. The brachial artery in the medial aspect of the ante-cubital fossa or the femoral artery in the groin should be felt.

If the pulse is absent for up to 10 seconds **start compressions**. **Compressions should also**

be started if there is an inadequate heart rate (less than 60/minute) BUT ONLY IF ACCOMPANIED BY SIGNS OF POOR PERFUSION which include pallor, lack of responsiveness and poor muscle tone. 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 circulation” are an indication to start chest compressions also. Signs of a circulation include: movement, coughing or normal breathing (not agonal gasps - these are irregular, infrequent breaths).

Start chest compressions if:

- no pulse **OR**
- slow pulse (less than 60 per minute in infant or young child with poor perfusion) **OR**
- no signs of circulation

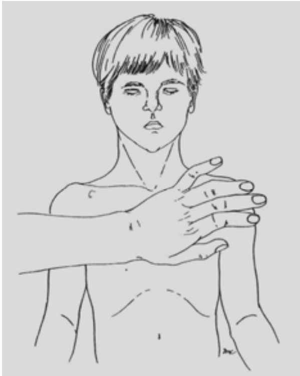
“Unnecessary” chest compressions are almost never damaging and it is important not to waste vital seconds before starting them. If the pulse is present – and has an adequate rate, with good perfusion – but apnoea persists, exhaled air resuscitation must be continued until spontaneous breathing resumes.

Chest compressions

For the best output the infant or child must be placed on his/her back, on a hard surface. The chest should be compressed by a third of its depth. Children vary in size, and the exact nature of the compressions given should reflect this. In general infants (less than 1 year) require a technique different from children up to puberty, in whom the method used in adults can be applied with appropriate modifications for their size.

Chest compressions in an infant

Chest compressions one-handed technique



Chest compressions two-handed technique

Position for chest compressions
Chest compressions should compress the lower third of the sternum. The finger/thumb or hand position for all ages is found by finding the angle where the lowest ribs join in the middle and placing the finger/thumb or hand one finger's breadth above this.

Infants Infant chest compression can be more effectively achieved using the hand-encircling technique: the infant is held with both the rescuer's hands encircling or partially encircling the chest. The thumbs are placed over the correct part of the sternum (as detailed above) and compression carried out, as shown in Figure. This method is only possible when there are two rescuers, as the time needed to reposition the airway precludes its use by a single rescuer if the recommended rates of compression and ventilation are to be achieved. The single rescuer should use the two-finger method, employing the other hand to maintain the airway position as shown in the Figure.

Pre-pubertal children Place the heel of one hand over the lower third of the sternum one finger's breadth above the angle of the junction of the ribs. Lift the fingers to ensure that pressure is not applied over the child's ribs. Position yourself vertically above the child's chest and, with your arm straight, compress the sternum to depress it by approximately one third of the depth of the chest (Figure). For larger children, or for small rescuers, this may be achieved most easily by using both hands with the fingers interlocked (Figure). The rescuer may choose one or two hands to achieve the desired compression of one third of the depth of the chest.

Once the correct technique has been chosen and the area for compression identified, **15 compressions should be given to 2 ventilations.**

Continuing cardiopulmonary resuscitation

The compression rate at all ages is 100 per minute. A ratio of 15 compressions to 2 ventilations is maintained whatever the number of rescuers. If no help has arrived the emergency services must be contacted after 1 minute of cardiopulmonary resuscitation. With pauses for ventilation there will be less than 100 compressions per minute although the *rate* is 100 per minute. Compressions can be recommenced at the end of inspiration and may augment exhalation. *Apart from this interruption to summon help, basic life support must not be interrupted unless the patient moves or takes a breath*.

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 the solo rescuer, and there is no easy solution. In the infant and small child, the free hand can maintain the head position. The correct position for compressions does not need to be re-measured after each ventilation.

The cardiopulmonary resuscitation manoeuvres recommended for infants and children are summarised in the Table.

Table 6 Summary of basic life support techniques in infants and children

	Infant (<1 yr)	Child (1 yr to puberty)
Airway		
Head-tilt position	Neutral	Sniffing
Breathing		
Initial slow breaths	Five	Five
Circulation		
Pulse check	Brachial or femoral	Carotid
Landmark	One finger-breadth above xiphisternum	One finger-breadth above xiphisternum
Technique	Two fingers or two thumbs	One or two hands
CPR ratio	15:2	15:2

Call emergency services (if they exist)

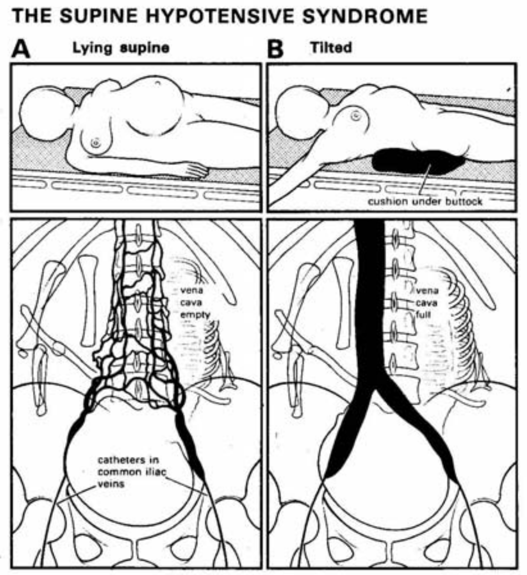
If no help has arrived, the emergency services must be contacted after a minute of resuscitation has been delivered. An infant or small child may be carried to a telephone or to get help and attempts continued. Apart from this interruption to summon help, basic life support must not be interrupted unless the patient moves or takes a breath.

(C) Circulation Actions in the pregnant mother

Call for emergency help (you may have to leave the victim alone).

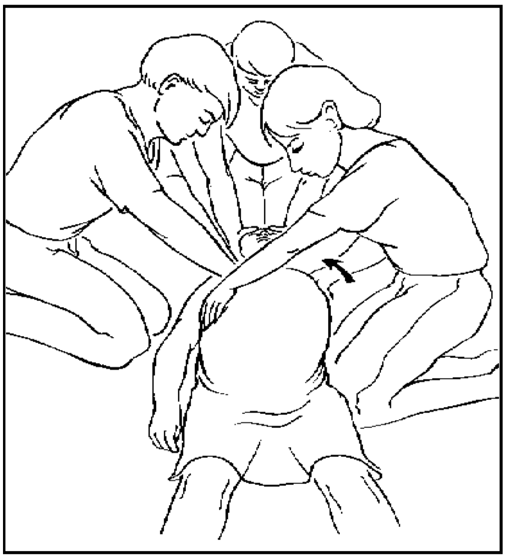
Place on hard surface in the left lateral tilt position (use pillow or coat or whatever available).

To overcome vena caval compression a wedge must be placed under the right hip to displace the gravid uterus to the left. If an assistant is available they can lift the uterus off the vena cavae. Effective chest compressions can be accomplished at a 15-30 degree tilt to the left.



THE SUPINE HYPOTENSIVE SYNDROME. These are both venograms. A, the mother is lying on her back, her uterus is occluding her vena cava, and all the blood from the lower part of her body is flowing through her paravertebral veins. B, a pillow has now been put under her right buttock tilting her to the left. Blood is now flowing normally in her vena cava. *Kindly contributed by Murray Carmichael.*

AND /OR UTERINE DISPLACEMENT



Then give 30 chest compressions. Loosen the outer clothing and using 2 interlocking hands

- Kneel by the side of the victim.
- Place the heel of one hand in the centre of the victim's chest.
- Place the heel of your other hand on top of the first hand.
- Interlock the fingers of your hands and ensure that pressure is not applied over the victim's ribs. Do not apply any pressure over the upper abdomen or the bottom end of the bony sternum (breastbone).
- Position yourself vertically above the victim's chest and, with your arms straight, press down on the sternum 4 - 5 cm.
- After each compression, release all the pressure on the chest without losing contact between your hands and the sternum.
- Repeat at a rate of about 100 times a minute (a little less than 2 compressions a second).
- Compression and release should take an equal amount of time.

Combine chest compression with rescue breaths.

- After 30 compressions open the airway again using head tilt and chin lift (use jaw thrust if you are experienced and capable of doing it properly)
- Pinch the soft part of the victim’s nose closed, using the index finger and thumb of your hand on her forehead.
- Allow her mouth to open, but maintain chin lift.
- Take a normal breath and place your lips around her mouth, making sure that you have a good seal.
- Blow steadily into her mouth whilst watching for her chest to rise; take about one second to make her chest rise as in normal breathing; this is an effective rescue breath.
- Maintaining head tilt and chin lift, take your mouth away from the victim and watch for her chest to fall as air comes out.
- Take another normal breath and blow into the victim’s mouth once more to give a total of two effective rescue breaths. Then return your hands without delay to the correct position on the sternum and give a further 30 chest compressions.
- Continue with chest compressions and rescue breaths in a ratio of 30:2.
- Stop to recheck the victim only if she starts breathing **normally**; otherwise **do not interrupt resuscitation.**
- If your rescue breaths do not make the chest rise as in normal breathing, then before your next attempt:
    - Check the victim's mouth and remove any visible obstruction.
    - Recheck that there is adequate head tilt and chin lift.
    - Try jaw thrust if you are able to do this effectively

- Do not attempt more than two breaths each time before returning to chest compressions.

- ***If there is more than one rescuer present, another should take over CPR about every 2 min to prevent fatigue. Ensure the minimum of delay during the changeover of rescuers.***

Chest-compression-only CPR.

- If you are not able, or are unwilling, to give rescue breaths, give chest compressions only.
- If chest compressions only are given, these should be continuous at a rate of 100 a minute. Stop to recheck the victim only if she starts breathing **normally**; otherwise do not interrupt resuscitation.

Continue resuscitation until:

- qualified help arrives and takes over
- the victim starts breathing normally
- you become exhausted.

Additional notes

Age definitions

It is unnecessary to establish the physical evidence for puberty at CPR. The rescuer should use paediatric guidelines if he or she believes the victim to be a child. If the victim is, in fact, a young adult, no harm will be caused as the causes of cardiac arrest is, in general, similar in this age group to that in childhood, i.e. hypoxic/ischaemic rather than cardiac in origin.

Compression: ventilation ratios

Experimental work has shown that coronary perfusion pressure in resuscitation increases if sequences of compressions are prolonged rather than curtailed. Equally, ventilations are a vital part of all resuscitation and are needed early especially in the hypoxic/ischaemic arrests characteristic of childhood. There is no experimental evidence to support any particular ratio in childhood but a 15:2 ratio has been validated by experimental and mathematical studies and is the recommended ratio for health care professionals.

If alone

Single health care professional rescuers can perform a ratio of 30 compressions to 2 ventilations for children if they find difficulty in the transition from compressions to ventilations.

BASIC LIFE SUPPORT AND INFECTION RISK

Only a few cases have been reported. The most serious concerns are meningococcus and TB. In the case of meningococcus, rescuers involved in the resuscitation of the airway in such patients should take standard prophylactic antibiotics.

There have been no reported cases of transmission of either hepatitis B or human immuno-deficiency virus (HIV) through mouth-to-mouth ventilation. Blood-to-blood contact is the single most important route of transmission of these viruses, and in non-trauma resuscitations the risks are negligible. Sputum, saliva, sweat, tears, urine and vomit are low-risk fluids. Precautions should be taken, if possible, in cases where there might be contact with blood, semen, vaginal secretions, cerebrospinal fluid, pleural and peritoneal fluids and amniotic fluid. Precautions are also recommended if any bodily secretion contains visible blood. Devices that prevent direct contact between the rescuer and the victim (such as resuscitation masks) can be used to lower risk; gauze swabs or any other porous material placed over the victim's mouth is of no benefit in this regard.

Infection rates vary from country to country and rescuers must be aware of the local risk. In countries where HIV/AIDS is more prevalent the risk to the rescuer will be greater.

If available bag valve mask ventilation is preferable to mouth to mouth ventilation.

Practice manikins must be regularly cleaned as in the manufacturer's instructions.

SECTION 6 QUIZ 1

1. **In the pathways of care for basic life support the following statements are true**

   a. the "SAFE approach" and "Are you alright" precede airway opening
   b. after airway opening and where there is no obvious breathing you give 5 rescue breaths
   c. the landmarks for chest compressions in an infant, child or mother are 1 fingerbreadth above the xiphisternum
   d. in the mother the rate of compressions to inflations is 3 to 1

2. **In basic life support the following statements are true**

a. the correct position for airway opening in a child older than 1 year is the neutral position
b. "SAFE" stands for "Shout" for help, "Ask" for help, "Free" from danger, "Evaluate ABC"
c. if pregnant the left lateral tilt position is needed

SECTION 6 QUIZ 2

1) **When giving basic life support in pregnancy the following statements are true**
   a) a hard surface is essential for chest compressions
   b) a 30° left lateral tilt is essential
   c) compress the chest by two thirds of it's A – P diameter
   d) the baby must be delivered as part of the resuscitation of the mother

2) **When giving basic life support in an infant the following statements are true**
   a) the head should be in the neutral position
   b) both the nose and mouth should be inflated by the rescuer's mouth
   c) jaw thrust is not used

ANSWERS:
3. abd 4. ab

Introduction

The vast majority of deaths from foreign body airway obstruction (FBAO) occur in pre-school children. Virtually anything may be inhaled, foodstuffs predominating. The diagnosis may not be clear-cut, but should be suspected if the onset of respiratory compromise is sudden and associated with coughing, gagging and stridor.

Airway obstruction also occurs with infections such as acute epiglottitis and croup. In these cases attempts to relieve the obstruction using the methods described below are dangerous. Children with known or suspected infectious causes of obstruction, and those who are still breathing and in whom the cause of obstruction is unclear should be taken to hospital urgently. The treatment of these children is dealt with in Section 13.

If a foreign body is easily visible and accessible in the mouth then remove it but while attempting this, take great care not to push it further into the airway. Do not perform blind finger sweeps of the mouth or upper airway as these may further impact a foreign body and damage tissues without removing the object.

The physical methods of clearing the airway, described below, should therefore only be performed if:

1. The diagnosis of FBAO is clear-cut (witnessed or strongly suspected) and ineffective coughing and increasing dyspnoea, loss of consciousness or apnoea have occurred.
2. Head tilt/chin lift and jaw thrust have failed to open the airway of an apnoeic child.

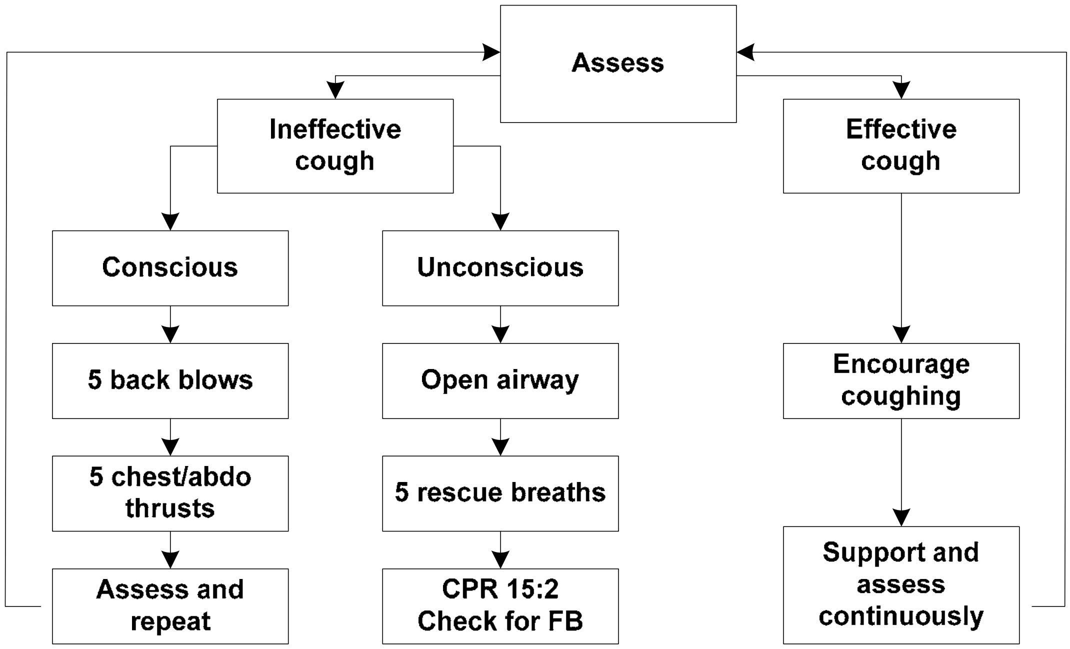


Figure The sequence of actions in a choking infant/ child and infant/child

If the child is coughing she/he should be encouraged. A spontaneous cough is more effective at relieving an obstruction than any externally imposed maneuver. An effective cough is recognised by the victim's ability to speak or cry and to take a breath between coughs. The child should be continually assessed and not left alone at this stage. No intervention should be made unless the cough becomes ineffective, that is quieter or silent, and the victim cannot cry, speak or take a breath, or if he becomes cyanosed or starts to lose consciousness. Then call for help and start the intervention.

These manoeuvres are then alternated with each other, and with examination of the mouth and attempted breaths as shown in the above figure.

Infants

Abdominal thrusts may cause intra-abdominal injury in infants. Therefore a combination of back blows and chest thrusts is recommended for the relief of foreign body obstruction in this age group.

The baby is placed along one of the rescuer's arms in a head-down position, with the rescuers hand supporting the infant's jaw in such a way as to keep it open, in the neutral position. The rescuer then rests his or her arm along the thigh, and delivers 5 back blows with the heel of the free hand.

If the obstruction is not relieved the baby is turned over and lay along the rescuer's thigh, still in a head-down position. Five chest thrusts are given using the same landmarks as for cardiac compression but at a rate of one per second. If an infant is too large to allow use of the single-arm technique described above, then the same manoeuvres can be performed by laying the baby across the rescuer's lap.

Figure Back blows in infant

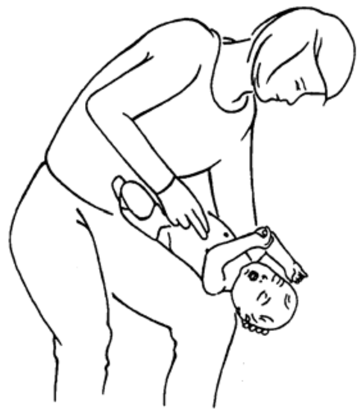


Figure Chest thrusts in an infant

Children

Back blows can be used as in infants or in the case of a larger child, with child supported in a forward leaning position. In the child the abdominal thrust (Heimlich manoeuvre) can also be used. This can be performed with the victim either standing or lying but the former is usually more appropriate.

If this is to be attempted with the child standing, the rescuer moves behind the victim and passes his or her arms around the victim's body. Owing to the short height of children, it may be necessary for an adult to raise the child or kneel behind them to carry out the standing manoeuvre effectively. One hand is formed into a fist and placed against the child's abdomen above the umbilicus and below the xiphisternum. The other hand is placed over the fist, and both hands are thrust sharply upwards into the abdomen. This is repeated 5 times unless the object causing the obstruction is expelled before then.

To carry out the Heimlich maneuver in a supine child, the rescuer kneels at his or her feet. If the child is large it may be necessary to kneel astride him or her. The heel of one hand is placed against the child's abdomen above the umbilicus and below the xiphisternum. The other hand is placed on top of the first, and both hands are thrust sharply upwards into the abdomen, with care being taken to direct the thrust in the midline. This is repeated 5 times unless the object causing the obstruction is expelled before that.

Figure Back blows in a small child

Following successful relief of the obstructed airway assess the child clinically. There may be still some part of the foreign material in the respiratory tract. If abdominal thrusts have been performed the child should be assessed for possible abdominal injuries.

Each time breaths are attempted look in the mouth for the foreign body and remove it if visible. Take care not to push the object further down and avoid damaging the tissues. If the obstruction is relieved the victim may still require either continued ventilations if not breathing, and chest compressions if there are no signs of a circulation. Advanced life support may also be needed.

Figure Heimlich maneuver in a standing child

If the child breathes effectively then place him in the recovery position and continue to monitor him.

Unconscious infant or child with foreign body airway obstruction

- Call for help.
- Place the child supine on a flat surface.
- Open the mouth and attempt to remove any visible object.
- Open the airway and attempt 5 rescue breaths, repositioning the airway with each breath if the chest does not rise.
- Start chest compressions even if the rescue breaths were ineffective.
- Continue the sequence for single rescuer CPR for about a minute then summon help again if none is forthcoming.
- Each time breaths are attempted, look in the mouth for the foreign body and remove it if visible. Take care not to push the object further down and avoid damaging the tissues.
- If the obstruction is relieved the victim may still require either continued ventilations if not breathing but is moving or gagging or both ventilations and chest compressions if there are no signs of a circulation. Advanced life support may also be needed.
- If the child breathes effectively then place her/him in the recovery position and continue to reassess.

SECTION 6 QUIZ 3

3) When treating the choking child the following statements are true

a) The diagnosis of foreign body airway obstruction is clear-cut (witnessed or strongly suspected) and ineffective coughing and increasing dyspnoea, loss of consciousness or apnoea have occurred.
b) a blind finger sweep of the mouth should first be undertaken
c) head tilt/chin lift and jaw thrust must have first failed to open the airway in the apnoeic patient

4) When treating the choking child the following statements are true

a) First assess whether there is effective coughing
b) 5 back blows with the head down is the most important manouevre if coughing is effective
c) in an infant under 1 year abdominal thrusts may also be used
d) the Heimlich manoeuvre (abdominal thrusts) may help in the child

ANSWERS:

1. ac 2. abd (abdominal thrusts may damage an infant)

SECTION 7: Advanced Life Support (IMEESC section 13 and WHO Pregnancy C-43)

Introduction

Management of the airway and breathing has priority in all situations. Resuscitation will fail if effective ventilation does not occur.

Before effective resuscitation techniques can be applied, it is essential that the operator is able to

1. Understand the airway equipment available and how to use it
2. Recognise respiratory failure and when it may occur
3. Perform a systematic and prioritised approach to the management of the infant, child or mother who has a problem of the airway or breathing

AIRWAY: Equipment and skills for opening and maintaining the airway

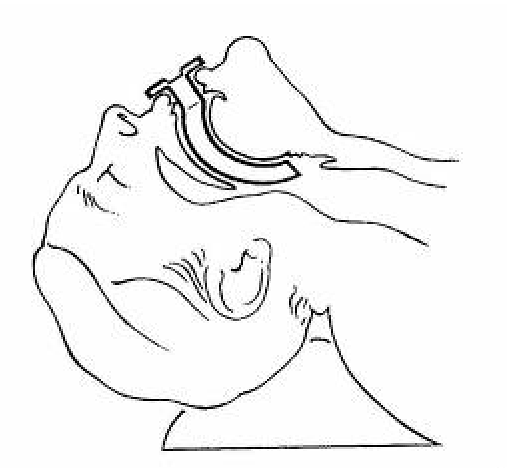
Suction

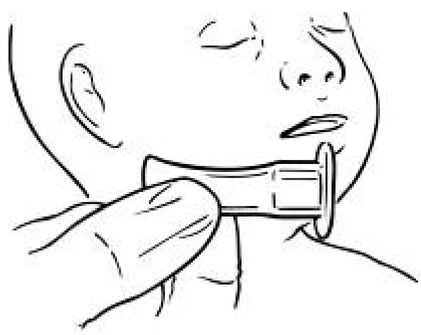
Remove blood and secretions from the mouth with a rigid suction tube. If attempts to clear the airway do not result in spontaneous breathing, this may be because the airway is still not patent or because the airway is open but there is no breathing.

- May be either wall mounted or portable
- To clear the oropharynx of debris eg.vomit a rigid sucker (e.g. Yankauer) should be used with care not to damage delicate tissue or induce vomiting.

Pharyngeal airways

Sizing the oro-pharyngeal airway





Correct Size

There are two main types of pharyngeal airway:

1. Oro-pharyngeal
2. Naso-pharyngeal

The oro-pharyngeal or Guedel airway is used 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 oro-pharyngeal 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.

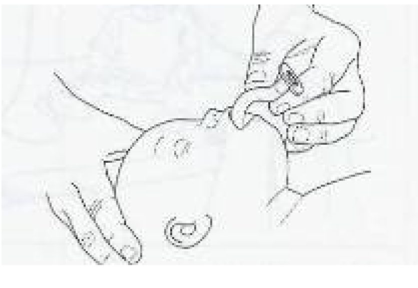
There are two methods for inserting the oro-pharyngeal airway depending on whether the child is small or large – however there is no especial age for change – it depends on practicality and skills of operator. The important issue is not to push the tongue back by inserting carelessly.

The twist technique is used for the larger child and adult and means that the convex side of the airway is used to depress the tongue as the airway is pushed into the mouth.

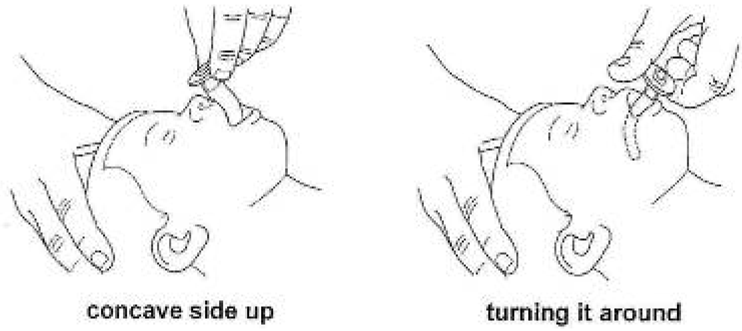
However, in the infant and small child, as the tongue is bigger relative to the size of the mouth, you can't turn it over after it's in the back of the mouth without causing trauma; hence the tongue is controlled with a spatula and not by the reversed airway. With small undernourished children up to (say) 5 years and babies use the spatula to depress the tongue and place the airway without rotation.

The nasopharyngeal airway is often better tolerated than the Guedel airway. It is contraindicated in fractures of the base of the skull. It may also cause significant haemorrhage from the vascular nasal mucosa. A suitable length can be estimated by measuring from the tip of the nose to the tragus of the ear. An appropriate diameter is one that just fits into the nostril without causing sustained blanching of the alae nasi. As small-sized nasopharyngeal airways are not commercially available, shortened endo-tracheal tubes may be used.

The test of success, as in all therapeutic interventions, is that insertion of one of these devices should result in improvement in the patient's condition. It if does not occur then a reappraisal of the choice or size of airway is urgently required.



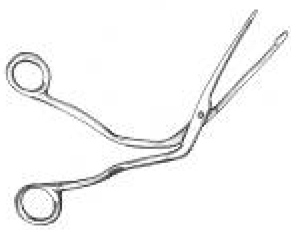
Inserting an oro-pharyngeal airway in an infant or young child (that is without rotation). A tongue depressor may be helpful



Inserting airway in a child or pregnant mother

Magill's forceps

Used to grasp a foreign body in the throat and remove it.



Advanced airway techniques are used when the above techniques fail to maintain and protect an airway over the longer term; particularly if there is potential for it to become obstructed and to prevent accurate control of oxygenation and ventilation. Advanced airway techniques (tracheal intubation, surgical cricothyroidotomy and surgical tracheostomy) are described later or in the CD/DVD rom).

SECTION 7 QUIZ 1

1. When using pharyngeal airways the following statements are true:

a. a nasopharyngeal airway must NOT be used in a head injury if there is a possibility of a base of skull fracture
b. an oro-pharyngeal airway is safe in a patient with a gag reflex
c. a correct size for an oro-pharyngeal airway reaches the angle of the mandible when the flange is at the centre of the incisors
d. most important is that insertion improves the patient's airway

ANSWERS:

1. acd

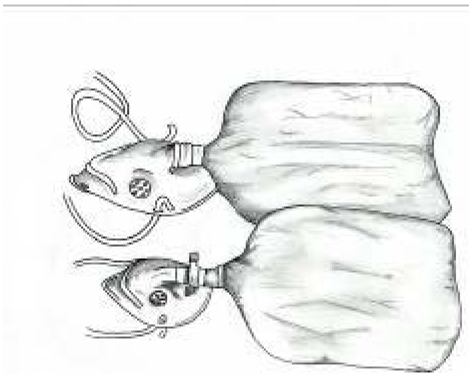
BREATHING: Equipment and skills for helping the patient to breathe

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 (difficult to see in black children) or if shocked or if fitting. If SaO_2 monitoring is available give O_2 if $SaO_2 < 92\%$ consistently (unless at high altitude)

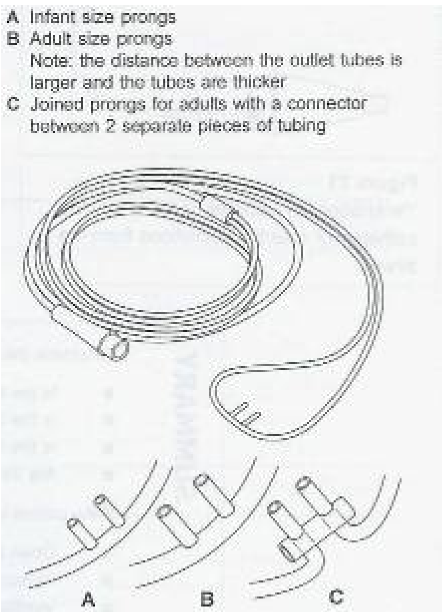
If oxygen supplies are limited, use oxygen at sufficient flow rates to maintain oxygen saturations at >94%. If using low flow rates do not use reservoir bag

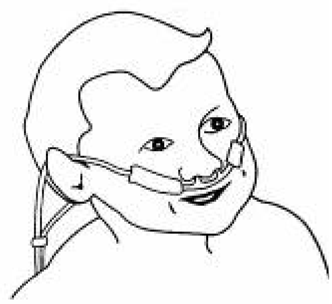
If using oxygen mask, ensure that mask is large enough to cover mouth and nose. Both low and high flow O_2 (up to 15l/min) can be given. Hold mask in place using the elastic strap around back of head or ask mother to hold it as close as possible to child's face.



A mask with a reservoir bag allows up to 100% oxygen to be delivered. Without a reservoir, it is only possible to deliver around 40%.

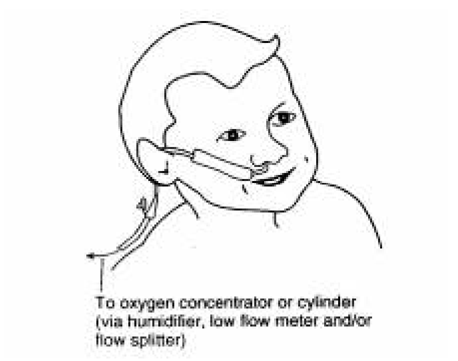
Nasal cannulae come in 3 sizes small, medium, large to give O_2 concentrations of up to 40%. Nasal cannulae have a curved appearance; apply by placing curve of cannulae into natural curve of nasal passage. Secure with small piece of tape on both cheeks over tubing.



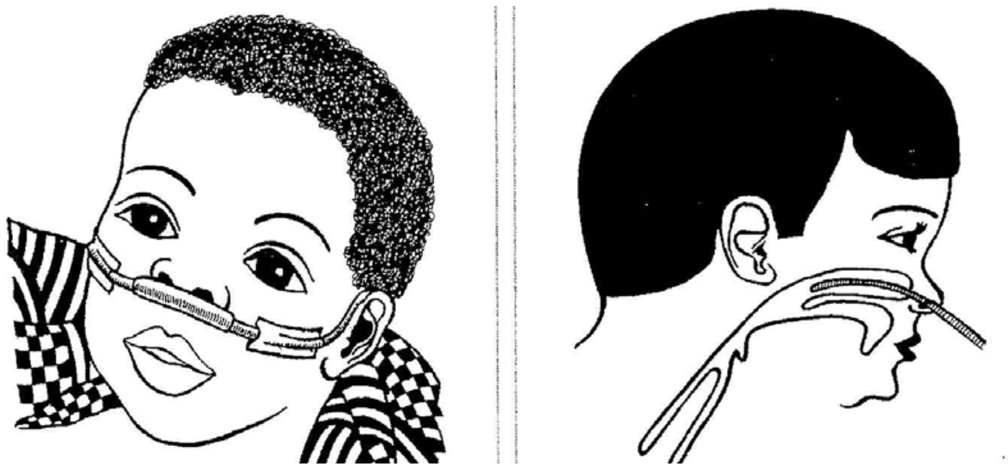


Short nasal cannulae in place

A single nasopharyngeal cannula can also be used

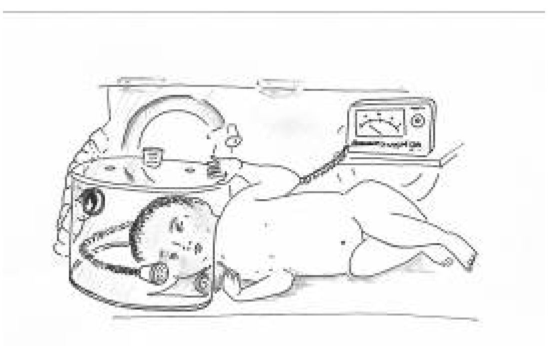


Single nasopharyngeal cannula in place



Correct positioning of nasal or naso-pharyngeal cannulae

In neonates a head-box can give up to 100% O_2



Head-box

O_2 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.

Flow meters are used to ascertain how much O_2 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 at bottom of flow meter and not moving.

DO NOT leave anything flammable near to the O_2 supply. DO NOT ALLOW SMOKING near to O_2.

Check adequate O_2 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 empty 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 may be available. They give >95% oxygen with a flow of 1-8 L/min.

Face masks with seal over nose and mouth for positive pressure ventilation

These are used for either mouth to mask or more commonly bag-mask ventilation. Masks are available in various sizes and the appropriate size to cover the mouth and nose should be chosen.

Self-inflating bags

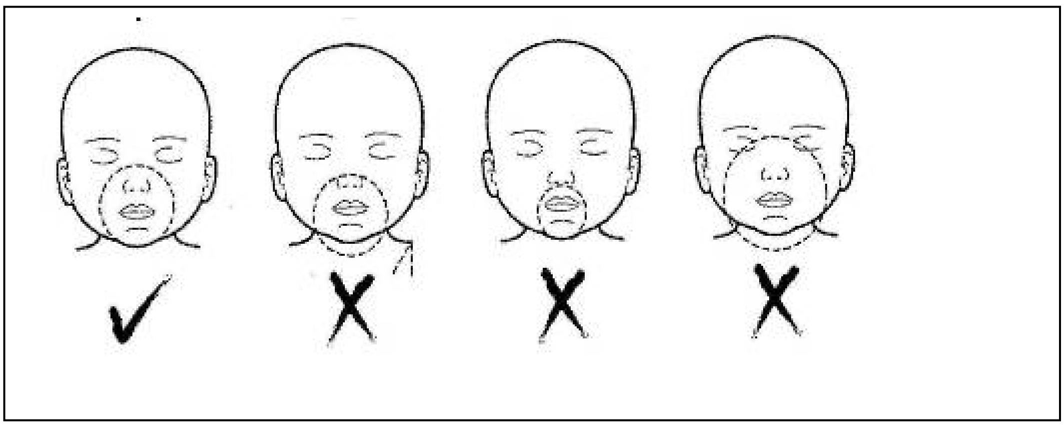
This is one of the most important pieces of equipment allowing hand ventilation by facemask without a supply of gas. The two appropriate sizes are **500ml** and **1600ml** **(the smaller for infants <1 year and the larger for children and mothers).** These bags have pressure-limiting valves that operate 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 O_2 has not been disconnected.

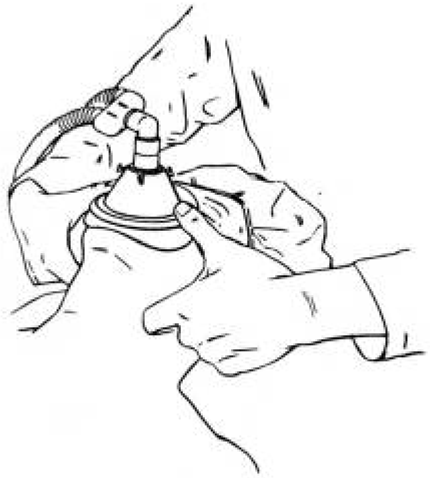
Always use high flow oxygen and reservoir bag during resuscitation

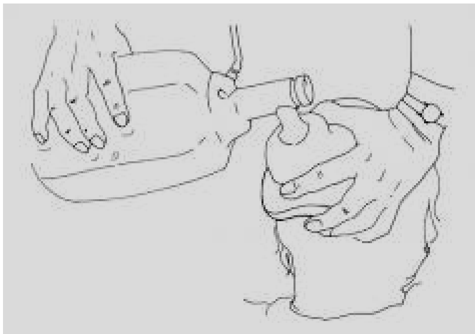
Clean the system after each patient

It is essential that the mask is properly sized and correctly placed over the mouth and nose of the patient.



Mask holding techniques





If the chest does not rise then the airway is not clear. The usual cause is failure to apply correctly the airway opening techniques previously discussed. The first step to try is to readjust head tilt / chin lift position and try again. If this is not successful jaw thrust should be tried. Failure of both head tilt / chin lift and jaw thrust should lead to suspicion that a foreign body is causing the obstruction.

Once breathing restarts, replace bag-valve-mask system with simple face-mask and reservoir. Because of the internal valves it is not possible to spontaneously breathe through the bag-valve-mask system.

SECTION 7 QUIZ 2

1. **When giving additional inspired oxygen the following statements are true:**
   a. 45% oxygen is the highest level that can be achieved with a reservoir
   b. it can be provided by an oxygen concentrator at a flow rate of 1 – 8 l/min
   c. is needed when treating respiratory distress, central cyanosis, shock or grand mal fitting

2. **When using bag valve mask ventilation the following statements are true:**
   a. you should include an oxygen reservoir bag during resuscitation
   b. there is a blow off valve set at 60 cm H_2O
   c. a 1600 ml size is suitable for an infant

ANSWERS:

1. bc 2. a

Chest tubes

In cases with a significant haemothorax or pneumothorax (particularly tension pneumothorax) ventilation may be compromised and insertion of a chest drain is mandatory.

Gastric tubes

Insertion of a gastric tube is essential after intubation and may also relieve respiratory distress in spontaneously breathing patients with abdominal emergencies or gastric stasis. It allows decompression of a stomach full with air from both bag and mask ventilation as well as air swallowed by a distressed patient. Without a gastric tube, the patient may vomit or aspirate on stomach contents. In addition venting of stomach gas will avoid diaphragmatic splinting. A nasogastric tube will increase airway resistance through the nose, which in a spontaneously breathing infant in respiratory failure can be significant. An oro-gastric tube has less effect on ventilation but is less easily tolerated and less easily fixed in position.

CIRCULATION: Equipment and skills for maintaining the circulation (IMEESC 13.3 and WHO Pregnancy C-21 and S-3)

Peripheral venous cannulation

Prepare kit:

IV cannula or butterfly needles: 2ml syringe and "T-piece" containing 0.9% sodium chloride for flushing: Tape or plaster of paris for scalp veins: Small splint (can be made from wooden spatula): Swab/spirit for skin cleaning: Local anaesthetic cream if available: Tourniquet (or assistant).

Cannula size: in situations of shock use the largest possible:

neonate 24-25G: infant 22-24G: child 20-22G: teenager and/or mother 14-20G.

Apply tourniquet to distend vein.

Choose vein:

Useful sites include the dorsum of feet and hands. The saphenous and antecubital veins are larger. The antecubital veins are also useful for venepunctures for laboratory studies.

If possible, place close to bone where more fixed.

Decide direction of blood flow.

Clean skin with antiseptic.

Fix and slightly stretch skin with other hand.

Pass cannula through skin at slight (10-20 degrees) angle-be decisive.

Stop once through skin.

Flatten cannula to skin and advance with long axis of cannula in same direction as vein-be decisive.

Aim to pass into vein at first attempt with steady advancement.

Always watch for blood appearing in hub of cannula. As soon as blood seen stop advancement.

Hold needle still, advance cannula over needle until hub at skin.

Hold cannula still and withdraw needle.

Connect connector, flush and fix. No subcutaneous swelling should be seen and there should be no resistance to injection.

If no blood seen on advancing cannula but felt to be beyond vein, stop and gently pull cannula back in same direction as advancement. If blood appears, stop once again. Follow procedure as if blood seen on first advancement (transfixion technique).

Connect T-piece and flush cannula gently with saline to confirm in vein.

Tape in place by looping thin piece of the tape under the hub and round to form a "V" shape fixing it to skin.

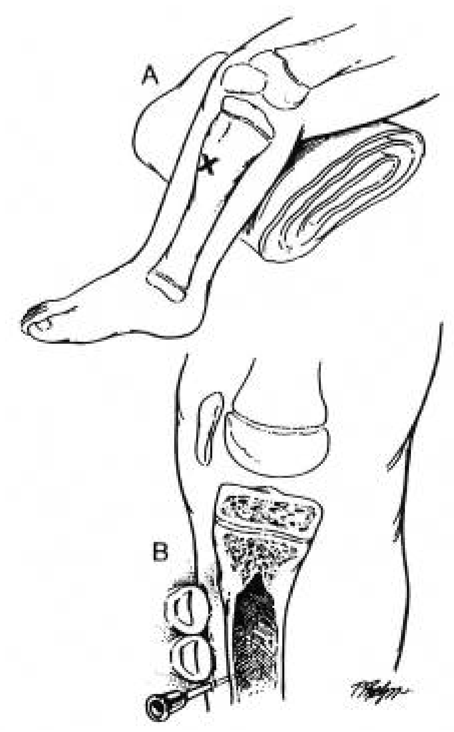
When splinting try to "double back" tape, i.e put a short and a long piece back to back leaving just the ends of longer piece sticky. This helps prevent excessive amounts of tape sticking to the baby, particularly important in more immature babies whose skin is easily damaged.

Note on flushing lines: the smaller the syringe used, the greater the pressure exerted on fluid in line. Therefore avoid using 1ml syringes to flush a blocked line - it may rupture or damage tissue.

Blood sampling from IV cannula

In children, blood can be dripped from end of cannula into appropriate bottles or a syringe and sterile needle can be used to gently aspirate blood from cannula. If cannula has been flushed with saline prior to insertion the first 0.5 - 1 ml of blood should be discarded. Ideally, sample from a separate site.

Intraosseous cannulation and infusion (IMEESC 13.3)



Indication

In emergency when other attempts at IV access have failed in an infant, child or pregnant mother.

1. Identify the infusion site. The landmark for the upper tibial site is shown below:

TIBIAL
Anterior surface, 2 - 3 cm below the tibial tuberosity

2. Clean the skin over the chosen site and apply sterile drapes.

3. Insert local anaesthetic (1% lidocaine with fine needle 22-25G) down to periosteum if patient is conscious.
4. Insert the needle at 90^{o} to the skin. Ideally 18G intra-osseous needle (at least 1.5cm in length). In situation of poor resources, a lumbar puncture needle or even standard 16-18 gauge needle can be used. For infants 21G green needles are quite adequate

5. Continued to advance the needle in a rotating fashion until a give is felt as the medullary cavity of the bone is entered. The needle should stand up by itself.

6. Attach the 5 ml syringe and aspirate blood/marrow for as required; cross match, Hb, culture, glucose and then flush with 0.9% saline to expel clots and observe for subcutaneous swelling to confirm correct positioning.

6. Attach the 50 ml syringe, usually containing, 0.9% saline, but can be compatible blood or 10% glucose if hypoglycaemia is suspected, and push in the infusion fluid in boluses.
7. Secure IV access as soon as possible. When needle is removed cover with sterile dressing.
8. Do not place distal to a major fracture or where there is infection.
9. GIVE PROPHYLACTIC ANTIBIOTICS after immediate emergency is managed.

Complications

Dislodgement
Misplacement (penetration through posterior cortex, failure to penetrate cortex producing
- haematoma
- tissue necrosis
- compartment syndrome

Skin infection
Osteomyelitis
Tibial fracture in babies

Useful issues

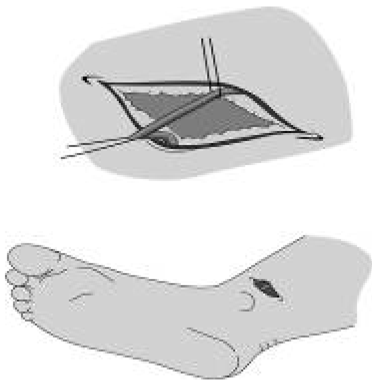
All drugs and fluids used for treating a sick child can be given.
IV access should be obtained as soon as possible after IO placement so that IO needle can be removed to reduce complication risk.
Measurement of Hb, platelets and wbc counts are inaccurate, but blood group and cross match and blood cultures can be performed.

External jugular vein

- Place in a 15 to 30° head-down position (or with padding under shoulders so that head hangs lower than shoulders).
- Turn head away from site of puncture. Restrain child as necessary in this position.
- Clean skin.
- Identify external jugular vein, which can be seen passing over sternocleidomastoid muscle at junction of its middle and lower thirds.
- Have an assistant place his or her finger at lower end of visible part of vein just above clavicle. This stabilises it and compresses it so that it remains distended.
- Puncture skin and enter vein.
- When free flow of blood is obtained, ensure no air bubbles are present in tubing and then attach a giving set.
- Tape cannula securely.

Cut down long saphenous venous cannulation

Indication: continuous IV access where percutaneous attempts have failed: (in an emergency an infant or child intra-osseous access is faster and easier)



Drawing of long saphenous vein anatomy

Equipment

Skin prep (iodine, alcohol)	Local anaesthetic
Scalpel	Curved artery forceps
Suture	Syringe and hypodermic needle
IV cannula	Sterile drapes
Assistant	

Procedure

IMEESC Make a transverse incision two finger breadths superior and two fingers anterior to the medial malleolus. Use the *patient's* finger breadths to define the incision: this is particularly important in the infant or child.

Identify landmarks:-

Infant	Half a fingerbreadth superior and anterior to medial malleolus
Small child	one fingerbreadth superior and anterior to medial malleolus
Older child and mother	two fingerbreadths superior and anterior to medial malleolus

1. Immobilise limb and apply blood pressure cuff at pressure between venous and arterial
2. Clean skin and drape with sterile towels.
3. Infiltrate local anaesthetic into skin after marking the site of the vein (if conscious).
4. Incise skin perpendicular to long axis of vein.
5. Bluntly dissect subcutaneous tissues with curved artery forceps (tips pointing downwards) parallel to vein. With tips pointing up scoop up tissues and open the forceps- you should have picked up vein. Clear about 2cm of vein from surrounding tissue.
6. If the vein is not collapsed insert the largest possible venous cannula into it as you would if going through the skin. If collapsed proceed as below.
7. Pass a proximal and distal ligature around vein. Tie only distal ligature and use for traction.
8. Make the smallest cut in the vein with a scalpel as possible to take the cannula proximal to the tied ligature and feed catheter into vein proximally (ideally up to the hub). Use the largest cannula possible. Tie proximal ligature around vein and catheter. Alternatively with the needle stylet still inside the catheter, use this to enter the vein.
9. Aspirate blood (if blood does not aspirate you may be against vein wall so pull catheter back a little and repeat) and flush with 0.9% saline.
10. Close incision with interrupted sutures, place antiseptic ointment (eg iodine) over wound, and suture catheter to skin (ensure local anaesthetic at suture site if conscious).
11. **IMEESC** Do not suture the incision close after catheter removal as the catheter is a foreign body. Allow any gap to heal by secondary intention.

SECTION 7 QUIZ 3

1. **When placing an intrasosseous needle the following statements are true:**

a. in an infant or child can be inserted on the anterior surface of the tibia 2 to 3 cm below the tibial tuberosity
b. does not need local anaesthetic first if conscious
c. must be a sterile procedure
d. blood group and cross match can be obtained from aspirated bone marrow specimen but Hb and platelet counts are inaccurate
e. can be placed distal to a major fracture

ANSWERS:

1. acd

Needle pericardiocentesis see under Trauma procedures Section 14.

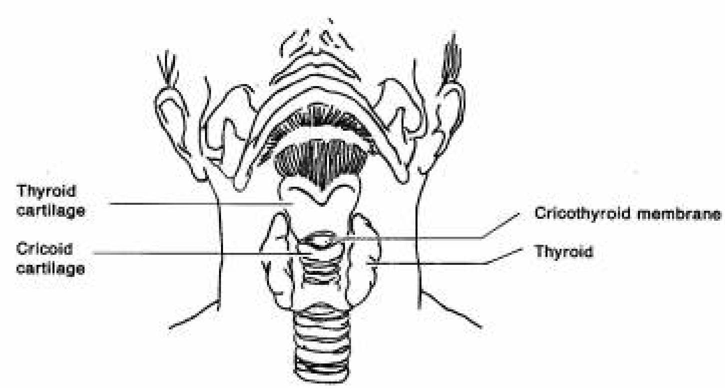
Additional procedures

Emergency Surgical airway: Surgical cricothyroidotomy (IMEESC Best Practice Protocol)

Only in desperate situation if other methods of airway opening procedures have failed

Call surgeon (ENT) and anaesthetist (if available)

1. Place supine.
2. If no risk of neck injury, consider extending neck to improve access. Otherwise, maintain a neutral alignment.
3. 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.
4. Prepare skin and, if patient is conscious, infiltrate with local anaesthetic.



5. 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.
6. 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.
7. Make a transverse incision through cricothyroid membrane, being careful not to damage cricoid cartilage.
8. Insert a tracheal spreader to open airway.
9. 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 e.g. size 6.0mm internal diameter for age 12-16years or size 7.0mm for adults.
10. 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.
11. Secure tube to prevent dislodgement.

IMEESC state that this procedure should not be used in a child under the age of 10 years; passing several needles through the membrane will give enough air entry.

Complications

- Asphyxia: Aspiration of blood or secretions: Haemorrhage or haematoma.
- Creation of a false passage into tissues: Surgical emphysema (subcutaneous or mediastinal).

- Pulmonary barotraumas: Subglottic oedema or stenosis: oesophageal perforation.
- Infection.

Pulse Oximetry (IMEESC 14.6 and 15.2)

How to Apply the Oximeter

1. Switch on the oximeter.
2. Make sure any mains supply is also switched on (this will charge the internal battery, if this exists) - the sensor should light up.
3. Apply the sensor to a relatively translucent part of the body, for example, a finger or toe in a child or adult, or to the side of the foot, the palm, thumb or big toe in an infant.
4. Fix the sensor in position:
   - **flexible** sensors should be secured with either their own sticky tape, or additional sticky tape that stretches, so arterial pulsations are not impaired
   - rigid sensors, or 'crocodile clips,' usually attach on a finger and do not need further fixation
5. In situations of bright light, or poor skin perfusion, consider covering the sensor further using, for example, a glove, mitten, or sock.
6. Wait for a short period of time, usually 30 seconds, before reading the measurement of SaO_2 and heart rate from the oximeter, but only when an adequate arterial (or other) 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.
7. Set the low and high alarm limits for the oxygen saturation (eg 85% and 100%) and pulse rate.
8. Take readings of SaO_2 and pulse rate when a good pulsation is present and the values are relatively stable.

Normal Values

- These are usually 95-100% when breathing room air at sea level, and in the presence of good pulse detection.
- Lower levels if breathing or cardiac problems.
- 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 have a significant retention of carbon dioxide).
- May not get accurate reading if patient shivering, moving, if cold hands or feet, wearing nail varnish or if there is carbon monoxide poisoning, as with for example burns.

Note: skin colour, sickle cell disease and other haemoglobin disorders do not significantly affect the measurement of SaO_2.

SECTION 7 QUIZ 4

1. **When making a surgical airway the following statements are true:**
   a. It is a desperate measure when other ways of opening the airway have failed
   b. can be kept open using an endo-tracheal tube slightly smaller than used for intubation

2. **When using a pulse oximeter the following statements are true:**
   a. normal values are not dependant on altitude
   b. accurate readings do not require good quality pulse waveforms
   c. readings are inaccurate if carbon monoxide poisoning or when nail varnish is present
   d. normal values are 95 – 100% when breathing air at sea level
   e. normal levels whilst breathing additional oxygen mean that ventilation is normal

ANSWERS:
1. ab 2. cd (high levels of CO_2 representing hypoventilation can be present with normal SaO_2 levels)

Spacers and nebulisers

Spacers

- Salbutamol can be delivered using spacer device 2-10 puffs ½-4 hourly.
- 0-3 years use mask and spacer. Take MDI and shake, place in end of spacer, ensure good facial seal (distraction and play are useful to ensure compliance). Press MDI once and ask child to take 5 normal (effective) breaths, press MDI second time and repeat (NB if breaths ineffective request 10 instead of 5 breaths). Shake MDI after each 2 puffs, as if this is not done only propellant will be delivered.
- Assess benefit after 10 puffs (whole process takes 5-10 minutes dependant on compliance).
- This can be repeated every ½ hour. As symptoms improve increase time between treatments to 1 hourly/2 hourly/4 hourly. Usually need to have 10 puffs 4 hourly for 48 hour then 2 puffs as required.
- After 3 years of age the mouth piece of the spacer can be used.
- If patient is requiring O_2 therapy via nasal cannula < 2 litres/minute it can be continued whilst spacer treatment is delivered.

Use of a spacer

- When spacer is new, and also between treatments, it should be washed with warm soapy water and left to dry naturally. Drying by any other means will build up static and encourage the drug to stick on the sides of the spacer rather than be delivered to the patient.
- As child takes a breath with a commercial spacer, a disk will be seen and heard to move back and forth allowing medication to be delivered. If child sleeping and still requiring treatment then the spacer and mask can be used. Place the mask over mouth and nose ensuring good seal. Tilt spacer 40º angle to open valve, medication will be naturally delivered. Ensure 5-10 breaths between puffs.

If there is no proper spacer:

- *A very effective spacer can be made using a plastic IV fluid bottle – see picture or soft drink bottle.*
- *Failing this an effective aid to inhalation is a paper bag. Express salbutamol into the paper bag and place the bag tightly around the nose and mouth of the patient. Have the patient breathe in and out ten times.*

Nebuliser

- Nebulisers can be driven by oxygen or electrically (must deliver at least 6-9 litres/minute). If severe asthma and possible hypoxia, use O2 to drive the nebuliser.
- Need regular cleaning and servicing.

- Equipment required
  Straight O_2 tubing (bubble tubing can be used if this is all that is available)
  Medication chamber
  Mask

Attach tubing to medication chamber, add dose of salbutamol to medication chamber and attach mask.
Switch O_2 on at 8 litres/minute (= best flow for dispersement of medication).
Continuous nebulised treatment can be given until symptoms improve. Then treatments can be reduced 1 hourly/2hourly/4 hourly and then as required to control symptoms. Change to MDI and spacer prior to discharge.
Mask should always be used for <7 years.
>7 year mouthpiece can be attached instead of mask. However this is difficult to use in severe asthma.

- Between treatments medication chamber and mask should be washed with warm soapy water and left to dry naturally.

If there is no nebuliser:
Use a spacer and give salbutamol continuously

SECTION 7 QUIZ 5

1. **When giving salbutamol via a spacer for acute severe asthma the following statements are true:**
   a. 2 – 10 puffs of the MDI can be given ½ to 4 hourly
   b. 5 effective breaths from the spacer are appropriate for each puff of the MDI
   c. it is not necessary to shake the MDI

2. **When giving salbutamol via a nebuliser for acute severe asthma the following statements are true:**
   a. it is safer to use oxygen to drive the nebuliser
   b. a mask can be used for babies and young children
   c. best oxygen flow for dispersing medication is 4 l/minute

ANSWERS:

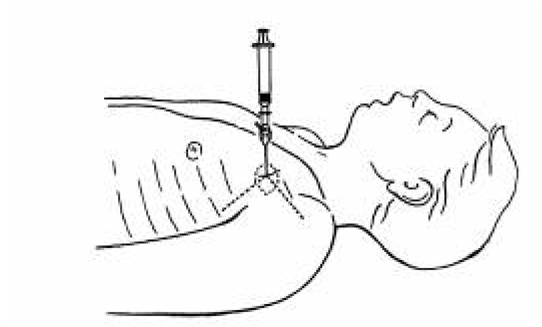
1. ab 2. ab

Needle thoracocentesis (IMEESC 16.3)

When a tension pneumothorax is present this procedure can be life saving. It can be performed quickly with minimum equipment. A confirmatory CXRay is not required or appropriate. It should be followed by chest drain placement.

Procedure for thoracocentesis

- Identify second intercostal space in mid-clavicular line on the side of the pneumothorax (opposite side to the direction of tracheal deviation)
- Swab chest wall with surgical prep
- Attach syringe ideally via a 3 way tap to needle / IV cannula/butterfly
- Insert needle / cannula vertically into chest wall, just above the rib below to avoid vessels, and aspirate
- If air is aspirated, leave cannula in place and proceed to chest drain insertion



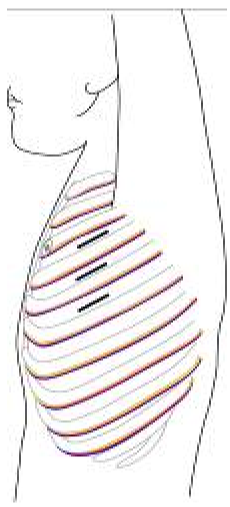
Chest drain insertion

This is best performed by an open technique as this minimizes lung damage by avoiding use of the trochar. The largest tube which will pass between the ribs is used.

Indications

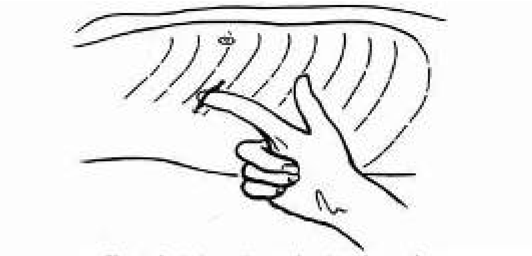
- Post thoracocentesis
- Simple pneumothorax
- Haemo-pneumothorax

Sites for chest drain



Procedure

- Prepare patient – this must be a fully sterile procedure
- Identify landmarks – 4^{th} or 5^{th} intercostal space, mid-axillary line (4^{th} intercostal space in pregnancy)
- If conscious use local anaesthetic
- Make a 1-3 cm incision immediately above the rib below (to avoid damage to the neurovascular bundle under the lower edge of the rib)
- Use artery forceps for blunt dissection between the ribs and puncture the pleura
- If possible, clear the path with a gloved finger (not possible in babies / small children)
- Hold about 1 cm from end and pass the chest drain through the hole and ensure all side holes are within the chest
- Connect to underwater seal or Heimlich valve
- Check the tube is in place (misting should occur and air entry should improve)
- Suture tube in place - make sure the area is anaesthetised
- Cover wound and get CXR if possible
- Check the patient has improved
- Ensure water level is always below the chest to prevent water leaking back into the chest
- **IMEESC** Suture tube in place - make sure the area is anaesthetized. Leave an additional suture untied adjacent to the tube for closing the wound after the tube is removed



If there is no Heimlich valve?
One can be made using the finger of a sterile surgical glove.

Complications of chest drains

1. Failure to position properly
2. Infection
3. Surgical (subcutaneous) emphysema
4. Haemorrhage
5. Damage to internal thoracic artery if drain is placed too medially
6. Damage to intrathoracic or abdominal structures
7. Kinking of chest tube or obstruction by blood clot

SECTION 7 QUIZ 6

1. **When treating a tension pneumothorax the following statements are true:**
   a. a chest x-ray is required before needle thoracocentesis
   b. the landmark for needle thoracocentesis is the 2nd intercostal space, mid-clavicular line on the side of the pneumothorax
   c. does not need to be an aseptic technique
   d. if air is aspirated proceed to chest drain

2. **When placing a chest drain the following statements are true:**
   a. use a trochar to pass tube between ribs
   b. the landmark in pregnancy is the 5th intercostal space in the mid-axillary line
   c. requires local anaesthetic if conscious

ANSWERS:
1. bd 2. c (a trochar may cause serious damage)

Measuring Blood glucose

Blood can be used from: samples taken for malarial screen etc – don't remove from bottle containing EDTA. Only require one drop

Capillary sample

- Source needs to be warm and well-perfused.
- Area needs to be clean (sugar free!) – but make sure alcohol has evaporated as this can confuse results.
- Using Vaseline (petroleum jelly) rubbed over skin makes drops easier to collect.
- Suitable areas include finger pulp and earlobes (sides of heels in neonate).
- If available use lancet/"tender-touch" etc. If an ordinary needle is used puncture skin at angle of 45 degrees to avoid unnecessarily deep wound.
- Squeeze GENTLY to gain drop.
- If using "BMstix" or "Dextrostix" check they have not expired, are dry and not discoloured. You can use one stick for more than one test if it is cut lengthways before use. Cover indicator mark with drop (do not smear). Wait one minute before wiping off drop and reading against the colour chart on tube.
- For Neonates readings are not reliable below 5 – if any doubt, treat as hypoglycaemia. Generally, hyperglycaemia if >10 and **hypoglycaemia if < 2.5 mmol/litre (45mg/dl).**
- Normal values – 3.3 - 5.5 mmol/l (63-99 mg/dl).

Lumbar puncture

Dangerous in the presence of raised intra-cranial pressure

Beware if blood clotting disorder (eg. platelets <80 x 10^9/litre).

Excessive neck flexion when positioning can lead to hypoxaemia and acute respiratory deterioration.

If spinal needle is unavailable and a normal (non-stylet) needle is used, the needle bore may become blocked with skin on insertion and hence not flow. There is also risk of tissue implantation leading to dermoid cyst.

Advance needle slowly. Subarachnoid space is only 0.5 to 0.7 cm below skin in premature infants and 1 cm in babies; hence over-penetration is an easy mistake. Over-penetration leads to puncturing of anterior vertebral venous plexus and a bloody sample, so that CSF microscopy is less informative or impossible.

Equipment

Skin prep, sterile gloves, sterile dressings pack, spinal needle with stylet (in poorly resourced healthcare facilities an ordinary 18-22 gauge needle may be used), small sterile dressing.

Positioning for lumbar puncture

Indications

- To diagnose meningitis.
- As part of a septic screen (especially in infants).

Procedure

- Full surgical asepsis must be undertaken.
- Position patient on the edge of the examination table in lateral decubitus or sitting up. An experienced assistant to hold patient is helpful. Flex spine maximally whilst avoiding excessive neck flexion.
- Clean the lumbar area with skin prep. Drape with sterile towels.
- Identify site of insertion: L4 to L5 lumbar space (on level with iliac crests).
- Slowly insert spinal needle in midline, aiming towards umbilicus.
- Stop advancing when "give"/puncture sensation is felt on entering subarachnoid space (often not felt in neonates). May have to do frequent stylet withdrawals during procedure to see if CSF flows, this is to ensure that subarachnoid space has been successfully entered.
- Withdraw stylet. Allow 6 drops of CSF to drip into each sample container.
- Replace stylet.
- Withdraw needle and swab puncture site with skin prep.
- Cover site with sterile dressing.
- Send samples for
  - o microbiology (gram stain, mycobacterium culture if suspected, microscopy, cell counts, culture and sensitivity).
  - o glucose and protein.

Gastric tube insertion (IMEESC 14.7)

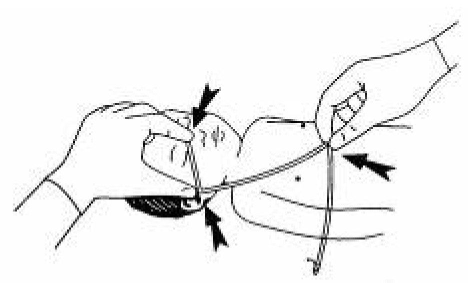
Equipment

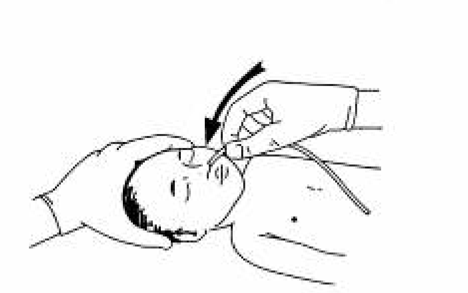
Syringe: Gastric tube: Lubricant (KY jelly or clean water): Stethoscope.

Litmus paper: Adhesive tape.

Procedure

- Place supine with head in 'sniffing' position.





Measure length of tube-from nose or mouth via earlobe to mid-point between xiphoid and umbilicus.

Feed tube lubricated with KY jelly or 0.9% Saline through either nose or mouth directly backwards. (The neonate is a nose breather and therefore the oral route is preferred). Try to advance tube as patient swallows. If infant has respiratory distress, oro- gastric tube is best. If passed through nose increases upper airway resistance.

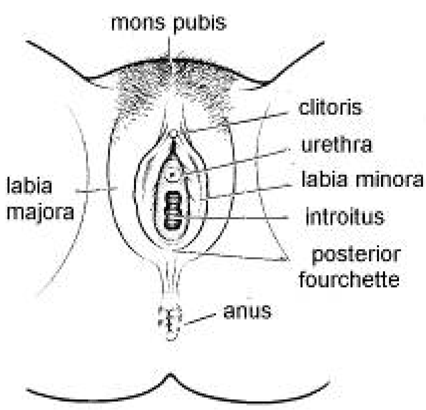
Check position of tube by aspirating stomach contents and checking a change in the litmus paper (blue to pink), or flush the tube with 2 to 3ml air (only 1ml in neonate) and listen over stomach. If in doubt Xray chest/abdomen. NB: acidity of gastric fluid may be reduced in preterm infants

- Secure the tube by taping it to cheek and record length of tube outside nose or mouth.

Urethral Catheterisation (IMEESC Best Practice Protocol and section 9 and WHO Pregnancy C-48)

Indications:
- To collect sample (eg infant – can be removed once sample obtained)
- Where no spontaneous urine output
- If continuous urine output measurement is required

Caution: Signs of urethral damage should be excluded first before urethral catheterization (eg blood at external meatus or bruising to the scrotum or perineum). If any doubt, or in cases of abdominal / pelvic injury, decision to catheterize must be decision of surgeon.



Methods:
Use appropriate size of catheter i. e. one that is smaller in diameter than the external urethral meatus (risk of subsequent urethral stricture formation).
Sterile NGT can also be used – there is a risk of it falling out, but with critically ill child this is adequate if taped to penis and medial aspect of thigh and patient nursed carefully. Do not attempt to use a tube larger than the meatus.
If male patient conscious (esp older children) use lidocaine gel if available. Lubricants should be used even in unconscious patients.
Use sterile precautions (gloves etc), wash area, have sterile pot to hand to take sample, large syringe or catheter bag if available, syringe of water to inflate balloon if is Foley balloon catheter and an assistant to hold legs away
With male hold glans penis securely; there is no need to try and retract foreskin for child less than 3 years. No need for force. Catheter is in sufficiently far when urine is seen in tube.

Rectal Administration of Drugs

In conscious patient explain what you are going to do – it should not be painful. Need consent from an older child.
In most situations rectal quills will not be available so a large NGT cut to about 7 cm, attached to syringe, can be used.
Patients should be on their side with legs bent ("fetal position") – ask the mother or an assistant to help hold patient in that position.
If KY jelly etc available place on index finger of gloved hand, open anal margin gently and cut end of NGT, advance tube as far as possible, inject drug whilst holding buttocks together.
Keeping plunger of syringe advanced withdraw the syringe and NGT whilst keeping buttocks together.

Continue holding buttocks together for 2 minutes more

SECTION 7 QUIZ 7

1. **When measuring blood glucose the following statements are true:**
   a. Hypoglycaemia = 2.5 mmol/l or less
   b. Hyperglycaemia = 10 mmol/l or more
   c. Normal values are 3.3 – 5.5 mmol/l

2. **A lumbar puncture is contraindicated if the following are present:**
   a. blood clotting is prolonged and/or a platelet count is less than 80 x 10^9/ litre
   b. there is raised intracranial pressure
   c. there is a high fever > 39° C

3. **When placing a gastric tube the following statements are true:**
   a. in the neonate a nasogastric is preferred to an oro-gastric tube
   b. if in doubt as to its position perform x-ray chest/abdomen
   c. length can be estimated as from nose/mouth to ear lobe and then to midpoint between xiphoid and umbilicus

ANSWERS:

1. abc 2. ab 3. bc

Management of cardiac arrest

Cardiac arrest has occurred when there is no effective cardiac output. Before any specific therapy is started effective basic life support must be established as described in Section 6.
Four cardiac arrest rhythms can occur:

1. Asystole
2. Pulseless electrical activity (including electro mechanical dissociation)
3. Ventricular fibrillation
4 Pulseless ventricular tachycardia

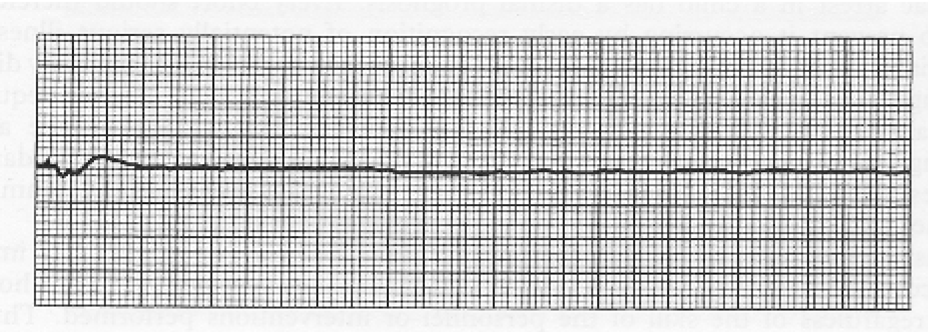
The four are divided into two groups: two that do not require defibrillation (called "non-shockable") and two that do require defibrillation ("shockable"). Only non-shockable rhythms will be discussed here.

Non-shockable cardiac arrest (asystole and pulseless electrical activity).

Asystole

This is the most common arrest rhythm in children and mothers. The response of the young heart to prolonged severe hypoxia and acidosis is progressive bradycardia leading to asystole.

The ECG will distinguish asystole from ventricular fibrillation, ventricular tachycardia and pulseless electrical activity. The ECG appearance of ventricular asystole is an almost straight line; occasionally P-waves are seen. Check that the appearance is not caused by an artifact e.g. a loose wire or disconnected electrode. Turn up the gain on the ECG monitor.



Asystole

Pulseless Electrical Activity (PEA)

This is the absence of a palpable pulse or other signs of circulation despite the presence on the ECG monitor of recognisable complexes which normally produce a pulse. PEA is treated in the same way as asystole and is often a pre-asystolic state.

PEA may be due to an identifiable and reversible cause. In children and in pregnancy there are reversible causes; severe hypovolaemia, tension pneumothorax or pericardial tamponade. PEA is also seen in hypothermic patients and in patients with electrolyte abnormalities. It may be seen after massive pulmonary thromboembolus.

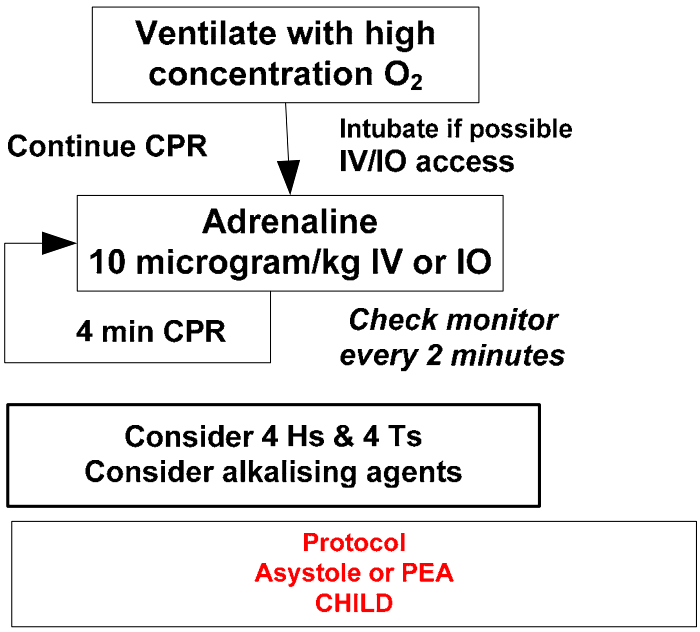
Management of Asystole / PEA

The first essential step is to establish ventilations and chest compressions effectively. Ensure a patent airway, initially using an airway maneuver 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 for an infant or child and 30:2 in pregnancy. Ideally a cardiac monitor is attached and if there are more than one health worker present, **continue chest compressions without pausing during ventilation.**

If asystole or PEA is identified give **adrenaline 10 micrograms per kilogram** (0.1 ml of 1:10,000 solution/Kg) **intravenously or intra-osseously in a child and 1mg IV in pregnancy.** Adrenaline increases coronary artery perfusion and enhances the contractile state of the heart and stimulates spontaneous contractions. This 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 saline flush (2 to 5 mls).

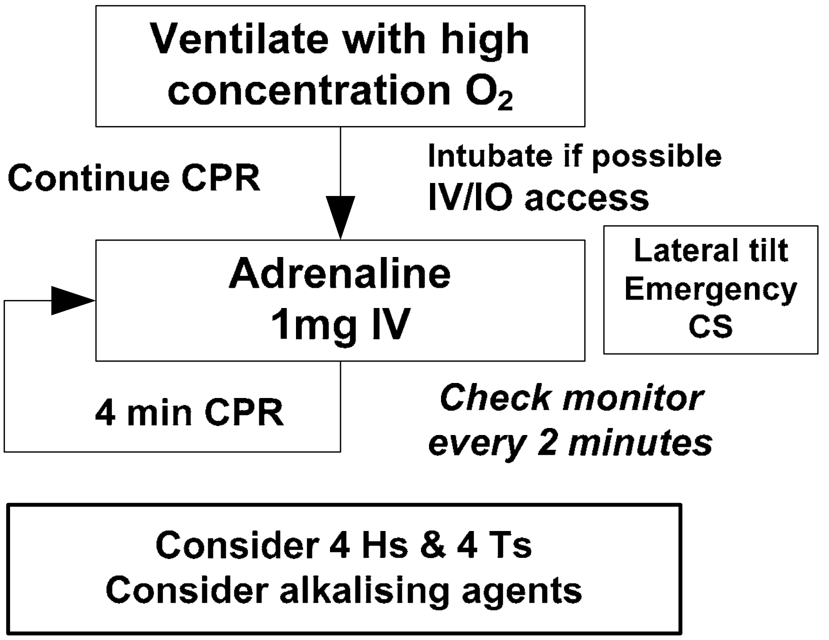
If available, and as soon as is feasible, a skilled and experienced operator should **intubate the patient's airway.** This will both control and protect the airway and enable chest compressions to be given continuously, thus improving coronary perfusion. Once the patient has been intubated and compressions are uninterrupted, the ventilation rate should be 10 per minute. It is important for the team leader to assess that the ventilations remain adequate when chest compressions are continuous.



*** IV atropine after first dose of adrenaline if asystole once only*

During and following adrenaline, chest compressions and ventilations should continue. Giving chest compressions is tiring for the operator so if others are available change regularly.

At intervals of about 2 minutes briefly pause in the delivery of chest compressions to assess the rhythm on the monitor. If asystole remains, continue CPR while again checking the electrode position and contact. If there is an organised rhythm, check for a pulse or signs of a circulation. If there is a return of spontaneous circulation, continue post-resuscitation care. If there is no pulse and no signs of a circulation, continue the protocol. Give adrenaline about every 4 minutes at a dose of 10 micrograms per kilogram IV/IO in a child and 1mg IV in a mother. If asystole, or in the mother slow PEA (< 60bpm), give one dose of IV/IO atropine (3mg in the mother and 20micrograms/Kg in the child –maximum here 600 micrograms) as soon as possible to prevent severe vagal effects.



Protocol asystole and PEA in pregnancy

*** IV atropine after first dose of adrenaline if asystole or PEA rate < 60bpm once only*

Reversible causes

Sometimes cardiac arrest is due to an identifiable and reversible cause, such as shock from massive haemorrhage. In the trauma setting cardiac arrest may be caused by severe hypovolaemia, tension pneumothorax and pericardial tamponade.

It is appropriate to give an early IV bolus of 0.9% saline (20 mls/kg in a child and 500ml to 1 litre in a mother - depending on her weight) as this will be supportive in cases related to severe hypovolaemia. In addition, however, a tension pneumothorax and/or pericardial tamponade require definitive treatment. Continuing blood replacement and the stopping of 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.

Continually, during CPR, 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 and 4Ts:**

Hypoxia is a prime cause of cardiac arrest in childhood and is key to successful resuscitation. **Hypovolaemia** may be significant in arrests associated with trauma, gastroenteritis, pregnancy related haemorrhage, anaphylaxis and sepsis and requires infusion of crystalloid or, if haemorrhage, give blood.
Hyperkalaemia, hypokalaemia, hypocalcaemia, acidaemia and other metabolic abnormalities may be suggested by the patient's underlying condition (e.g. renal failure), tests taken during the resuscitation or clues given in the ECG (see CD/DVD rom). Intravenous calcium (0.2 mls/kg of 10% calcium gluconate) is indicated in hyperkalaemia and hypocalcaemia.
Hypothermia is associated with drowning incidents and requires particular care and a low reading thermometer must be used to detect it (see CD/DVD rom).

Tension pneumothorax and cardiac **tamponade** are especially associated with PEA and are often found in trauma cases.
Toxic substances, either as a result of accidental or deliberate overdose or from a iatrogenic mistake, may require specific antidotes.
Thromboembolic phenomena (pulmonary or amniotic fluid) in pregnancy.

Drugs in Cardiac Arrest

Adrenaline is the first line drug for cardiac arrest

The initial IV or IO dose is 10 micrograms/kg (0.1 ml/kg of 1:10,000 solution) in a child and 1mg (1ml of 1 in 1000 solution) in a mother. In the child with no existing IV access, the intraosseous 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 5mls).

Sodium Bicarbonate

Good basic life support is more effective than alkalizing agents, which may be considered if spontaneous circulation has not returned after the first or second dose of adrenaline. It is recommended in the treatment of patients with hyperkalaemia and tricyclic antidepressant overdose.

The dose is 1 mmol/kg in a child (1 ml/kg of an 8.4% solution or 2ml/kg of 4.2% solution) or 50mmol in a mother.

- Bicarbonate must not be given in the same intravenous line as calcium because precipitation will occur.
- Sodium bicarbonate inactivates adrenaline and dopamine and therefore the line must be flushed with saline if these drugs are subsequently given.
- Bicarbonate must not be given by the intra-tracheal route.

Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl)

All patients, especially infants and pre-school age children, can become hypoglycaemia when seriously ill. Blood glucose should be checked frequently and **hypoglycaemia must be corrected**. If suspected and blood glucose cannot be measured always give 5ml/kg 10% glucose in a child or 50 ml of 50% glucose in a mother, preferably IV if not enterally (gastric tube). If blood glucose levels can be measured then avoid hyperglycaemia (blood glucose >12mmol/l).

Cardiac arrest and cardiopulmonary resuscitation in the obstetric patient

Background

Cardiac arrest in late pregnancy or during delivery is rare and maternal survival is very low (3-33% in published series). The cause of the arrest is not often reversed and the physiologic changes present in late pregnancy hinder effective CPR.

Cardiac arrest in the mother 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 include

1. Massive haemorrhage
2. Pulmonary embolism
3. Trauma
4. Amniotic fluid embolism
5. Severe infection
6. Local anaesthetic toxicity

Physiologic changes of pregnancy as they relate to cardiopulmonary resuscitation

- Mothers more easily develop hypoxaemia.
- The enlarged uterus along with the resultant upward displacement of the abdominal viscera decreases lung compliance.
- The most serious is aorto-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%.
- CS early in resuscitation vastly improves the effectiveness of maternal resuscitation.

Peri-mortem Caesarean section (CS)

- CS 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 mother. CPR must be continued throughout the procedure until spontaneous and effective cardiac activity occurs.
- Assisted ventilation may have to be continued for a longer period of time. Some infants have survived when delivered after 20 minutes of maternal resuscitation.
- Without CS <10% arresting in hospital will survive to discharge. Removal of the infant improves maternal circulation during resuscitation – cardiac output immediately increases 20 – 25%.

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.

When to stop resuscitation *(local guidelines should be in place)*

Resuscitation efforts are unlikely to be successful, and can be discontinued, if there is no return of spontaneous circulation at any time after 30 minutes of cumulative life support and in the absence of recurring or refractory VF/VT. Exceptions are patients with a history of poisoning or a primary hypothermic insult where prolonged attempts may occasionally be successful. Prolonged external cardiac compressions during which central (femoral or arterial) pulses were felt has successfully resuscitated children with tricyclic antidepressant overdoses.

The presence of parents at the child's side during resuscitation enables parents to gain a realistic understanding of the efforts made to save their child's life.

SECTION 7 QUIZ 8

1. **In cardiac arrest (absence of an effective circulation) the following statements are true:**
   a. in the trauma setting may have resulted from severe hypovolaemia, tension pneumothorax and pericardial tamponade
   b. is not caused by hypothermia or electrolyte disturbances or severe acid base disorders
   c. the first line drug is IV or IO adrenaline
   d. an IV fluid bolus should be given where hypovolaemia is a possibility
   e. if the cause is time limited, prolonged cardiac compressions may be effective (e.g. tricyclic poisoning)

ANSWERS:

1. acde

SECTION 8: The structured approach to the seriously ill infant, child or mother. (WHO Pregnancy C-1)

Introduction

The outcome for children following cardiac arrest is poor. Earlier recognition and management of potential respiratory, circulatory, or central neurological failure will reduce mortality and secondary morbidity. The following section outlines the physical signs that should be used for the rapid assessment of mothers, babies and children. It is divided systematically into looking for signs of potential respiratory (airway and breathing), circulatory and central neurological failure and constitutes the primary assessment.

Assessment and resuscitation occur at the same time. The order of assessment and resuscitation enables identification of immediately life threatening problems, which are treated as they are found.

Primary assessment during emergencies

Airway/Breathing/Circulation/Disability ABCD

Primary Assessment of the Airway

Vocalisations, such as crying or talking, indicate ventilation and some degree of airway patency.

Assess patency by

Looking for chest and/or abdominal movement

Listening for breath sounds

Feeling for expired air

Reassess after any airway opening manoeuvres – ie jaw and neck positioning

In addition, note other signs that may suggest upper airway obstruction:

- the presence of stridor
- evidence of recession

Give oxygen throughout this time

Consider suction and foreign body removal and oro- or naso- pharyngeal airway

Consider intubation and surgical cricothyroidotomy if all else fails and the upper airway is severely obstructed

Primary assessment of Breathing

Respiratory rate (make count over 1 minute when patient is calm)

Rates “at rest” at different ages are:

Age (yrs)	Respiratory rate
<1	30-40
1-2	25-35
2-5	25-30
5-12	20-25
>12 and Pregnancy	15-20

Care should be taken in interpreting single measurements: infants can show rates of between 30 and 90 breaths per minute depending on their state of activity. More useful are trends in measurements as an indicator of improvement or deterioration.

In children with respiratory disorders:

WHO definitions of Fast Breathing are:

< 2 months	**is ≥ 60 breaths per minute**
2 – 12 months	**is ≥ 50 breaths per minute**
12 months to 5 years	**is ≥ 40 breaths per minute**

Tachypnoea – from either airway or lung disease or metabolic acidosis

Bradypnoea – due to fatigue, raised intracranial pressure, or pre-terminal

Recession

- intercostal, sub-costal or sternal recession shows increased effort of breathing (particularly seen in infants with more compliant chest walls)
- degree of recession indicates 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

- seen in infants and children with stiff lungs to prevent airway collapse (represents closure of the larynx during expiration)
- is a sign of severe respiratory distress

Accessory muscle use

In infants the use of the sternocleidomastoid muscle creates “head bobbing” and is ineffectual

Flaring of alae nasi

Gasping

A sign of severe hypoxaemia and may indicate impending respiratory arrest and death

Exceptions

Increased effort of breathing DOES **NOT** OCCUR in 3 circumstances:

1. exhaustion
2. central respiratory depression eg. from raised intracranial pressure, poisoning or encephalopathy
3. neuromuscular disease eg. poliomyelitis

Efficacy of breathing

Breath sounds on auscultation

1. reduced or absent
2. bronchial
3. symmetrical or asymmetrical

Chest expansion (**most important**) / abdominal excursion

Pulse oximetry (normal oxygen saturation (SaO_2) in a patient at sea level is 95 – 100% in air).

Effects of breathing failure on other physiology

Heart rate Increased by hypoxia, fever or stress and by pregnancy

Bradycardia with hypoxia is a sign of impending cardio-respiratory arrest

Skin colour

Hypoxia first causes vasoconstriction and pallor

Cyanosis is a late sign and may indicate impending cardio-respiratory arrest

Mental status

Hypoxic child will be agitated first, then drowsy, then unconscious

Pulse oximetry may be difficult to measure in the agitated patient

Primary assessment of Circulation

Circulatory status

Heart rate

Heart rate increases in shock. Bradycardia may be a sign of imminent cardio-respiratory arrest.

Rates "at rest" at different ages are:

Age (yrs)	Heart rate (beats/min)
<1	110-160
1-2	100-150
2-5	95-140
5-12	80-120
>12	60-100
Pregnancy	65-115

WHO definitions for tachycardia are: > 160 bpm aged under 1 year and >120 bpm aged 1 to 5 years.

Heart rates in pregnancy are increased by 10-15% (65-115 beats/min)

Pulse volume

Absent peripheral pulses or reduced central pulses can indicate shock

Capillary refill

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.

May be prolonged by shock, cold environment, or the vasoconstriction that is present as a fever develops.

Not a specific or sensitive sign of shock

Should not be used alone as a guide to the response to treatment

Blood pressure

Cuff should cover at least 80% of the length of the upper arm, and the bladder more than two thirds of the arm's circumference (in pregnancy to avoid missing a raised blood pressure the largest possible cuffs should be used).

Korotkoff 5 sounds (disappearance) should be used for measuring diastolic pressure. K4 sound should only be used if the sound does not disappear until near zero.

Hypotension is a late sign of circulatory failure in both children and pregnant mothers and will rapidly be followed by cardio-respiratory arrest unless treated urgently

Blood pressure may increase in pregnancy and be accompanied by proteinuria and oedema.

Age (yrs)	Systolic blood pressure	Diastolic blood pressure
<1	70-90	
1-2	80-90	
2-5	80-95	
5-12	90-110	
>12	100-120	
Pregnancy	90 -120	50-70

Blood pressure is a difficult measure to obtain and interpret especially in infants and children <5 years. A formula for calculating normal systolic blood pressure in children is

80 + (2 x Age in years)

The cardiovascular system in a child and mother 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 inadequacy on other organs

Respiratory system – tachypnoea and hyperventilation occurs with acidosis eg. poor tissue perfusion

Skin – pale or mottled skin indicates poor perfusion

Mental status – agitation, then drowsiness, then unconsciousness

Urine output - <2ml/kg/hour in infants <1ml/kg/hour in a child <30ml/hour in pregnancy indicates inadequate renal perfusion

On uterus can lead to fetal compromise

Cardiac failure

Features suggesting cardiac cause of respiratory inadequacy

Cyanosis, not corrected with oxygen therapy
Tachycardia out of proportion to respiratory distress
Raised jugular venous pressure
Gallop rhythm
Enlarged liver
Absent femoral pulses in an infant or child
Basal lung crepitations

Primary assessment of Disability

Always assess and treat **A**irway, **B**reathing and **C**irculatory problems before undertaking neurological assessment.

Neurological function

Conscious level: **AVPU**

A	**ALERT**
V	**responds to VOICE**
P	**responds to PAIN**
U	**UNRESPONSIVE**

If the patient does not respond to voice it is important that assessment of the response to pain is undertaken. 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.

Posture

Many patients who are suffering from a serious illness in any system are hypotonic. Stiff posturing, such as that shown by decorticate (flexed arms, extended legs) or decerebrate (extended arms, extended legs), are signs 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. A stiff neck and full fontanel in infants are signs which suggest meningitis.

Pupils

Many drugs and cerebral lesions have effects on pupil size and reactions. However, the most important pupillary signs to seek are dilatation, unreactivity, and inequality, which indicate possible serious brain disorders.

Check blood glucose. **Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) can cause unconsciousness**

Raised Intracranial Pressure may cause

Hyperventilation

Slow sighing respirations
Apnoea
Hypertension
Bradycardia

Respiratory effects of central neurological failure

The presence of any abnormal respiratory pattern in a patient with coma suggests mid- or hind-brain 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*.

Assessment by Exposure

Although not part of the primary assessment, the examination of the seriously ill patient will involve examination for markers of illness that will help provide specific emergency treatment.

Temperature

A fever suggests an infection as the cause of the illness, but may also be the result of prolonged convulsions or shivering.

Rash
Examination is made for rashes, such as urticaria in allergic reactions, purpura, petechiae and bruising in septicaemia, child abuse or partner violence, or maculo-papular and erythematous rashes in allergic reactions and some forms of sepsis.

Summary

The whole assessment should take less than a minute.

Summary: rapid clinical assessment of an infant, child or pregnant mother

Airway and **B**reathing

Effort of breathing: Respiratory rate/rhythm: Stridor/wheeze: Auscultation: Skin colour

Circulation

Heart rate: Pulse volume: Capillary refill: Skin temperature

Disability

Mental status/conscious level: Posture: Pupils: Blood glucose

Only when airway, breathing and circulation problems have been recognised and treated should definitive management of underlying condition proceed.

During treatment, **reassessment of ABCD at frequent intervals** will be necessary to assess progress and detect deterioration.

The structured approach to the seriously ill infant, child or mother

• Primary assessment
• Resuscitation
• Secondary assessment and looking for key features
• Emergency treatment
• Stabilisation and transfer to definitive care

Primary assessment and *resuscitation* involve management of the vital ABC functions and assessment of disability (CNS function). This assessment and stabilisation occurs before any illness-specific diagnostic assessment or treatment takes place. Once the patient's vital functions are supported, secondary assessment and emergency treatment begins. Illness-specific pathophysiology is sought and emergency treatments are instituted. During the secondary assessment vital signs should be checked frequently to detect any change in the patient's condition. If there is deterioration then primary assessment and resuscitation should be repeated.

PRIMARY ASSESSMENT AND RESUSCITATION
In a severely ill patient a rapid examination of vital functions is required. The physical signs described above are used in an ABC approach. This primary assessment and any necessary resuscitation must be completed before the more detailed secondary assessment is performed.

Airway
Primary assessment
Assess that the airway is open by:

- *looking* for chest and/or abdominal movement
- *listening* for breath sounds
- *feeling* for expired air.

Vocalisations, such as crying or talking, indicate ventilation and some degree of airway opening. If there is obvious spontaneous ventilation, look for other signs which may suggest upper airway obstruction:
- presence of stridor
- evidence of recession.

If there is no evidence of air movement then chin lift or jaw thrust manoeuvres should be carried out. **Reassess the airway after any airway-opening manoeuvres.**
If there continues to be no evidence of air movement then airway opening can be assessed by performing an airway-opening maneuver while giving rescue breaths.

Resuscitation
If the airway is not patent, then this can be secured by:
- a chin lift or jaw thrust
- the use of an airway adjunct such as oropharyngeal or nasopharyngeal airway
- tracheal intubation (call for anaesthetist if available)

Breathing
Primary assessment
An open airway does not ensure adequate ventilation. The latter requires an intact respiratory centre and adequate pulmonary function augmented by coordinated movement of the diaphragm and chest wall. The adequacy of breathing can be assessed as described above.

Resuscitation
Give high-flow oxygen (flow rate 15 l/min) through a

non-rebreathing mask with a reservoir bag to any patient with respiratory difficulty or hypoxia.

In the patient with inadequate breathing this should be supported with bag– valve–mask ventilation or intubation and intermittent positive pressure ventilation (if this is available).

Circulation

Primary assessment
The assessment of circulation has been described above and is more difficult to assess than breathing. Individual measurements must not be over-interpreted.
Resuscitation
Give high-flow oxygen to every patient with an inadequate circulation (shock). This will be through either a non-rebreathing mask with a reservoir bag (or an endotracheal tube if intubation has been necessary).
Venous or intraosseous access should be gained and an immediate infusion of crystalloid, colloid or blood as appropriate (20 ml/kg in a child and 500ml to 1 litre in an adult) given. Urgent blood samples may be taken at this point.

FOR A CHILD WEIGHT CAN BE CALCULATED AS FOLLOWS:

Estimate of Weight

Infant = up to 12 months old
Birth weight - doubles by 5 months
- triples by 1 year
- quadruples by 2 years

After 12 months, the formula can be applied, but needs to be modified according to whether the child is small or large compared with the average

Weight (Kg) = 2 x (age in years + 4)

Disability (neurological evaluation)

Primary assessment
Both hypoxia and shock can cause a decrease in conscious level. Any problem with ABC must be addressed before assuming that a decrease in conscious level is due to a primary neurological problem. The rapid assessment of central neurological failure has been described above. In addition, any patient with a decreased conscious level or convulsions must have an initial glucose stick test performed.
Resuscitation
Consider intubation (if this is safely available) to stabilise the airway in any patient with a conscious level recorded as P or U (only responding to painful stimuli or unresponsive).

Treat hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) with 5 ml/kg of 10% dextrose after having taken blood for glucose measurement (ideally by both stick tests and in the laboratory).

Intravenous/intraosseous lorazepam, buccal midazolam or rectal diazepam should be given for prolonged or recurrent fits (see section 10 and 12).

SECONDARY ASSESSMENT AND EMERGENCY TREATMENT
The secondary assessment takes place once vital functions have been assessed and the initial treatment of those vital functions has been started. It includes a medical history, a clinical examination and specific investigations. It differs from a standard medical history and examination in that it is designed to establish which emergency treatments might benefit the patient. Time is

limited and a focused approach is essential. At the end of secondary assessment, the practitioner should have a better understanding of the illness affecting the patient and may have formulated a differential diagnosis. Emergency treatments will be appropriate at this stage – either to treat specific conditions (such as asthma) or processes (such as raised intracranial pressure). The establishment of a definite diagnosis is part of definitive care.

The history often provides the vital clues that help the practitioner identify the disease process and provide the appropriate emergency care. In the case of infants and children the history is often obtained from an accompanying parent, although a history should be sought from the child if possible. Do not forget to ask the first responder about the patient's initial condition and about treatments and response to treatments that have already been given.

Some patients will present with an acute exacerbation/complication of a known condition such as pregnancy, asthma or epilepsy. Such information is helpful in focusing attention on the appropriate system but the practitioner should be wary of dismissing new pathologies in such patients. The structured approach prevents this problem. Unlike trauma (which is dealt with later), illness affects systems rather than anatomical areas. The secondary assessment must reflect this and the history of the complaint should be sought with special attention to the presenting system or systems involved. After the presenting system has been dealt with, all other systems should be assessed and any additional emergency treatments commenced as appropriate.

The secondary assessment is not intended to complete the diagnostic process, but rather is intended to identify any problems that require emergency treatment.

The following gives an outline of a structured approach in the first hour of emergency management. It is not exhaustive but addresses the majority of emergency conditions that are amenable to specific emergency treatments in this time period.

The symptoms, signs and treatments relevant to each emergency condition are elaborated in the relevant chapters that follow.

Airway and Breathing

Secondary assessment

Common symptoms	**Signs**	**Emergency investigations**
Breathlessness Coryza Tachypnoea Choking Cough Abdominal pain Chest pain Apnoea Feeding difficulties Hoarseness	Bubbly noises in throat Cyanosis Recession Noisy breathing – grunting, stridor Drooling and inability to drink Wheeze Tracheal shift Abnormal percussion note Crepitations on auscultation Acidotic breathing	O2 saturation Blood culture if infection suspect Chest X-ray (selective)

Emergency treatment

• If "bubbly" noises are heard the airway is full of secretions. These may require clearance by suction.

• If in a pre-school child there is a harsh stridor associated with a barking cough and severe respiratory distress upper airway obstruction due to severe croup should be suspected. Give the child oral prednislone and nebulised adrenaline (5 ml of 1:1000 nebulised in oxygen).
• If there is a quiet stridor and drooling in a sick-looking child consider epiglottitis or tracheitis. Intubation is likely to be urgently required, preferably by an anaesthetist. Do not put the airway at risk by unpleasant or frightening interventions. Give intravenous antibiotics. Surgical airway may be needed so contact a surgeon.
• With a sudden onset and significant history of inhalation consider a laryngeal foreign body. If the "choking" protocol has been unsuccessful the patient may require laryngoscopy. Do not put the airway at risk by unpleasant or frightening interventions but contact an anaesthetist/ENT surgeon urgently. However in extreme, life threatening cases immediate direct laryngoscopy to remove a visible foreign body with Magill's forceps may be necessary.
• Stridor following ingestion/injection of a known allergen suggests anaphylaxis. Patients in whom this is likely should receive IM adrenaline (*10 microgram/kg for a child* and 1mg for an adult).
• Patients with a history of asthma or with wheeze, significant respiratory distress, and/or hypoxia should receive inhaled *salbutamol* and oxygen. Infants with wheeze and respiratory distress are likely to have bronchiolitis and require oxygen.
• In acidotic breathing take blood glucose. Treat diabetic ketoacidosis with IV 0.9% saline and insulin (sections 10 and 12).

Circulation

Secondary assessment

Common symptoms	**Signs**	**Emergency investigations**
Haemorrhage Breathlessness Palpitations Feeding difficulties Abdominal pain Chest pain Apnoea Feeding difficulties Hoarseness Drowsiness	Tachycardia or bradycardia Abnormal pulse volume or rhythm Abnormal skin perfusion or colour Haemorrhage or hidden haemorrhage Severe malnutrition Fever Hypo- or hypertension Cyanosis Pallor Enlarged liver Lung crepitations Poor urine output Cardiac murmur Peripheral oedema Raised jugular venous pressure Low muscle tone Dehydration Purpuric rash	O2 saturation Blood culture if infection suspect Chest X-ray (selective) ECG (selective) HB Urea and electrolytes (if available) Clotting studies (if available) Malarial parasites

Emergency treatment

• Further boluses of fluid should be considered in shocked patients who have not had a sustained improvement to the first bolus given at resuscitation. However in trauma, where there is uncontrolled bleeding, early surgical intervention has priority and too much IV fluids may be harmful.
• Consider inotropes, intubation and central venous pressure monitoring if available.
• Consider IV broad spectrum antibiotics in shocked patients with no obvious fluid loss as sepsis is likely.
• If a patient has a cardiac arrhythmia the appropriate protocol should be followed.
• If anaphylaxis is suspected give IM adrenaline 10 micrograms/kg in a child, or 1mg in a mother, in addition to fluid boluses.

- Targeted treatment for obstetric emergencies known to cause shock (may include urgent surgery).

• Surgical advice and intervention for certain gastro-intestinal emergencies.
The following symptoms and signs may suggest intra-abdominal emergencies: vomiting, abdominal pain, abdominal tenderness, rectal bleeding, abdominal mass.

Disability (neurological)
Secondary assessment

Common symptoms	Signs	Emergency investigations
Headache Drowsiness Vomiting Change in behavior Visual disturbance	Altered or change in conscious level Convulsions Bradycardia Altered pupil size and reactivity Abnormal postures Meningism Fever Papilloedema or retinal haemorrhage Altered deep tendon reflexes Hypertension	Blood glucose O2 saturation Blood culture if infection suspect HB Urea and electrolytes (if available) Malarial parasites

Emergency treatment

If hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) is possible, treat urgently.

- If convulsions persist treat as in Sections 10 and 12.
- If evidence of raised intracranial pressure (decreasing conscious level, abnormal posturing and/or abnormal ocular motor reflexes) then the child should undergo:
  - o Bag valve mask ventilations if apnoea or slow or poor breathing
  - o Nursing with head in-line and 20–30 degree head-up position (to help cerebral venous drainage)
  - IV infusion with mannitol 250 to 500 mg/kg over 15 minutes, and repeated as needed
  - Consider dexamethasone 500 microgram/kg twice daily (for oedema surrounding a space occupying lesion)

• In a child with a depressed conscious level or convulsions consider meningitis/encephalitis. Give antibiotics and acyclovir as appropriate.
• In drowsiness with sighing respirations check blood glucose. Think of salycylate poisoning. Treat diabetic ketoacidosis with IV 0.9% saline and insulin.
• In unconscious patients with pin-point pupils consider opiate poisoning. A trial of naloxone should be given.

External (exposure)
Secondary assessment

Signs
Rash Purpura Swelling of lips/tongue and/or urticaria Fever

Emergency treatment

• In a child with circulatory or neurological symptoms and signs a purpuric rash suggests septicaemia/meningitis or Dengue haemorrhagic fever. The patient should receive IV broad spectrum antibiotics preceded by a blood culture.
• In a patient with respiratory or circulatory difficulty the presence of an urticarial rash or angio-oedema suggests anaphylaxis. Give adrenaline **IM** (*10 microgramg/kg for a child* or 1mg for a mother).

Further history
Developmental and social history
Particularly in a small child or infant knowledge of the child's developmental progress and immunisation status may be useful. The family circumstances may also be helpful, sometimes prompting parents to remember other details of the family's medical history.
Drugs and allergies
Any medication that the patient is currently, or has been, on should be recorded. In addition ask about any medication in the home that a child might have had access to if poisoning is a possibility. A history of allergies should be sought.

SUMMARY
The structured approach to the seriously ill patient outlined here allows the practitioner to focus on the appropriate level of diagnosis and treatment during the first hour of care. Primary assessment and resuscitation are concerned with the maintenance of vital functions, while secondary assessment and emergency treatment allow more specific urgent therapies to be started. This latter phase of care requires a system-by-system approach and this minimises the chances of significant conditions being missed.

SECTION 8 QUIZ 1

1. **When undertaking assessments during emergencies the following statements are true**
   a) resuscitation occurs at the same time
   b) airway patency is assessed by looking, listening and feeling
   c) reassessments occur at frequent intervals

2. **When assessing and providing emergency treatment for the airway, which of the following may be required**
   a. oxygen
   b. suction
   c. oropharyngeal airway
   d. gastric tube

ANSWERS:

1. abc 2. abc

SECTION 8 QUIZ 2

1) **When assessing and providing emergency treatment for breathing the following are correct maximum healthy respiratory rates**
   a) 60/minute if aged 1 – 5 years
   b) 50/minute if aged 1 month – 1 year

2) **Which of the following are some signs of serious breathing abnormalities**
   a) gasping
   b) grunting

3) **A soft inspiratory stridor cannot be due to severe upper airway obstruction**
   a) true
   b) false

4) **Which of the following are true statements: in respiratory failure increased effort of breathing may not occur**
   a) when exhausted
   b) when central respiratory depression
   c) in neuromuscular disease

ANSWERS:

1. b 2. ab 3. b (in the most severe obstruction stridor may be difficult to hear) 4. abc

SECTION 8 QUIZ 3

1. **When assessing the patient for circulatory failure the following statements are true**
   a. bradycardia is more serious than tachycardia
   b. capillary refill time is not a specific marker of shock and may be increased by a cold environment or during the development of fever
   c. hypotension is an early sign of circulatory failure in children and in pregnancy

2. **The following are normal values for systolic blood pressure**
   a. 80 + (4 x age in years)
   b. 90 – 120mm Hg in pregnancy
   c. 70 – 90 mm Hg in infancy

3. **When measuring BP, the cuff should cover more than 80% of the length of the upper arm and the bladder more than one third of the arm's circumference**
   a. true
   b. false

ANSWERS

1. ab 2. bc 3. b

SECTION 8 QUIZ 4

1) **Which of the following are values for urine output which might indicate under perfusion of the kidneys as a result of circulatory failure?**
   a) < 4 ml/kg/hour in infancy
   b) < 1 ml/kg/hour in a child
   c) < 30 ml/hour in pregnancy

2) **Which of the following are signs of cardiac failure?**
   a) Raised JVP
   b) enlarged liver
   c) crepitations in the upper zones of the lungs
   d) gallop rhythm

ANSWERS:

1. bc 2. abd

SECTION 8 QUIZ 5

1) **Fill in the following table with respect to the assessment of conscious levels**
   a) A--------------
   b) V --------------
   c) P --------------
   d) U --------------

2) **Raised intracranial pressure usually causes**
   a) both hyperventilation and slow sighing respiration
   b) apnoea
   c) tachycardia
   d) hypertension

ANSWERS:
1. a) Alert b) responding to Voice c) responding to Pain d) Unresponsive

2. abd

SECTION 9: MANAGEMENT OF MEDICAL EMERGENCIES IN PREGNANCY

THE PREGNANT MOTHER WITH SPECIFIC AIRWAY AND BREATHING PROBLEMS

(IMEESC 13.8 and WHO Pregnancy S-126 and S-129)

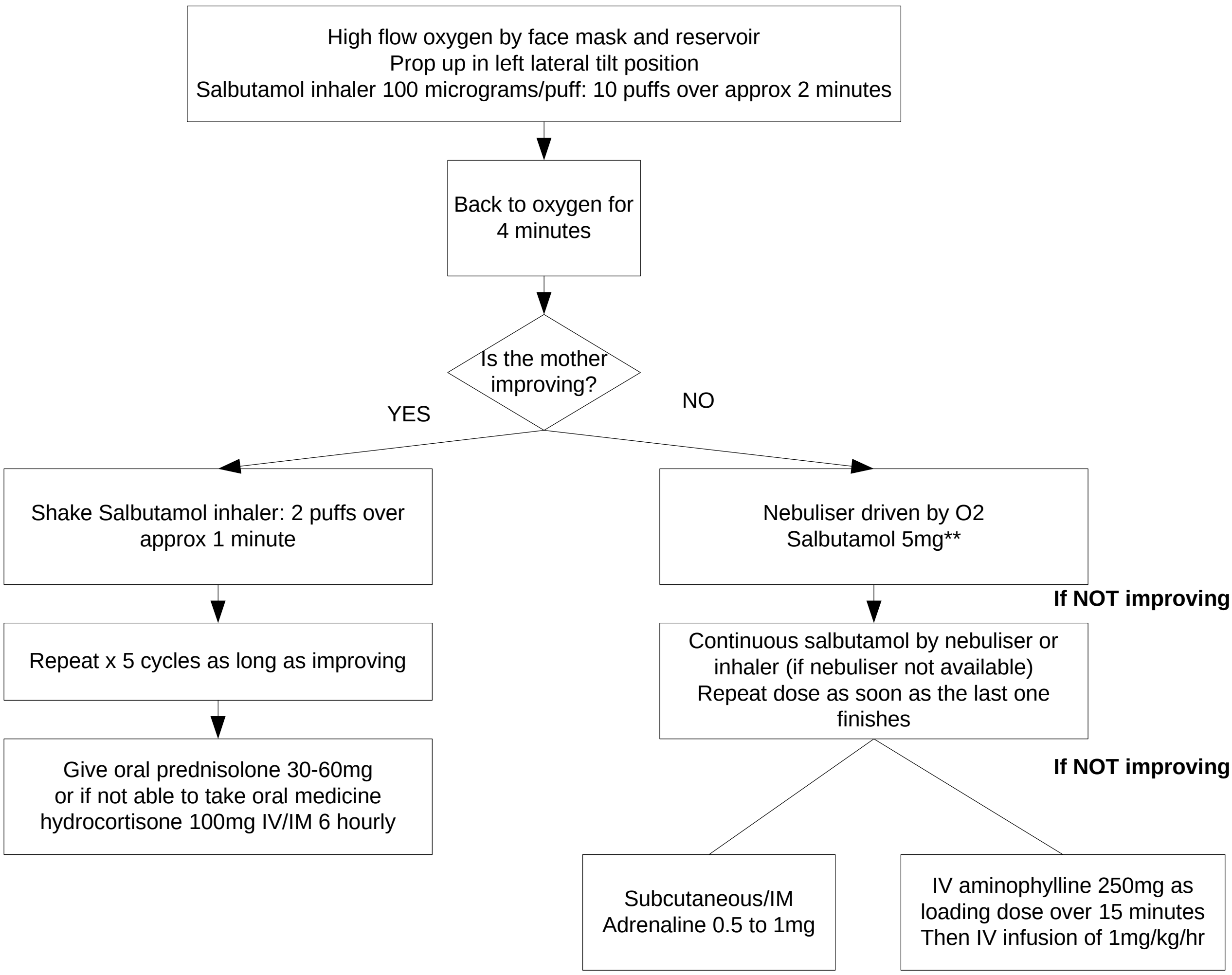
Severe Bronchial Asthma

Assessment

Features of severe asthma	Features of life-threatening asthma
too breathless to eat or talk	conscious level depressed / agitated
recession/use of accessory muscles	exhaustion
respiratory rate>40 breaths/min	poor respiratory effort
pulse rate >120 beats/min	SaO_2 < 85% in air / cyanosis
	silent chest

- Bronchial asthma complicates 3–4% of pregnancies. Pregnancy is associated with worsening of the symptoms in one-third of affected mothers.
- A CXR is indicated only if there is severe difficulty in breathing, uncertainty about the diagnosis, asymmetry of chest signs (possible pneumothorax) or signs of severe infection.
- Continuous pulse oximetry is valuable (if available) since hypoxaemia is a major feature of all severe asthma attacks.
- Avoid prostaglandins. For the prevention and treatment of post partum haemorrhage give oxytocin 10 units IM <u>and</u> ergometrine 500 micrograms IM

Severe Asthma – Pathway of Care in pregnancy



** Salbutamol may inhibit uterine contractions

If not responding, or deteriorating condition

1. Nebulised salbutamol may be given continuously.
2. In those with poor respiratory effort, depressed conscious level and poor oxygenation despite maximum oxygen therapy

   - attempt to support ventilation with bag-valve-mask
   - summon experienced support if available and consider intubation for mechanical ventilation with IV ketamine induction

Other measures

- Reassure patient, avoid upset
- IV fluids - restrict to two-thirds of the normal requirements
- Antibiotics - give only if there are clear signs of infection
- When recovered review maintenance treatment and inhaler technique

SECTION 9 Quiz 1

1) **Features of severe asthma in pregnancy are**
   a) respiratory rate < 40/minute
   b) too breathless to talk
   c) silent chest

2) **Management of severe asthma in pregnancy includes**
   a) high flow O_2
   b) salbutamol by metered dose inhaler and/or nebulisers
   c) prostaglandins if PPH occurs in a mother with asthma
   d) Prednisolone or hydrocortisone

ANSWERS:
1. bc 2. abd (prostaglandins are dangerous in asthma)

Lower respiratory tract infection

Always consider HIV infection, the resulting opportunistic infections and tuberculosis.

A high fever usually means pneumonia, epiglotittis or bacterial tracheitis. In the absence of stridor and wheeze, breathing difficulties in association with a significant fever are likely to be due to pneumonia.

Pleuritic chest pain, neck stiffness and abdominal pain may be present if there is pleural inflammation. Pleural effusions and empyema are complications of pneumonia.

Emergency treatment

- Assess ABC
- High concentration of oxygen via a facemask with reservoir bag. Attach pulse oximetry
  - If a low flow maintains SaO_2>94% then nasal cannulae may be used with a flow up to 2 l/min
- Antibiotics - cefuroxime ± fluxcloxacillin (for staph aureus), erythromycin (for chlamydia or mycoplasma pneumonia) or whatever is available locally and is appropriate
- Sit upright in left lateral tilt
- Maintain hydration
  - extra fluid may be needed to compensate for fluid loss from fever
  - restriction may be needed because of inappropriate ADH secretion
- Chest x-ray is indicated
  - large pleural effusions/empyemas should be diagnosed where possible by ultrasound and pleural drainage under ultrasound cover (beware of placing chest drain into the heart, liver or an undiagnosed tumour or hydatid cyst). **Remember that in advanced pregnancy the diaphragm is elevated.**
  - Effusions/empyemas adjacent to the heart on the left side may cause pericarditis and arrythmias (listen regularly for pericardial rub and ideally monitor ECG until stable)

Heart Failure (WHO Pregnancy S-126 and S-127)

Assessment

Features suggesting a cardiac cause of breathing difficulty

- cyanosis, not correcting with O_2
- tachycardia out of proportion to respiratory difficulty
- raised jugular venous pressure
- gallop rhythm / murmur
- enlarged liver
- basal lung crepitations

Rheumatic Heart Disease

This is a common cause of heart failure in the pregnant mother. The risk of heart failure is increased by anaemia.

Damage to the heart valves increases the chance of sub-acute bacterial endocarditis so that any invasive procedures and labour should be covered by antibiotics (1gm amoxycillin plus 120 mg gentamicin IM). If the mother is allergic to amoxycillin an IV infusion of vancomycin (1gm over 60 minutes) plus gentamycin (120 mg IV) is an alternative..

Treatment

- Assess ABC
- High concentration of oxygen via facemask with reservoir bag
- If there are signs of pulmonary congestion or a large heart on chest x-ray give IV frusemide 40mg (and repeat as required). Venesection may be required.
- If severely anaemic a partial exchange transfusion may help. Careful transfusion of packed cells, with 40mg IV frusemide for each unit of packed cells, will almost always be required.
- Morphine 10mg IM
- Sit upright on left side
- Bed rest
- Consider digoxin
- Consider nitroglycerine 300 micrograms under the tongue, repeated in 15 minutes, if necessary.

Management of heart failure during labour

MAKE SURE THE MOTHER DELIVERS SITTING UP.

Give her oxygen from a face mask.

Prop up in the left lateral tilt position.

Limit infusion of IV fluids, to decrease the risk of circulatory overload, and maintain a strict fluid balance chart.

Ensure adequate analgesia.

If oxytocin infusion is required, use a higher concentration at a slower rate while maintaining a fluid balance chart (e.g. the concentration may be doubled if the drops per minute are decreased by half). Consider early reduction of oxytocin when contractions become established.

Increase the rate of oxytocin infusion only to the point where good labour is established and then maintain infusion at that rate.

Do not give ergometrine.

Have the mother avoid sustained bearing down efforts during the second stage, if possible.

Perform an episiotomy and assist delivery by vacuum extraction or forceps.

Ensure active management of third stage.

Heart failure is not an indication for Caesarean section.

SECTION 9 Quiz 2

1) When heat failure occurs during labour the following treatments are correct:

a) prop up in left lateral position
b) give O_2
c) ensure adequate analgesia
d) give ergometrine after birth of baby
e) reduce maternal efforts during 2nd stage e.g. by vacuum
f) frusemide

ANSWERS:

1. abcef (ergometrine is dangerous-give oxytocin only)

Severe Anaemia (IMEESC 13.8 and WHO Pregnancy S-126 and S-127)

In normal pregnancy there is an increased total blood volume and a marked increase in plasma, thus haemoglobin concentration falls. Pathological anaemia is mainly due to iron deficiency, associated with depleted iron stores before pregnancy and poor diet. Anaemic women cope poorly with blood loss at delivery. 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. WHO recommends an iron supplement of 60 mg per day for mothers with adequate iron stores and 120mg/ day for those with none. If oral therapy is not tolerated, or is not possible, give 250mg IM monthly x 3.

- Treat any malaria, consider and prevent future inoculations with impregnated bed nets etc.
- Treat any chronic parasitaemia eg hookworm or schistosomiasis.

- Genetic blood disorders such as thalassaemia and sickle cell syndrome may be causes of chronic anaemia and may be passed on to the fetus. Check for these using Hb Electrophoresis.
- Severe anaemia exists if Hb < than 5 g/dl or if there are signs of heart failure and Hb is <7.5g/dl. It is very dangerous for both mother and baby.
- In haemolysis the urine will usually be dark brown in colour.
- The patient will be weak, with palms, soles and tongue near white, and signs of heart failure
- If heart failure give high concentration of oxygen, bed rest and sit upright on left side
- A transfusion of 500ml whole blood or 1 unit (330 ml) of packed cells can increase the Hb by 1 gm/dl. Transfusion with packed cells is optimal when the Hb is less than 5 g/dl. If blood cannot be centrifuged let the bag hang until the cells have settled. Infuse the cells slowly and dispose of the remaining serum.
- **Give 40 mg frusemide IV with each unit of blood transfused.**
- Partial exchange transfusion may be safer
- Over-hydration may lead to pulmonary oedema

IF LABOUR occurs when **severely anaemic**

- deliver sitting up in left lateral position
- Cross match blood in case of subsequent post partum haemorrhage
- Consider shortening the second stage by using a ventouse
- Manage the third stage actively (give oxytocin) and suture any tears without delay
- The mother is in danger for at least 24 hours after delivery
- After delivery the store of iron in her body will probably not be normal, so give her iron 120mg/day for 3 months and folate 400 micrograms/day during the puerperium.

SECTION 9 Quiz 3

1) Severe anaemia is a serious problem in pregnancy. Which of the following treatments is appropriate?

a) treat and prevent malaria
b) treat parasitaemia
c) transfuse with 1 unit (330 ml) packed cells if Hb< 5g/dl
d) in labour deliver propped up in left lateral position
e) cross matching of blood is not necessary during labour

ANSWERS:

1. abcd

Anaphylaxis (IMEESC 13.1)

Assessment

An allergic reaction to ingested, inhaled or topical substances, which may present as either shock or respiratory distress. Common causes include allergy to penicillin, radiographic contrast media, latex and certain foods, especially nuts.

This situation is potentially life-threatening and may result in: change in conscious level, collapse, respiratory or cardiac arrest. Some patients may carry their own adrenaline.

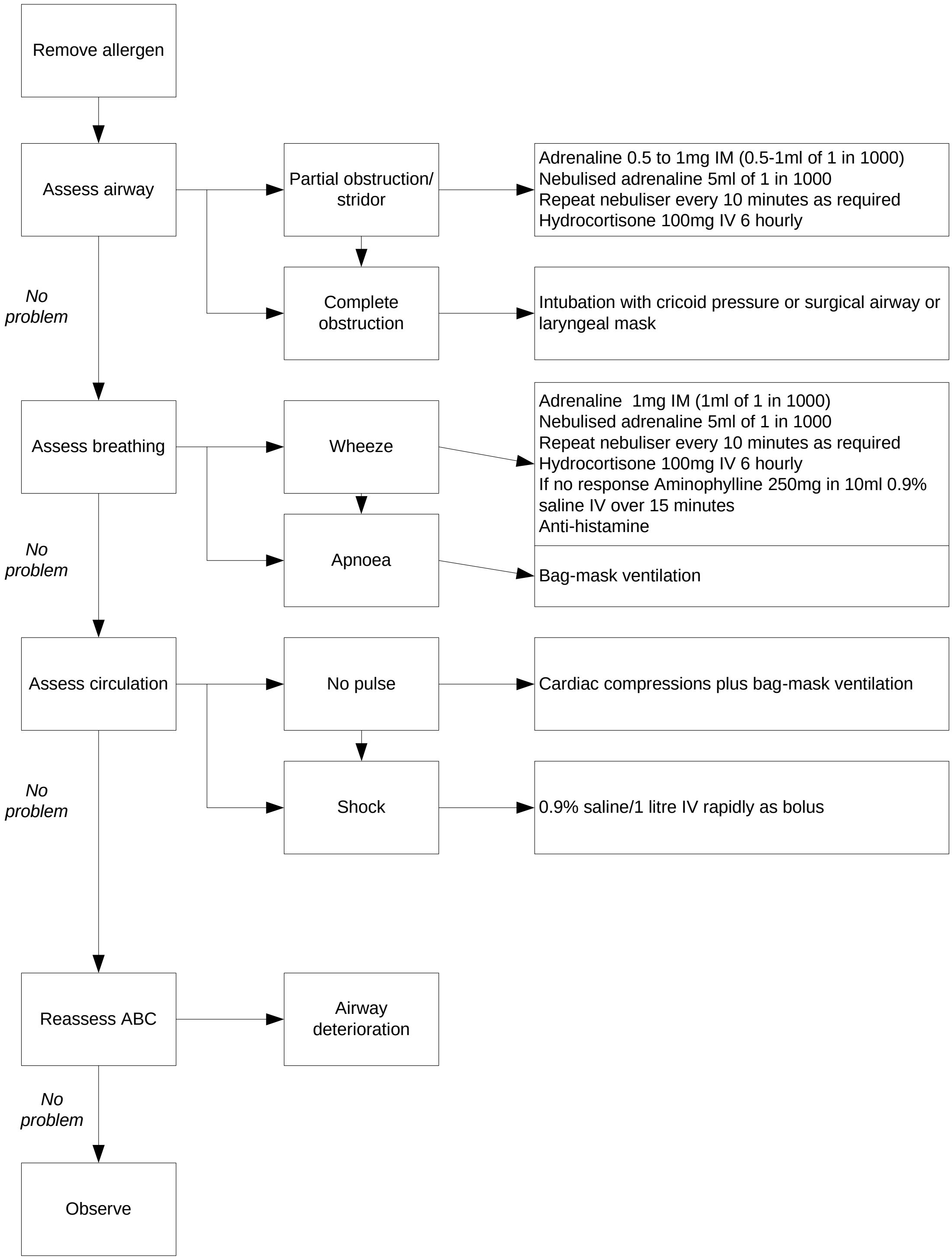
Note: Adrenaline 1mg is given IM, unless intractable shock or cardiac arrest on presentation when give the same dose IV

Moderate to severe anaphylaxis symptoms

	Moderate
Symptoms	- Coughing/ wheezing - Loose bowel motions - Sweating - Irritability
Signs	- Bronchospasm - Tachycardia - Pallor

	Severe
Symptoms	- Difficulty breathing - Collapse - Vomiting - Uncontrolled defaecation
Signs	- Severe bronchospasm - Laryngeal oedema - Shock - Respiratory arrest - Cardiac arrest

Pathway of care for Anaphylaxis in pregnancy (WHO Pregnancy C-28)



Pulmonary embolism (IMEESC 13.1)

The incidence in pregnancy in the UK is between 0.3 and 1/1000. Pregnancy causes a 5-6 fold increase in risk. Most deep venous thromboses in pregnancy are in the ileo-femoral vessels which are more likely to embolise than calf thromboses. Additional risk factors include operative delivery, prolonged labour, instrumental vaginal delivery, the mother > 35 years and obesity.

Signs and symptoms of pulmonary embolism

Findings	Patients with proven Pulmonary embolism (%)
Tachypnoea	89
Dyspnoea	81
Pleuritic pain	72
Apprehension	59
Cough	54
Tachycardia	43
Haemoptysis	34
Temperature >37^{0}C	34

Physical findings may be few. Prevention with anti-embolism stockings and subcutaneous heparin for medium and high-risk women, particularly if they are immobilised, is important.

Management

- Suspect pulmonary embolism in all patients presenting with sudden onset of shortness of breath, chest pain, unexplained rapid heartbeat or cardiovascular collapse.
- Call senior obstetrician, anaesthetist and medical team (if available)
- Assess and ensure adequate **A**irway, **B**reathing and **C**irculation
- Transfer the patient to a high dependency area and commence non-invasive monitoring of blood pressure, pulse oximetry, ECG and urine output. Send the blood for full blood count. Request chest x-ray and ECG.
- Treat any suspected pulmonary embolism (confirmatory tests are unlikely to be available).
- Patients in shock should be referred, when possible, for expert and intensive management such as intubation, ventilation, inotropes and more intensive monitoring.
- Commence anticoagulation. Treatment should be commenced with Low Molecular Weight Heparin (LMWH) such as enoxaparin given subcutaneously. The drug is available in syringes of 40, 60, 80 and 100 mg. The dose closest to the patient's pre-pregnancy weight should be given 12 hourly (for example if weight is 70Kg give 60 or 80mg). If coagulation tests are available the aim is to achieve an APTT of 1.5 to 2.5 times the pre-treatment level. If these tests are not available careful monitoring for signs of overdose which can cause haemorrhage should be performed and the mother warned of the symptoms to look for.
- The mother can then be discharged home having been taught how to administer the injections and dispose safely of the needles.

- LMWH should be continued for the duration of the pregnancy and at least 3 months after delivery. An expert should be consulted about the use of prophylactic heparin during any further pregnancy.
- On entering labour the mother should not give any further doses of LMWH until after the delivery of the placenta. If an elective Caesarean section is planned the mother should have the usual dose of LMWH on the night before surgery but omit the morning dose. After delivery the twice daily dose of enoxaparin should be restarted 4 hours after a vaginal delivery and 8 hours after a Caesarean Section.

Amniotic fluid embolism

This 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 cardio respiratory collapse and clotting problems with disseminated intravascular coagulation (DIC).

Presentation

Amniotic fluid embolism usually presents during the late stages of the first stage of labour. Symptoms include shivering, sweating, anxiety and coughing. Clinical signs are respiratory distress, shock (which may proceed to cardiac arrest) and DIC.

Diagnosis is essentially clinical. Amniotic fluid embolism may occur during labour (70%), during Caesarean section (19%) or immediately post-partum (11%).

Diagnosis of other causes of collapse to consider

Pulmonary embolism-does not often present in labour; often has chest pain

Septic shock: raised temperature with symptoms of infection or interference to abort a pregnancy
Eclampsia- raised blood pressure
Massive obstetric haemorrhage. Consider a concealed bleed
Aspiration of gastric contents- usually in an unconscious patient or around the time of a general anaesthetic

Management

Support Airway, Breathing and Circulation. Look for and treat the underlying cause.

SECTION 9 Quiz 4

1) **If a mother develops anaphylactic shock which of the following dose of adrenaline should be given**
   a) Adrenaline 1 mg IM
   b) Adrenaline 10 mg IM
   c) Adrenaline 10 mg IV

2) **Signs and symptoms of a pulmonary embolus in pregnancy include which of the following?**
   a) tachypnoea
   b) dyspnoea
   c) pleuritic pain
   d) shock
   e) hypothermia

ANSWERS:
1. a (both others are incorrect and dangerous)
2. abcd

THE PREGNANT MOTHER WITH SHOCK (IMEESC 12.2 and WHO Pregnancy S-1)

The mother who is shocked will be pale, cold and clammy, have a rapid pulse and may be confused or unconscious. Shock may be due to blood loss, a cardiac cause or sepsis. In labour the most likely cause of shock is blood loss, but in the post-partum period the shock may be due to infection acquired before or during labour.

Major haemorrhage in first trimester

- Ectopic pregnancy
- Abortion, spontaneous or induced (consider if hypertonic saline or sharp instruments may have been used to procure abortion)
- Molar pregnancy

Major haemorrhage in second or third trimester (IMEESC Chapter 12 and WHO Pregnancy S-7)

1) Antepartum haemorrhage

- Placental abruption– placental separation with blood loss concealed or revealed
- Placenta praevia – placenta lies across the cervix
- Vasa praevia – placental blood vessels lying in the membranes and in front of the baby's head.
- Uterine rupture – usually related to a previous Caesarean Section or other operation on the uterus

2) Postpartum haemorrhage

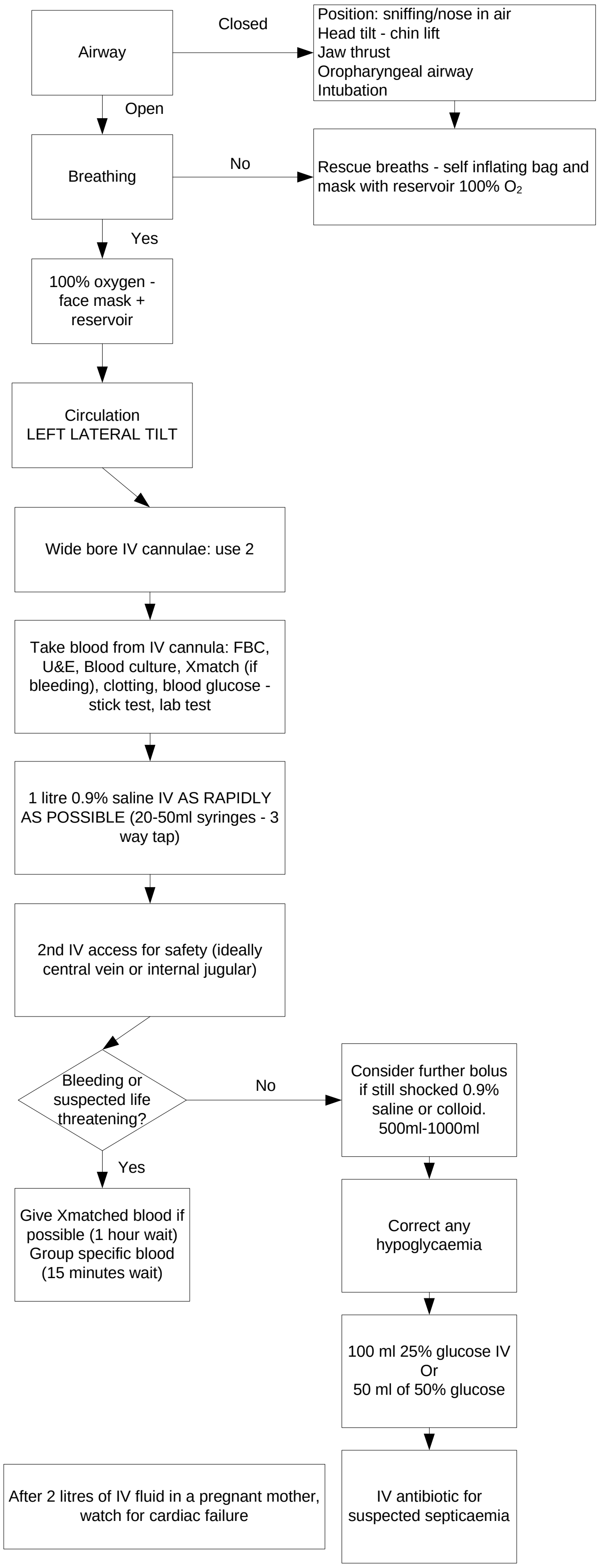
- Uterine atony: the commonest cause
- Genital tract injury
- Retained products of conception. This is can be retained pieces, or the entire placenta. This is particularly likely if the placenta is excessively adherent as sometimes happens after a previous Caesarean Section

3) Coagulation Failure

This may be due to a pre-existing coagulation problem, or in relation to complications of the pregnancy causing excessive bleeding and consumption of the clotting factors.
Causes include:

- Placental separation before delivery
- Pre-eclampsia or eclampsia
- Retained dead fetus
- Septicaemia including intra-uterine sepsis
- Incompatible blood transfusion
- Amniotic fluid embolism

Pathway of Care for shock in pregnancy



SECTION 9 Quiz 5

1) **Which of the following are features of shock during pregnancy?**
   a) Patient is pale, cold and clammy
   b) Usually heart rate is < 115 bpm
   c) Confusion
   d) Capillary refill 4 seconds or longer

2) **When treating shock in pregnancy which of the following are important actions?**
   a) ABC
   b) 100% O_2
   c) Supine position
   d) 2 wide bore IV cannulae
   e) 200 ml IV bolus 0.9% saline
   f) 1 litre IV bolus 0.9% saline

ANSWERS:
1. acd
2. abdf

Major haemorrhage in first trimester

Ectopic pregnancy (IMEESC 12.2 and 12.3 and WHO Pregnancy S-7, S-8, S-13and S-14)

Must be considered in any girl or mother at any age where pregnancy is possible who presents with acute abdominal pain and shock

Assessment

Abdominal Pain:	lower abdominal cramping or stabbing pain, shoulder tip pain or rectal pain (free blood)
Vaginal Bleeding	variable – classically irregular and dark in colour
Pregnancy Symptoms	breast tenderness, nausea and tiredness
Abdominal Examination	tenderness with rebound and guarding tip patient head down: **may** produce shoulder tip pain
Pelvic Examination	tenderness – can be unilateral +/- mass in fornix uterus and cervix softer than when non pregnant uterus smaller than dates from last menstrual period

Diagnosis

Always consider in any girl or woman with abdominal pain of childbearing age

Pregnancy Test Do a pregnancy test in all potentially fertile girls/women.

Ultrasound Positive pregnancy test but no intra-uterine pregnancy.

Free fluid and/or an echogenic mass

Emergency Treatment

Maintain the airway and supplement breathing with high concentration of **oxygen** through a face mask/reservoir or via a bag-valve-mask as needed.

Circulation

- Gain IV access with 2 wide-bore IV cannula (if possible 16-18G)
- Take blood for FBC, cross matching (4 units) and whole blood clotting time
- Give IV fluids and blood as needed to resuscitate (remember that young, healthy women can lose a lot of blood before becoming shocked, especially if the leak is slow as opposed to a sudden large loss)
- Start with a rapid fluid bolus of 1 litre IV of 0.9% saline

If diagnosis is ruptured ectopic with heavy bleeding and shock do a Laparotomy whilst resuscitation is underway. Control the bleeding initially to allow the anaesthetist to 'catch up' with the resuscitation before surgical removal of the ectopic and fallopian tube.

Follow up

Counsel not to use intrauterine contraceptives and obtain early ultrasound in next pregnancy.

SECTION 9 Quiz 6

1) The symptoms/signs of an ectopic pregnancy can include which of the following?

a) a possibility of pregnancy
b) lower abdominal pain
c) vaginal bleeding
d) early pregnancy symptoms such as breast tenderness, nausea
e) collapse/fainting

2) Emergency treatments for an ectopic pregnancy that is actively bleeding with shock include which of the following?

a) ABC
b) Laparotomy whilst resuscitation underway
c) 2 wide bone IV cannulae
d) Repair of the fallopian tube
e) 1 litre bolus of IV 0.9% saline
f) Cross match 1 unit of blood

ANSWERS:

1. abcde
2. abce (cross match 4 units and remove the tube containing the pregnancy)

DIAGNOSIS of abdominal pain in early pregnancy

Symptoms	Clinical Signs	Possible diagnosis
Abdominal pain Light vaginal bleeding	Palpable, tender discrete mass in lower abdomen Adnexal mass on vaginal examination	Ovarian cyst
Lower abdominal pain Anorexia Low-grade fever Nausea/vomiting	Rebound tenderness Paralytic ileus Increased white blood cell count	Appendicitis
Dysuria Retropubic/suprapubic pain Increased frequency and urgency of urination Abdominal pain		Cystitis
Dysuria Retropubic/suprapubic pain Spiking fever/chills Increased frequency and urgency of urination Abdominal pain Anorexia, nausea/vomiting	Loin tenderness	Acute pyelonephritis
Fever/rigors Lower abdominal pain Anorexia Nausea/vomiting	Rebound tenderness Rigid abdomen Abdominal distension Absent bowel sounds Shock	Peritonitis
Abdominal pain Fainting Light vaginal bleeding Amenorrhea Shoulder tip pain	Closed cervix Tender adnexal mass Uterus slightly larger than normal Uterus and cervix softer than normal	Ectopic pregnancy

Acute appendicitis (IMEESC 7.6 and WHO Pregnancy S-115**)**

Give a combination of antibiotics before surgery and continue postoperatively until fever-free for 48 hours (ampicillin 2 g IV 6 hourly plus gentamicin 5 mg/kg body weight IV 24 hourly plus metronidazole 500 mg IV 8 hourly).

Perform an immediate surgical exploration (regardless of stage of gestation). In pregnancy the site of the incision should be placed over the point of maximum tenderness.

Abortion (miscarriage) (IMEESC 12.3 and WHO Pregnancy S-7, S-8 to S-12**)**

Consider abortion in any woman of reproductive age who has a missed period and has one or more of the following: bleeding, cramping, partial expulsion of products of conception, dilated cervix or smaller uterus than expected. The important differential diagnosis to exclude is an ectopic pregnancy.

If **abortion is a possible diagnosis** identify and treat any complications immediately (remove any herbs, local medications or caustic substances in cases of suspected unsafe abortion).

MANAGEMENT

THREATENED ABORTION =conservative. May settle or progress to one of the following

COMPLETE ABORTION =conservative unless associated with complications, see below

INEVITABLE ABORTION =allow to abort, but treat any complications. If incomplete proceed as below.

INCOMPLETE ABORTION

If bleeding is light to moderate and pregnancy < 16 weeks: use fingers or ring (or sponge) forceps to remove products of conception protruding through the cervix.

If bleeding is heavy and pregnancy < 16 weeks,

-evacuate the uterus using manual vacuum aspiration (sharp curettage should only be done if vacuum is unavailable)

- If **evacuation is not immediately possible:** give ergometrine 500 micrograms IM (repeated after 15 minutes if necessary) OR misoprostol 400 micrograms orally (repeated once after 4 hours if necessary).

If pregnancy >16 weeks:

- Infuse oxytocin 40 units in 1 Litre 0.9% saline or Hartmanns at 40 drops per minute until expulsion of products of conception occurs.

- If necessary give misoprostol 200 micrograms vaginally every 4 hours until expulsion, but do not administer more than 800 micrograms in total.

- Evacuate any remaining products of conception from the uterus manually.

Emergency Treatment if shocked

Maintain the airway and supplement breathing with high concentration of **oxygen** through a face mask/reservoir or via a bag-valve-mask as needed.

Circulation

- Gain IV access with 2 wide-bore IV cannula (if possible 16-18G)
- Take blood for FBC, cross matching (4 units) and whole blood clotting time
- Give IV fluids and blood as needed to resuscitate (remember that young, healthy women can lose a lot of blood before becoming shocked, especially if the leak is slow as opposed to a sudden large loss)
- Start with a rapid fluid bolus of 1 litre IV of 0.9% saline

If severe septic shock is possible give IV antibiotics in high doses immediately: Ampicillin (2 g IV loading dose then 1 gram 6 hourly) plus gentamicin (5 mg/kg body weight IV 24 hourly, WHO 80mg IM 8 hourly) plus metronidazole (500 mg IV 8 hourly).

Diagnosis and management of complications of abortion (miscarriage)

• Lower abdominal pain rebound tenderness • Tender uterus • Prolonged bleed • Malaise / Fever • Purulent discharge • Cervical excitation	**Infection/sepsis**	Begin antibiotics[a] as soon as possible before attempting manual or vacuum aspiration.
• Abdominal cramps • Rebound tenderness • Abdominal distension • Rigid abdomen • Shoulder pain • Nausea/vomiting • Fever	**Uterine, vaginal or bowel injuries**	Perform a Laparotomy to repair the injury and perform manual vacuum aspiration simultaneously. Seek further assistance if required.
[a] Give for example ampicillin 2 g loading dose the 1 gram IV 6 hourly PLUS gentamicin 5 mg/kg body weight IV 24 hourly (or WHO 80mg IM 8 hourly) PLUS metronidazole 500 mg IV 8 hourly until the mother is fever-free for 48 hrs.		

SECTION 9 Quiz 7

3) **Which of the following are causes of abdominal pain in early pregnancy?**
   a) ectopic pregnancy
   b) threatened miscarriage
   c) urinary tract infection
   d) appendicitis
   e) Ovarian cyst

4) **Which of the following are features suggesting a septic and unsafe abortion?**
   a) high fever
   b) lower abdominal pain
   c) peritonitis from uterine, vaginal or bowel injuries
   d) purulent vaginal discharge

ANSWERS:
3. acde
4. abcd

Major haemorrhage in second or third trimester (IMEESC Chapter 12 and WHO Pregnancy S-7)

1) Antepartum haemorrhage

- Placental abruption– placental separation with blood loss concealed or revealed
- Placenta praevia – placenta lies across the cervix
- Vasa praevia – placental blood vessels lying in the membranes and in front of the baby's head.
- Uterine rupture – usually related to a previous Caesarean Section or other operation on the uterus

2) Postpartum haemorrhage

- Uterine atony: The commonest cause
- Genital tract injury
- Retained products of conception. This is can be retained pieces, or the entire placenta. This is particularly likely if the placenta is excessively adherent as sometimes happens after a previous Caesarean Section

3) Coagulation Failure

This may be due to a pre-existing coagulation problem, or in relation to complications of the pregnancy causing excessive bleeding and consumption of the clotting factors. Causes include:

- Placental separation before delivery
- Pre-eclampsia or eclampsia
- Retained dead fetus
- Septicaemia including intra-uterine sepsis
- Incompatible blood transfusion
- Amniotic fluid embolism

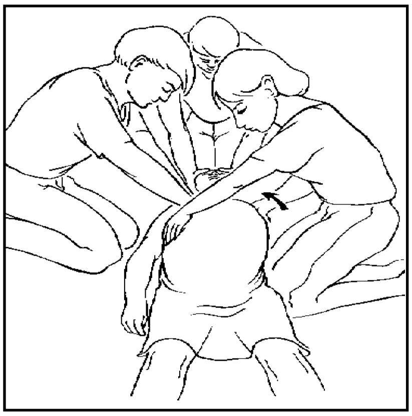
Management of major haemorrhage in the second or third trimester

Call for the most senior help available

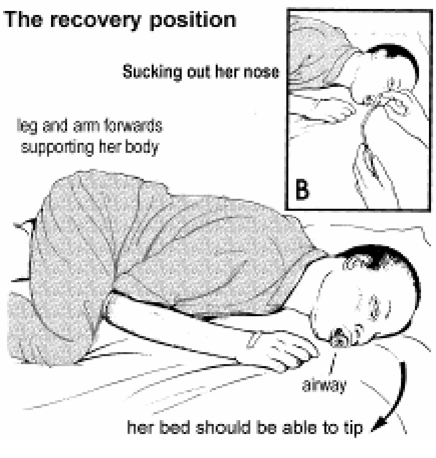
Think about possible causes when taking a history and assessing the patient.

Recognise signs of hypovolaemia
- Tachycardia
- Cold, pale, sweaty and possibly cyanosed skin
- Alteration of mental state: confusion or unconscious
- Fall in urine output
- Narrowed pulse pressure
- Hypotension (late sign)

Restore circulating volume
- Position mother in the left lateral position to minimise the effects of aorto-caval compression. A wedge may be used during obstetric procedures. Assistants can also manually displace the uterus.



- Administer high concentration oxygen (10-15 L per minute) with close fitting face mask and reservoir regardless of her oxygenation assessment.
- Assess the airway and respiratory effort. Intubation (if safe and available) may be necessary to protect the airway if the woman has depressed consciousness or to maximise the oxygenation. Otherwise place in the recovery position.



- Establish two IV lines using the largest available cannula. Lower limb and femoral vessels should be avoided.
- Take blood for Hb, whole blood clotting time and cross match blood (minimum 4 units).

- Initial replacement should be with 1 litre of 0.9% saline or Hartmann's solution over 15-20 minutes followed by an additional 1 litre over 30 minutes until blood is available. O Rh negative blood can be used in life-threatening haemorrhage but ideally ABO and Rhesus compatible blood should be used

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

Blood transfusion

If time allows full cross match should be undertaken. If the mother's blood group is known and she needs blood very urgently type specific blood can be given. In the life-threatening situation O Rhesus Negative blood may be used.

One unit (500 ml) of whole blood will raise the haemoglobin by 1 g/dl. Concentrated red cells have a volume of 300 ml (220 ml of red cells and 80 ml of saline-adenine- glucose-mannitol solution).

Frequent checks of the haematocrit are helpful to guide massive transfusions, particularly when adequate measure of loss is impossible. Stored blood has a reduction in platelet numbers and important clotting factors so if a massive transfusion is required the administration of clotting factors and platelets will be required. If not give blood which is as fresh as possible.

Any large volume of IV fluids or blood should be carefully warmed before use, ideally by a dry electrical warmer. Traditional water baths carry the risk of electrical hazards. If no warmer is available an assistant can warm each bag against their body. Keeping the patient warm is also essential.

If large volumes of blood are needed uregently, inflate a blood pressure cuff around the bag of IV fluid to increase rate of infusion. Alternatively use 3 way tap, 20 or 50 ml syringes and rapid manual infusion.

Evaluation of response

Essential monitoring includes pulse, BP, respiration rate, SaO_2 and fluid balance. Regular checks of the haematocrit and whole blood clotting time are important.

ANTEPARTUM HAEMORRHAGE (WHO Pregnancy S-17)

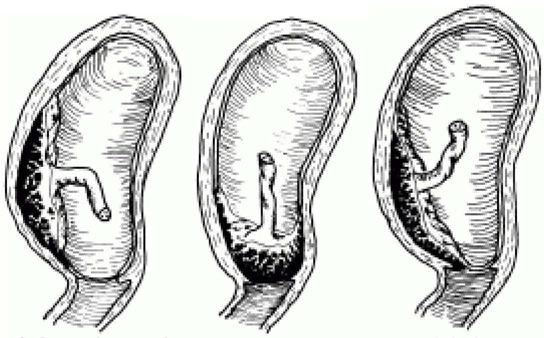
Placental abruption (separation)

Bleeding may be concealed or revealed. Findings include continuous abdominal pain, uterine tenderness and a woody, hard uterus. The baby is often dead. If not, urgent Caesarean Section, if safe and available, should be performed. If the baby is dead, early attempts to induce labour will help to reduce further maternal bleeding. Coagulation problems may occur after a fetus has been dead for > 4 weeks. Failure of uterine contraction after delivery increases the risk of a large post-partum haemorrhage.

Placenta Praevia

Major bleeding usually occurs in the last month of pregnancy, but there is often history of smaller bleeds previously. The bleeding is painless and without obvious cause. Diagnosis is best made by abdominal ultrasound scan. Certain clinical signs suggest placenta praevia, for example an oblique lie or a soft uterus not suggestive of an abruption. If ultrasound is not possible then Caesarean section should be performed.

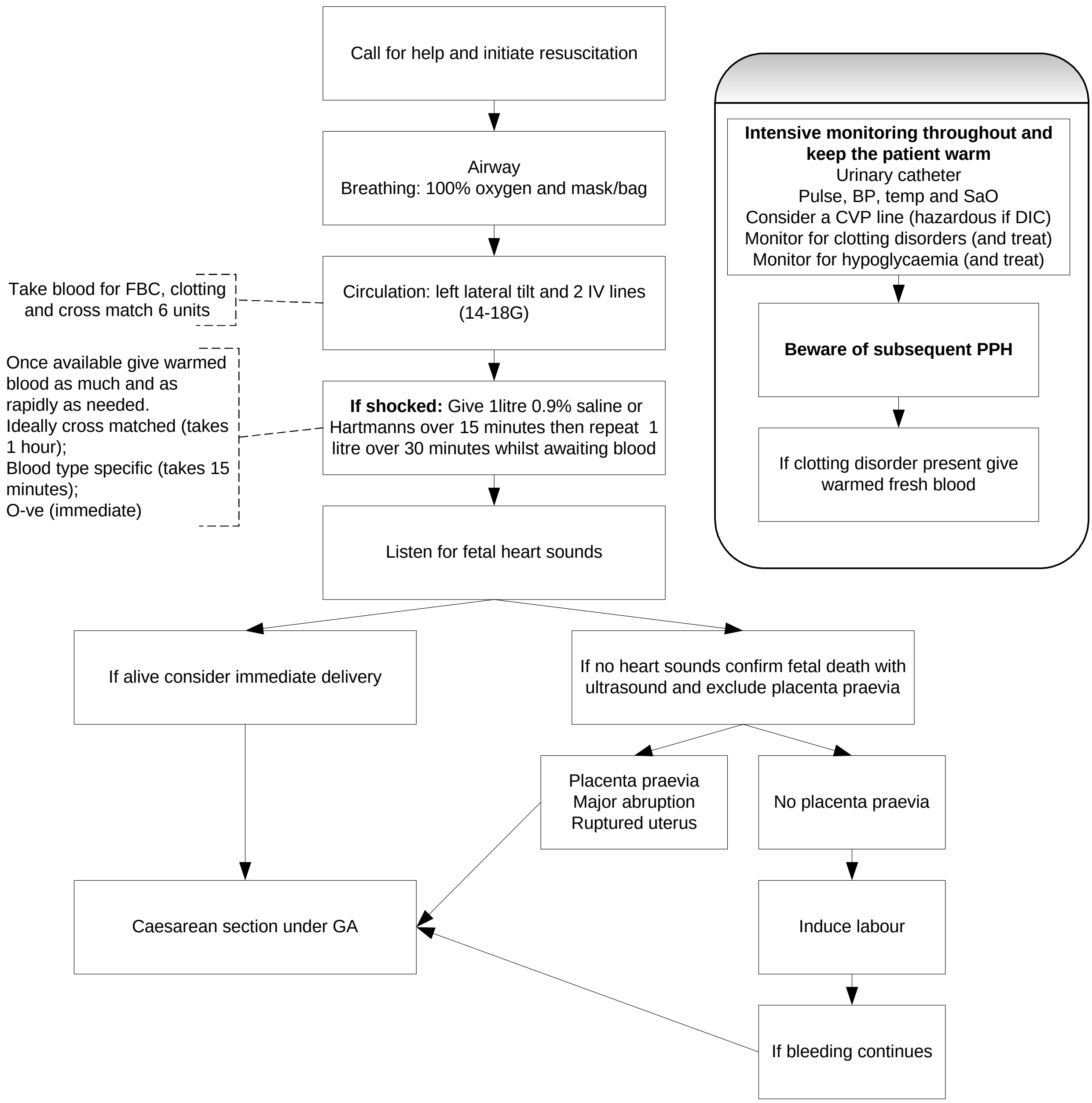
There is an increased risk of placenta praevia and accreta (abnormal placental adherence) in mothers who have had a previous Caesarean Section.



Clinical features of a large ante-partum haemorrhage (APH)

Pallor, tachycardia, shock, pain (may be absent), vaginal bleeding (may be concealed).

Pathway of care massive APH



IT IS THE APH THAT WEAKENS AND THEN THE PPH THAT KILLS. ATTENTION SHOULD CONSTANTLY FOCUS ON RESUSCITATION TO MAINTAIN THE CIRCULATION.

SECTION 9 Quiz 8

1) **Which of the following are causes of massive APH in the 2nd or 3rd trimester?**
   a) placental abruption
   b) placenta praevia
   c) vasa praevia
   d) uterine rupture
   e) ruptured ovarian cyst

2) **When managing a massive APH describe the sequence that should be undertaken in order of priority with 1 first and 6 last**

Listen for fetal heart sounds	
Call for help and start resuscitation	
Breathing 100% O_2	
Airway control	
Left lateral tilt and 2 IV lines	
If shocked give 1 - 2 litres 0.9% Saline whilst waiting for blood	

ANSWERS:
1. abcd
2. downward sequence in blank column is 613245

Ruptured uterus

This usually presents with hypovolaemic shock but vaginal bleeding can be concealed.
The baby is usually dead

A previous Caesarean Section scar may rupture during labour. However obstructed labour, even without a uterine scar, particularly in a woman of high parity, may cause uterine rupture. Excessive doses of oxytocin during labour, particularly if there is cephalo-pelvic disproportion, can precipitate this. Rupture of the uterus can also occur following violence or trauma.

Symptoms and signs

- o Change in nature of pain in labour from severe intermittent to constant
- o PV bleeding may or may not be present (a haemo-peritoneum from a ruptured uterus can fail to drain vaginally due to an impacted fetal head and care should be taken to gently dislodge the head a little to look for signs of bleeding)
  - Maternal shock plus dehydration, exhaustion and acidosis if prolonged obstructed labour
  - Abdominal palpation is tender, fetal parts easily palpated, absent fetal heart
- o On VE the presenting part may be high or impacted: the fetal head may have retreated into the uterus
  - Differential diagnosis is placental abruption.

Management

1. Suspect in any patient with risk factors such as previous CS

2. Emergency treatment:
Airway and Breathing oxygen by mask/reservoir and with self inflating bag if inadequate breathing
Circulation – 2 wide bore IV cannulas (14 – 18 g)
Blood sent for FBC and cross-match
IV fluids to replace volume-1000ml of 0.9% saline initially as rapidly as possible
3. Call obstetrician (if available)
4. Obtain consent
5. Perform urgent Laparotomy under anaesthesia
6. Give IV prophylactic antibiotics (ampicillin 2g or cefuroxime 1.5g plus metronidazole 500mg)

Post partum haemorrhage (WHO Pregnancy S-25)

Causes

Indicated by vaginal bleeding. Other signs may include pallor, tachycardia, shock, and bradycardia

Heavy bleeding after delivery can arise from
- atonic uterus
- trauma to the genital tract
- retained products of conception

In these situations the bleeding is revealed, **although the uterus can fill with blood before any becomes apparent vaginally**. Ruptured uterus can cause concealed bleeding as can bleeding following CS.

Tachycardia is the first sign of shock, but if a woman is pale and bradycardic do a vaginal examination to remove clot from cervix or reveal uterine inversion.

IM syntometrine (5 units oxytocin plus 500 micrograms of ergometrine) or oxytocin (5 or 10 units IM) with delivery of the anterior shoulder of the fetus is recommended to aid the 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 before such drugs are given that there is not another baby.** If the placenta has not delivered within 30 minutes of delivery of the baby, further management will be required.

Delayed severe secondary PPH is usually caused by retained products of conception which undergo necrosis, become infected and prevent involution of the uterus.

A fever suggests an infectious cause, and purpura suggests Disseminated Intravascular Coagulation = DIC

Management of large PPH

Call for help

Airway

- Use an opening maneuver, if not patent, or partially obstructed. If there is improvement, use airway adjuncts to support the airway.
- Suction as required

Breathing

- Provide 100% oxygen through a face mask with reservoir bag if adequate spontaneous respiration

- For inadequate ventilation or depressed conscious level (AVPU), give chest inflations with a bag-valve-mask and 100% O_2 and summon anaesthetist (if available)

Circulation

- Assess pulse rate and volume, Capillary refill time, BP and urine output

STOP FURTHER BLEEDING using procedures below at same time as gaining IV or if not possible IO access

- Insert wide-bore IV cannulae x 2 (14G-18G) and send blood for FBC, cross-match (4 units) and clotting
- Give 1 litre 0.9% saline if shocked
- Give an additional 1 litre bolus IV of 0.9% saline or plasma expander until blood arrives
- Give O negative or group specific blood if no time for cross-match
- Give fresh blood as soon as possible

Uterine atony

Poor contraction of the uterus after delivery is the commonest cause of post-partum haemorrhage.

Drugs to make the uterus contract

A repeat dose of 10 iu oxytocin IM/IV and repeat again after 20 minutes. If the mother does not have eclampsia, pre-eclampsia or hypertension, ergometrine 0.2mg IM will help uterine contraction.

Supplement the above bolus drugs with an IV infusion of oxytocin 40 u in 500ml 0.9% saline or Ringer Lactate over 4 hours.

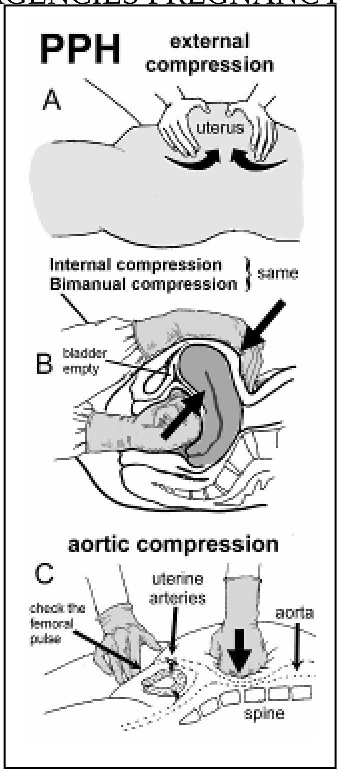
(WHO recommended dose: 20 u in 1 litre of 0.9% saline or Ringer Lactate at a rate of 180ml/hour (60 drops/minute) for 4 hours then 10 u in 1 litre of 0.9% saline or Ringer lactate at 90ml/hour (30 drops/minute).)

If this fails misoprostol is an excellent alternative which unlike oxytocin does not need to be kept in a refrigerator. It is given sublingually as 4 of 200 microgram tablets or rectally as 4 to 5 of 200 microgram pessaries.

Abdominal massage of the uterus

If the uterus does not contract a contraction may be rubbed up by abdominal massage.

- Massage fundus in a circular motion with cupped palm of the hands until contracted
- When well contracted, place fingers behind fundus and push down in one swift action to expel clots



Bimanual uterine compression

If heavy PPH continues despite uterine massage and oxytocin/ergometrine/misoprostol treatment and the placenta is not in place apply bimanual uterine compression.

- o Must wear sterile gloves
- o Introduce right hand into vagina, clench fist with back of hand posteriorly and knuckles in the anterior fornix
- o Place other hand on abdomen behind the uterus and squeeze the uterus firmly between both hands
- o Continue compression until bleeding stops (no bleeding when compression released)

Aortic compression

If bleeding still persists apply aortic compression:

- o Feel femoral pulse
- o Apply pressure above umbilicus to stop bleeding with sufficient pressure that femoral pulse cannot be felt
- o After finding correct site show an assistant how to apply the pressure
- o Continue until bleeding stops. If bleeding continues continue pressure whilst transferring mother to hospital.

Exclude trauma to cervix or vagina

If the bleeding continues, examine to exclude trauma to the vagina or cervix for retained products of conception or a ruptured uterus.

Uterine packing

Uterine packing with a hydrostatic balloon such as a Rusch balloon or condom over a foley catheter can help to control haemorrhage.

Retained placenta

Risk factors include previous retained placenta, high parity, history of previous uterine surgery and placenta praevia.

Spinal anaesthesia may be used for manual removal of the placenta. The mother should be adequately resuscitated with IV fluids/blood, oxygen. There should be close monitoring of pulse rate and volume, blood pressure, oxygen saturation and urine output.

After removal of the placenta, massage the uterus to encourage a tonic uterine contraction and an IV infusion of oxytocin 40 units in 500 ml of 0.9% saline should be administered over 4 hours to ensure continued uterine contraction.

After manual removal give ampicillin 2g IM/IV

If fever > 38.5C, foul smelling lochia or history of ruptured membranes for 18 or more hours add gentamicin 80mg IM/IV to the ampicillin. Continue antibiotics IM/IV until 48 hours after end of fever and then give oral amoxillin 500mg tds until 7 days of treatment has been completed.

Large postpartum haemorrhage: Pathway of Care

AIM FOR A CONTRACTED AND EMPTY UTERUS

Give baby to mother and place on her breast

Call for help and initiate resuscitation

Airway
Breathing: 100% oxygen and mask/bag

Circulation: 2 IV lines (14-18G)

Take blood for FBC, clotting and cross match 6 units

If shocked: Give 1-2 litres 0.9% saline as rapidly as possible whilst awaiting blood

Once available give warmed blood as much and as rapidly as needed.
Ideally cross matched (takes 1 hour);
Blood type specific (takes 15 minutes);
O-ve (immediate)

Is the uterus contracted?

Intensive monitoring throughout and keep the patient warm
Urinary catheter
Pulse, BP, temp and SaO
Consider a CVP line (hazardous if DIC)
Monitor for clotting disorders (and treat)
Monitor for hypoglycaemia (and treat)

Beware of subsequent PPH

If clotting disorder present give warmed fresh blood

Yes

Take to theatre and do EUA
If retained products: remove + antibiotics
If genital tract trauma: repair ± vaginal pack
If uterine inversion: reduce
If none of these: laparotomy and repair

No

Treatment aims at contracting the uterus
Rub up the uterus ± bimanual compression
Syntometrine (oxytocin 5iu/ergometrine 0.5mg) IM (WHO ergometrine 200 micrograms IM or IV)
Then **either**:
IV infusion PGE_2 (10micrograms/minutes) or
Oxytocin 40iu in 500ml 0.9% saline over 4 hours (WHO oxytocin 20 units/litre at 30 drops/minute) **or**
place sterile foley catheter into uterus and give intrauterine infusion PGE_2 (7.5 micrograms/min) **or** 800 micrograms of misoprostol (4 x 200 micrograms) rectally

If still bleeding

Hydrostatic balloon into uterus inflated with 400-500ml 0.9% saline

If still bleeding

Take to theatre and perform a laparotomy
Can press on aorta and undertake specialist surgery

Check Hb or haematocrit after resuscitation and consider iron orally if anaemic

SECTION 9 Quiz 9

1) **Which of the following are some of the symptoms or signs of a ruptured uterus?**
   a) shock
   b) change in pain from intermittent to constant
   c) chest pain
   d) fetal parts easily palpable

2) **Put the following causes of PPH into order of frequency with the most frequent placed first**

Uterine atony	
Retained products of conception	
Genital tract injury	
Coagulation failure	

ANSWERS:

1. abd 2. sequence is 1,2,3,4

Uterine inversion (IMEESC Chapter 12 and WHO Pregnancy S-27, S-33, P-91 and P-92)

Definition

In this condition the uterus, after or during delivery of the placenta, is inverted and can appear at the introitus

Prevention

Prevent by avoiding cord traction until there are signs of placental separation

Clinical signs

Early recognition is vital.
Associated with haemorrhage in >90% of cases.

Shock is most common complication (40%). Shock out of proportion to blood loss may be due to increased vagal tone.

Most commonly presents as a pelvic mass, sometimes protruding from the vagina. Where it does not protrude from the vagina, it may go undetected resulting in a sub-acute or chronic inversion or even unexplained maternal death.

Symptoms and signs include severe lower abdominal pain in the third stage of labour, haemorrhage, shock out of proportion to blood loss, uterus not palpable on abdominal examination and vaginal examination showing a mass in the vagina.

A bradycardia may be present due to increased vagal tone.

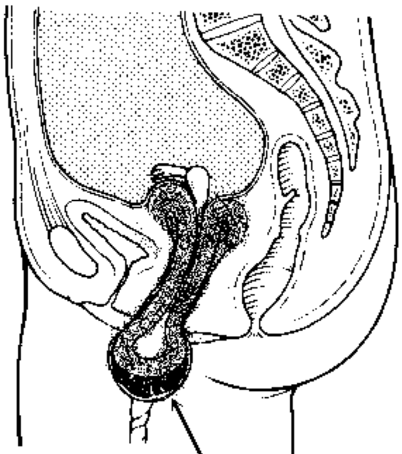
Concealed intra-abdominal bleeding producing tachycardia and shock may be present.

Incomplete inversions present more subtly with continuing PPH despite a contracted uterus; the fundus of the uterus may feel dimpled.

Suspect diagnosis

- If shock with little obvious bleeding
- If continuing PPH despite apparently well contracted uterus
- If associated lower abdominal pain
- If dimpled uterine fundus or fundus not palpable abdominally

Inversion of the uterus



Management

Urgent to replace as it becomes more fixed over time

Call for senior help: If available

Emergency treatment

Airway

- Use an opening maneuver, if not patent, or partially obstructed. If there is improvement, use airway adjuncts to support the airway.
- Suction as required
- The airway may need to be secured by intubation using experienced senior help (if available)

Breathing

- Provide high concentration of oxygen through a face mask with reservoir bag for adequate spontaneous respiration
- For inadequate ventilation or depressed conscious level (AVPU), give chest inflations with a bag-valve-mask and 100% O_2 and summon experienced senior help (if available)

Circulation

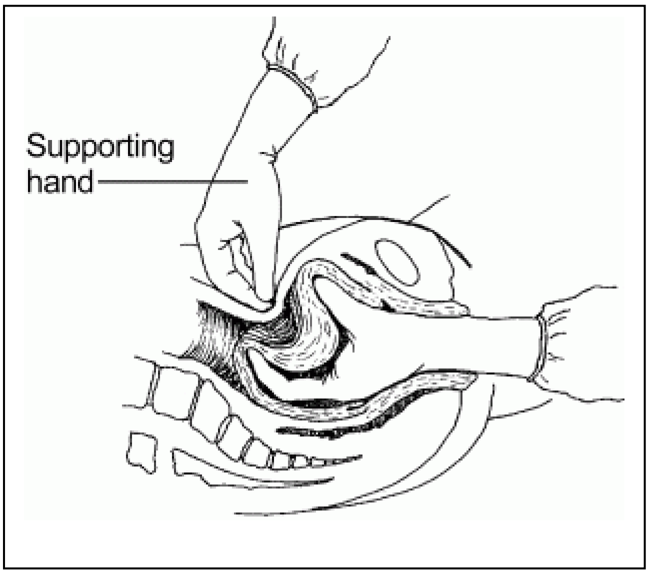
- Assess pulse rate and volume, Capillary refill time, BP and urine output
- Insert wide-bore IV cannulae x 2 (14G-18G) and send blood for FBC, cross-match and clotting
- Give 1 litre 0.9% saline IV as rapidly as possible if shocked
- Give atropine 0.6mg IV if heart rate <60/minute.

Manual replacement

As soon as possible attempt manual replacement of the uterus by pushing the fundus back through the cervix (the longer the delay the more difficult)

Grasp the uterus and push it through the cervix towards the umbilicus to its normal position, using the other hand to support the uterus. If the placenta is still attached, perform manual removal after correction.

It is important that the part of the uterus that came out last (the part closest to the cervix) goes in first.



Placental Delivery

Do not attempt to separate the placenta until inversion corrected

Hydrostatic correction

Place the woman in deep Trendelenburg position (lower her head about 0.5 metres below the level of the perineum).

Prepare a high-level sterile douche system with large nozzle and long tubing (2 metres) and a warm reservoir (1 to 2 litres of sterile 0.9% saline).

Note: This can also be done using warmed normal saline and an ordinary IV administration set.
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 recognized by where the rugose vagina becomes the smooth vagina.

Place the nozzle of the douche in the posterior fornix.

At the same time, with the other hand hold the labia sealed over the nozzle and use the forearm to support the nozzle.

Ask an assistant to start the douche with full pressure (raise the water reservoir to at least 2 metres). 0.9% saline will distend the posterior fornix of the vagina gradually so that it stretches. This causes the circumference of the orifice to increase, relieves cervical constriction and results in correction of the inversion.

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 whilst the wide end lies against the inverted uterus vaginally.

If above unsuccessful, replace the uterus under general anaesthesia as above or via Laparotomy

Drugs such as Magnesium sulfate 2-4 grams infused IV over five minutes may be helpful to relax the cervical ring and help replacement.

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.

Grasp the inverted uterus and push it through the cervix in the direction of the umbilicus to its normal anatomic position. If the **placenta is still attached**, perform a manual removal after correction.

Post procedure care

Once the inversion is corrected, infuse IV oxytocin 40 units in 500 ml normal saline or Ringer's lactate over 4 hours:

- If the **uterus does not contract after oxytocin**, give misoprostol 4 of 200 microgram pessaries rectally.

Give a single dose of prophylactic antibiotics after correcting the inverted uterus. - ampicillin 2 g IV PLUS metronidazole 500 mg IV

Give appropriate analgesic drugs.

Pathway of Care Uterine Inversion

Airway: maintain as level of consciousness requires

Breathing: Give 100% O_2 by face mask or bag and mask if needed

Circulation: **Shock is usually severe** 2 IV lines (14-18G)

Take blood for FBC, clotting and cross match 4-6 units

Give 1 litre 0.9% saline IV as rapidly as possible whilst awaiting blood

Give atropine 600 micrograms IV if heart rate < 60/minute

Establish monitoring of pulse, BP, respiratory rate, SaO_2, urine output

Establish adequate analgesia and call for senior help (if available)

<u>Attempt manual replacement as soon as possible</u>: gently push the fundus back through the cervix **before attempting to separate off the placenta**

Uterine relaxation helps these processes. Give MgSO4 2-4 grams IV over 5 minutes. A general anaesthetic will usually be needed

Unsuccessful

<u>Hydrostatic replacement:</u>
2 litres warmed 0.9% saline run in under gravity from a height of 2 metres into the posterior fornix using 2 wide bore tubes using clenched fist to maintain a seal at the introitus. A silastic ventouse cup can be used to deliver the fluid and provide a seal. The reduction is usually achieved in 5-10 minutes.

If fails (<3%) requires a laparotomy

Successful

Once reduced, maintain hand in uterine cavity until a firm contraction occurs, and IV oxytocin is being given. Then remove the placenta and explore the cavity gently for trauma

.

SECTION 10 Quiz 10

1) In addition to ABC which of the following are techniques can help to stop a massive PPH?

a) rub up uterus +/- bimanual compression
b) left lateral tilt
c) oxytocin 5 units plus ergometrine 500 micrograms IM
d) misoprostal orally or rectally
e) hydrostatic balloon into uterus filled with 400 – 500 ml 0.9% saline

2) In addition to ABC which of the following techniques can help to treat a mother with uterine inversion?

a) remove the placenta before trying manual replacement
b) atropine 600 micrograms IV if bradycardic
c) manual replacement under GA
d) hydrostatic replacement

ANSWERS:

1. acde 2. bcd

Septic causes of shock (WHO Pregnancy S-108, S-110 and C-29)

Sepsis is a common cause of maternal death and long term morbidity.

Important causes of sepsis in obstetric patients

- Infection of the uterus and birth canal after septic abortion or birth of the baby: postpartum endometritis (puerperal sepsis)
- Acute gastroenteritis
- Pneumonia
- Meningitis
- Malaria
- Pyelonephritis
- Wound infection
- Acute appendicitis with peritonitis

Clinical signs of sepsis

- tachypnoea
- tachycardia
- fever
- altered mental state
- shock

Some septic patients may not have a fever. Infection after delivery can be slow in onset and progress rapidly. Treatment of underlying infection must be linked to monitoring and supporting failing organ functions. Appropriate monitoring in the early stages of sepsis includes temperature, pulse, respiratory rate, blood pressure, SaO_2 and hourly urine output. Early investigations include full blood count, whole blood clotting time, urine microscopy, urea and electrolytes, liver function tests and blood cultures.

Management of sepsis

Airway and Breathing

Maintenance of adequate oxygenation is an important step in the resuscitation of patients with sepsis. Many patients who develop shock will ideally require intensive care including intubation and ventilation because of the development of adult respiratory distress syndrome.

Circulation

Almost all patients with septic shock have hypovolaemia and IV fluid resuscitation is a mainstay of treatment. Patients who remain hypotensive despite adequate fluid resuscitation will require more intensive fluid management with central venous pressure monitoring and inotropes.

Prevention of infection

Prophylactic antibiotics should be seriously considered following invasive procedures such as Caesarean Section, manual removal of placenta and during the delivery of a mother with a valvular heart disease. Septic abortion is a major cause of mortality and antibiotic cover should be considered for instrumental uterine evacuation.

The mother with severe acute gastroenteritis

- Is a common cause of dehydration and shock
- Assess fluid deficit (extent of dehydration) and measure ongoing losses of fluid
- Weigh
- Keep accurate fluid balance chart
- Important to give fluids which:

  - Correct deficit
  - Provide maintenance
  - Replace ongoing losses

Differential Diagnosis

Look for abdominal mass or abdominal distension.

Remember

- HIV infections
- surgical conditions such as acute appendicitis, peritonitis, bowel obstruction (if suspected resuscitate and call for surgical opinion)
- typhoid (high grade fever, rash, hepato-splenomegaly, toxicity)
- antibiotic associated colitis
- rarely, inflammatory bowel disease

Treatment if not shocked

- Start ORAL REHYDRATION SOLUTION (ORS) with 1 to 2 litres over 2-4 hours
- Carer gives small amounts of ORS fluid (eg small cup)
- Gradually increase the amount as tolerated using tablespoon, cup or glass
- REASSESS HYDRATION after 2-4 hours, then progress to the maintenance phase or continue re-hydration

Severe dehydration (> or =10% fluid deficit +/-shock)

- If shocked, start IV re-hydration immediately (2 intravenous lines if possible, or long saphenous vein cut down or intra-osseous needle)
- Give 1 litre bolus of Ringer's lactate (Hartmann's) solution, or 0.9% saline as rapidly as possible IV
- Reassess pulse, perfusion (capillary refill) and mental status and repeat bolus if still abnormal
- DO NOT EVER USE low sodium containing IV fluids such as 0.18% saline with 4% glucose which can be DANGEROUS if given quickly (hyponatraemia and cerebral oedema). Instead use Hartmanns or 0.9% saline, ideally also containing 10% glucose (obtained by adding 100ml of 50% glucose to each 500ml)
- **When shock has resolved and the patients level of consciousness returns to normal, the remaining estimated deficit MUST BE TAKEN by mouth or by gastric**

tube especially if severe malnutrition and/or anaemia (danger of large IV fluid volume IV)

Assess hydration status frequently

Oral Fluids

Recommendations for oral replacement therapy in gastroenteritis are:

- use either low-sodium ORS (containing 40-60 mmol/L of sodium), or
- if unavailable, use ORS containing 75-90 mmol/L of sodium with an additional source of low-sodium fluid (eg water)
- Dose = 300-500ml/hour
- giving high osmolar fluids may contribute to hypernatraemia, whilst giving water alone, or low salt drinks may cause hyponatraemia
- oral glucose within ORS enhances electrolyte and water uptake in the gut
- home made ORS can be made by adding a pinch of salt (1ml) and a handful of sugar (5ml) to a glass of clean water (250ml)

Intravenous Fluids

- even in patients who are drinking poorly, try to give enteral fluids by mouth or by gastric tube until the IV drip is running
- use Ringer's Lactate or Hartmann's Solution which has Na 131mmol/l; K 5mmol/l; HCO3 29mmol/l; Ca 2mmol/l
- Hartmann's solution has no glucose to prevent hypoglycaemia: this can be corrected by adding 100ml of 50% glucose to 500ml of Hartmann's giving approximately a 10% glucose solution (adding 50ml gives a 5% solution)
- Ringer's Lactate Solution already prepared with 5% dextrose has the added advantage of providing glucose to help prevent hypoglycaemia.
- If Ringer's Lactate or Hartmann's is unavailable, use 0.9% saline. It does not contain a base to correct acidosis and does not replace potassium losses, therefore add 5mmol/litre of Potassium Chloride. Also it does not contain glucose and therefore add 100ml of 50% glucose to 500ml of 0.9% saline to give approximately a 10% glucose solution (adding 50ml of 50% glucose gives a 5% solution).

- **Do NOT use plain 5% glucose solutions, or 0.18% saline + 4% glucose. They do not contain adequate electrolytes, do not correct the acidosis or hypovolaemia and can produce dangerous hyponatraemia**
- all patients should start to receive some ORS solution (about 300ml per 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

- oedematous (puffy) eyelids may be a sign of over hydration, cardiac failure (as in severe malnutrition), chronic malnutrition or protein losing enteropathy

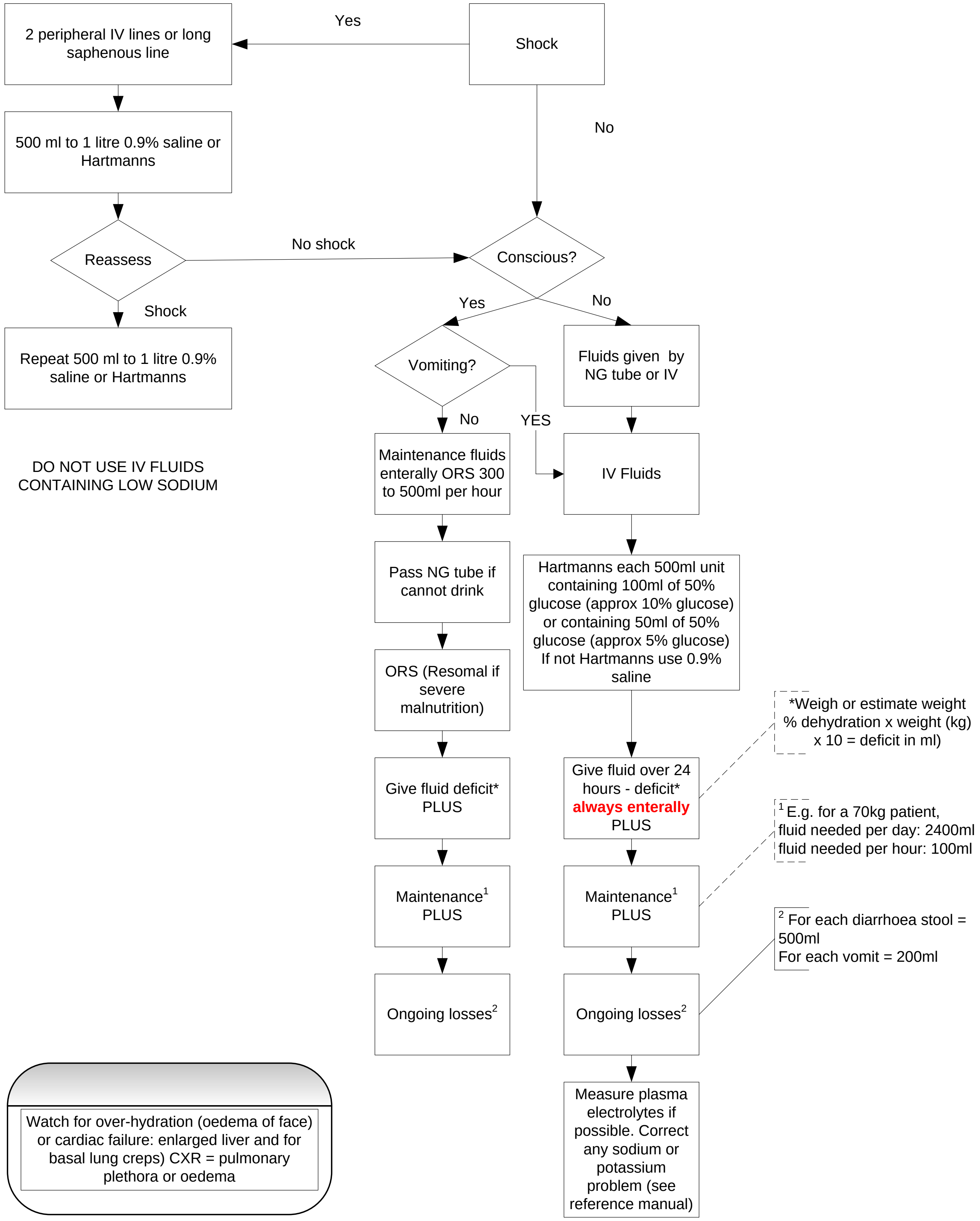
- cardiac failure (especially in severe malnutrition or severe anaemia), chronic malnutrition or protein losing enteropathy
- A CXR may be helpful in showing pulmonary plethora or oedema
- stop giving ORS solution, but give plain water and food
- do not give a diuretic

When the oedema has gone, resume giving ORS solution

Reassess

- ABC
- state of intravascular repletion
- plasma electrolytes if possible
- urine output and urine electrolytes
- give fluid according to plan, don't forget ongoing losses
- reassess regularly (including biochemistry if possible)
- don't forget glucose

Pathway of care for severe dehydration (10% or more) in pregnancy (IMEESC 13.4)



SECTION 9 Quiz 11

1) **Which of the following are features of severe sepsis in pregnancy?**

   a) tachypnoea
   b) bradycardia
   c) fever
   d) altered mental state
   e) shock
   f) purulent vaginal discharge

2) **When treating dehydration due to acute gastroenteritis in pregnancy which of the following statements are true?**

   a) 5% glucose or 0.18% saline plus 4% glucose are helpful when given IV if not able to take enteral fluids
   b) if using 0.9% saline IV add potassium and glucose
   c) maintenance fluid in pregnancy is 100 ml/hour
   d) % dehydration x body weight kg x 10 = deficit in ml
   e) replace losses as 500 ml for each stool and 200 ml for each vomit

ANSWERS:

1. acdef 2. bcde (5% glucose or 0.18% saline with 4% glucose are dangerous in gastroenteritis)

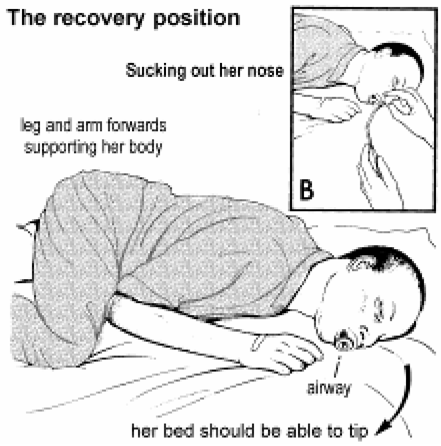
THE CONFUSED, FITTING OR UNCONSCIOUS PREGNANT MOTHER (IMEESC 13.1 and Best Practice Protocol and WHO Pregnancy S-35)

Primary assessment and resuscitation

a) 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. Assess the airway and maintain its patency. Apply oxygen at 15 litres per minute via a tight fitting face mask with a reservoir bag. If an anaesthetist is present intubation can be performed to protect the airway, otherwise adopt the recovery position. Careful suction of the nose and/or mouth maybe helpful.

the semi-prone or recovery position



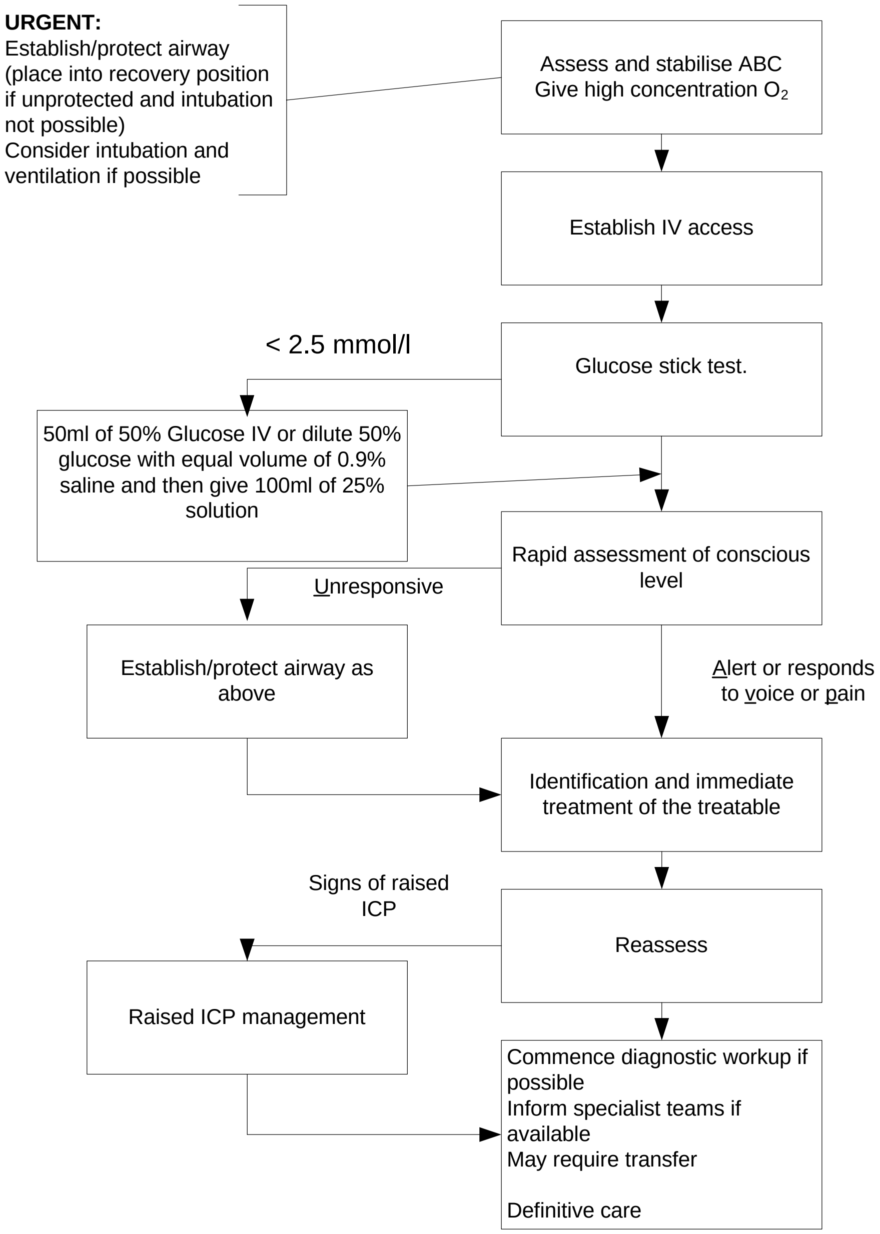
b) Breathing

Assess the breathing, give high flow O_2 via face mask and reservoir bag if necessary. Assist ventilation.

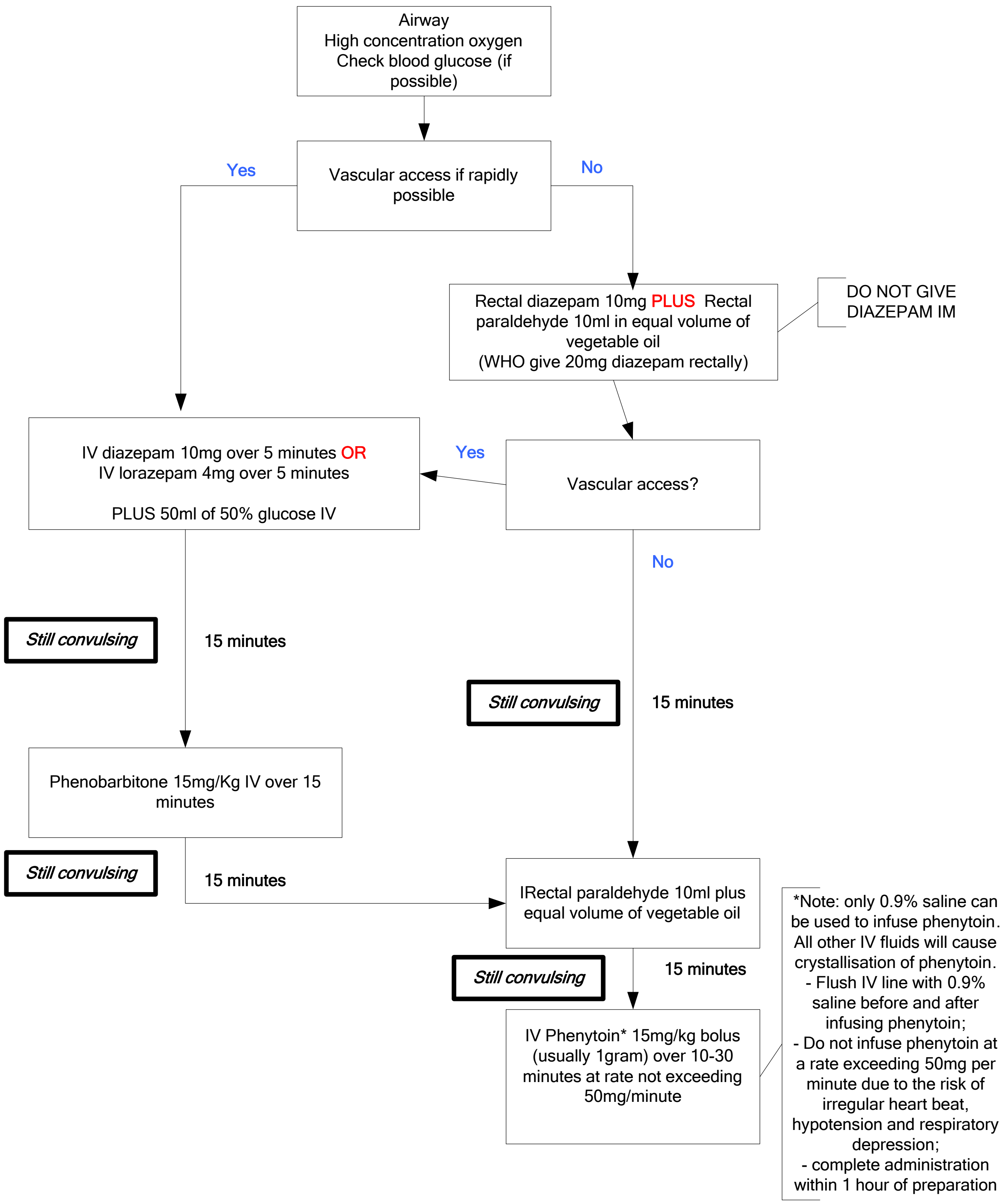
c) Circulation

Inadequate perfusion of blood to the brain initially produces confusion and later 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. IV access should be achieved and blood sent for blood count, blood smear for malarial parasites, electrolytes, liver function tests, blood glucose, and blood culture. **If the blood sugar is low** give 50 ml of 50% glucose IV and add 100ml of 50% glucose to each 500ml of 0.9% saline infused (10% dextrose in 0.9% saline).

Pathway of care in coma in a mother (IMEESC Chapter 10)



Pathway of Care status epilepticus in pregnancy (not due to eclampsia)



When the patient is stable, consider the following causes of confusion, coma or fits.

1 Eclampsia
2 Trauma
3 Cerebral malaria
4 Meningitis
5 Pre-existing epilepsy
6 Sub-arachnoid haemorrhage
7 Cerebral thrombosis
8 Hypoglycaemia (usually in mothers on insulin especially in early pregnancy)
9 Drug intoxication
10 Anaesthetic complications eg total spinal block.

Convulsions

If there are fits, has the mother got eclampsia? Test the urine for protein and measure her blood pressure.

If she is not suffering from eclampsia, prevent her having more fits with a loading dose and subsequent maintenance doses of phenytoin.

PHENYTOIN

Loading dose

Infuse phenytoin 1 g (approximately 18 mg/kg body weight) in 50–100 ml 0.9% saline over 30 minutes (final concentration not to exceed 10 mg per ml):

Note: Only 0.9% saline can be used to infuse phenytoin. All other IV fluids will cause crystallization

Flush IV line with 0.9% saline before and after infusing phenytoin.

Do not infuse phenytoin at a rate exceeding 50 mg per minute due to the risk of arrhythmias, 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.

SECTION 9 Quiz 12

1) **Which of the following can cause generalised convulsions in pregnancy?**
   a) eclampsia
   b) cerebral malaria
   c) pre-existing epilepsy
   d) cerebral haemorrhage
   e) ectopic pregnancy

2) **When managing a mother with status epilepticus not due to eclampsia please put the following treatments in order of their priority that is 1 first and 5 last**

Phenytoin loading dose IV	
ABC including high flow O_2	
Rectal diazepam 5 – 10 mg	
IV Lorazepam 4 mg over 5 mins	
IV access if rapidly possible	

ANSWERS:
1. abcd 2. Sequence is 5,1,3,4,2

Pre-eclampsia and eclampsia (IMEESC Chapter 10 and WHO Pregnancy S-35 to S-50)

This is pregnancy-induced hypertension (BP 140/90 or greater) in association with proteinuria (usually > 0.5 gram per 24 hours). It is a multi-system rather than a primary hypertensive disorder. Eclampsia is fitting associated with the syndrome of pre-eclampsia, but seizures can occur without any previous signs or symptoms. Severe hypertension (diastolic blood pressure exceeding 110 mm of mercury) increases the risk of eclampsia and control of blood pressure is an important part of the management. HELLP is a syndrome comprising haemolysis, elevated liver enzymes and low platelets. It commonly occurs in eclamptic patients, sometimes without significant hypertension.

Pre-eclampsia and eclampsia remains one of the main causes of maternal mortality and morbidity. Thirty-eight per cent of eclamptic fits occur ante-natally, 18% intra-partum and the remaining 44% post-partum, usually in the first 24 to 48 hours after delivery. Pre-eclampsia constitutes a substantial risk to the pregnant woman and her unborn fetus.

Maternal complications:

- eclampsia
- risk of cerebro-vascular accident
- renal failure
- liver failure
- disseminated intra-vascular coagulation
- pulmonary oedema
- pulmonary haemorrhage
- placental abruption

Important clinical signs include:

- headache
- visual disturbances
- epigastric pain

- vomiting
- generalised oedema
- pulmonary oedema
- right upper quadrant abdominal tenderness
- hyper-reflexia with clonus

Management of severe pre-eclampsia

Consider admission if blood pressure exceeds 140/90 mm Hg, with significant proteinuria or if there are symptoms as described above. Full assessment of the patient includes regular measurement of blood pressure, reflexes and fluid balance with tests for urinary protein and urine output, fetal heart rate monitoring and ultrasound.

Investigations

- full blood count (ideally with platelet count)
- urea and electrolytes
- liver function tests (if available)
- coagulation screen (whole blood clotting time)
- urine for protein

Blood Pressure Control

Hypertension should be treated if it exceeds 170/110 mm Hg. Careful fetal monitoring during 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. Intravenous hydralazine or labetalol may be used to lower the blood pressure. As hydralazine may cause increased maternal heart rate, labetalol is preferable if the maternal pulse exceeds 120 beats per minute. If the gestation is less than 36 weeks, betamethasone 12 mg IM in 2 doses 24 hours apart should be given to improve fetal lung maturity and prevent neonatal respiratory failure.

Fluid balance

Mothers with pre-eclampsia and eclampsia are effectively hypovolaemic. However, they have hypoalbuminaemia and are easily fluid overloaded. Accurate fluid balance charts are essential. Measurement of central venous pressure may aid fluid management, but if unavailable a fluid infusion of the same quantity as the urinary output in each preceding hour plus 30 ml is safe. The need for in-utero transfer should be considered, particularly if there are maternal complications likely to require high dependency care. The need for delivery is dependent on the maternal and fetal condition. 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 are controlled, severe hypertension treated and hypoxia corrected, delivery can be expediated.

Management of imminent eclampsia or eclampsia (see pathway of care for eclampsia)

General measures

- do not leave the patient alone
- call for help
- prevent maternal injury during convulsion
- place in a semi-prone position

Airway and Breathing

- assess, maintain and protect airway
- apply oxygen mask with reservoir: give oxygen 12 - 15 litres per minute
- assess breathing
- assist ventilation as required

Circulation

- Evaluate pulse and blood pressure.
    - if absent initiate CPR
    - left lateral tilt and manually displace uterus from vena cava
    - secure IV access
    - monitor blood pressure
    - attach pulse oximeter
    - insert urinary catheter with strict fluid input/output chart

Medication for the management of seizures:

Magnesium sulfate treatment

The majority of seizures are self-limiting and do not require diazepam which increases the risk of respiratory arrest. Magnesium sulfate is the anti-convulsant of choice.

Loading dose in well resourced settings

4g of magnesium sulfate = 20ml of 20% solution (to make 20ml of a 20% solution = add 8ml of 50% $MgSO_4$ solution to 12 ml sterile water) IV in 200ml of 5% dextrose solution over 20 minutes. If there is a recurrence of convulsions (after completion of the loading regime) give 2g (10ml of 20% solution) magnesium sulfate in 100ml 5% dextrose IV slowly over 20 minutes.

Loading dose in poorly resourced settings

5g (10ml of 50% solution=5g in 10ml) by deep intramuscular injection in <u>each</u> buttock (plus 1ml of 2% lidocaine in same syringe). Thus total dose given = 10 grams.
ASEPTIC TECHNIQUE ESSENTIAL

Maintenance dosage

1. **Well resourced**: Provided there is close monitoring (ideally with a burette in giving set), give 1g/hour IV in normal saline every 4 hours for 24 hours.
2. **Poorly resourced**: 5g IM 4 hourly (plus 1ml of 1% lidocaine (WHO 1ml of 2%) in same syringe) using alternate buttocks. Continue for 24 hours after the last convulsion or delivery.

Continue for 24 hours after delivery or after last convulsion provided that:

- respiratory rate is > 16 per minute
- urine output > 30 ml per hour (WHO >100ml over 4 hours)
- patella reflexes present
- remember to subtract volume infused from total maintenance infusion volume to avoid fluid overload

When using magnesium sulfate, monitor hourly urine output, respiratory rate, SaO_2 and patellar reflexes every 10 minutes for the first 2 hours and then every 30 minutes

Side effects

These are warmth/flushing, nausea, vomiting, absent tendon reflexes, diplopia, somnolence/slurred speech, respiratory depression and arrest, hypotension and arrhythmias.

Keep IV fluids at a rate less than 100ml per hour (WHO rate < 1 litre in 6 to 8 hours).

Contra-indications to magnesium sulfate

DO NOT GIVE, OR STOP INFUSION OF, MAGNESIUM SULFATE IF

1. Patellar reflexes are absent
2. There is respiratory depression (respiratory rate less than 15/min)
3. Urine output is less than 30ml/hour over last 4 hours

If respiratory depression develops: give 100% oxygen by face mask with reservoir and give Calcium gluconate 1g (10ml of 10% solution) IV slowly over 10 minutes

If respiratory arrest occurs:

1. Prompt chest inflations with bag mask ventilation with 100% oxygen
2. Injection calcium gluconate 1g (10mlof 10%) IV slowly over 10 minutes

The magnesium sulfate infusion may be recommenced at a reduced dose if thought necessary once normal respiration and reflexes have returned.

Note: There is an increased sensitivity to muscle relaxants (particularly non-depolarising agents) in patients on magnesium.

Progressive symptoms of magnesium toxicity:

1. feeling of warmth, flushing, double vision, slurred speech
2. loss of tendon reflexes
3. respiratory depression
4. respiratory arrest
5. cardiac arrest

If magnesium toxicity is suspected, stop infusion and administer antidote of 10 ml 10% calcium gluconate IV over 10 minutes.

Although pre-eclampsia and eclampsia are commonest in primagravida, they can occur in multiparous patients. Each maternity unit should have an emergency box for eclampsia to ensure that appropriate equipment is readily available.

Emergency box for eclampsia	
Equipment	Quantity
Drugs	Magnesium sulfate 50%, 5 g in 10 ml ampoule x 10 ampoules Calcium gluconate 10% 10 ml ampoule x 2 ampoules Hydralazine 20 mg in 1 ml ampoule x 2 ampoules Labetalol 200 mg in 20 ml ampoule x 1 ampoule 0.9% Sodium chloride 10 ml ampoule x 10 ampoules
Intravenous fluids	500ml bag of 0.9% saline Giving set x 1 IV blood giving set x 1
Venous access	20-gauge Cannula (pink) x 2 18-gaugeCannula (green) x 2 16-gaugeCannula (grey) x 2 Tourniquet x 1 Fixation tape x 1 roll
Airway equipment	Guedel airways: sizes 4, 3, and 2 Self inflating bag, mask and valve Green oxygen tubing 2 meters Yankaeur sucker
Other equipment	50 ml syringe x 2 20 ml syringe x 2 10 ml syringe x 2 Green needles x 2 Reflex hammer x 1

Pathway of care for eclampsia

Place in recovery position
Protect from injury but do not restrain
Call for HELP
obstetrician
anaesthetist

Do not leave patient alone

Airway

Assess
Maintain patency
Consider oropharyngeal airway

Breathing

Assess
High O2 by mask and reservoir
Ventilate as required

Circulation

Evaluate pulse and BP
If absent, initiate CPR and call arrest team
Secure IV access as soon as possible
Urinary catheter
Restrict IV fluids to no more than 100ml/hour

Control seizures

Loading dose $MgSO_4$
4g $MgSO_4$ IV over 20 minutes.
Add 8ml of 50% $MgSO_4$ solution to 12 ml 0.9% saline

Maintenance dose $MgSO_4$
1g per hour infusion Add 25g $MgSO_4$ (50ml of 50%) to 250ml 0.9% saline
1g $MgSO_4$ = 12ml per hour IV

If seizures continue or recur

$MgSO_4$ 2g < 70kg; 4g >70kg
IV as per loading dose over 5-10 mins. If this fails:
diazepam 10mg IV
Monitor: Hourly urine output respiratory rate, O_2 saturation and patellar reflexes- every 10 minutes for first 2 hours and then every 30 minutes

Stop infusion if:
Urine output< 100ml in 4 hours
OR if patellar reflexes are absent
OR if respiratory rate < 16/minute
OR if SaO2 <90%

Antidote: 10% calcium gluconate 10 ml IV over 10 minutes

If pulmonary oedema give IV frusemide 40mg

Control hypertension

Treat hypertension if systolic BP>170 mmHg or diastolic BP >110mmHG or MAP >125mmHg
Aim to reduce BP to around 130-140/90-100mmHg
Beware treatment related maternal hypotension and FHR abnormalities- monitor FHR continuously

Hydralazine 10 mg IV slowly (WHO 5mg)
Repeated doses of 5mg IV 30 minutes apart may be given if necessary. If heart rate > 120 do not give hydralazine but labetolol
Close liason with the anaesthetists as may require plasma expansion

Labetolol 50 mg IV slowly if BP still uncontrolled
If necessary repeat after 20 minutes or start IV infusion:
200mg in 200ml 0.9% saline at 40mg/hour, increasing dose at half-hourly intervals as required to a maximum of 160mg/hour

If not postpartum
Deliver baby

There is no place for the continuation of pregnancy if eclampsia occurs

STABILISE THE MOTHER BEFORE DELIVERY

Ergometrine should not be used in severe pre-eclampsia and eclampsia

Consider prophylaxis against thromboembolism

Maintain awareness as the majority of eclamptic seizures occur after delivery

OBSERVATIONS

Pulse oximeter BP
Respirations
Listen to lungs for basal creps
Temperature
Test urine for protein
Hourly urine output
Fluid balance charts
FHR – monitor continuous
Reflexes-patellar

INVESTIGATIONS

Hb, cross match, whole blood clotting time
Regular urine protein checks

SECTION 9 Quiz 13

1) **Which of the following are features of pre-eclampsia or eclampsia?**
   a) High BP
   b) proteinuria
   c) oedema
   d) a risk of generalised convulsions
   e) abdominal pain

2) **Which of the following BP levels could indicate pre-eclampsia?**
   a) 150/90
   b) 130/80
   c) 160/110

3) **Which of the following are complications of severe pre-eclampsia or eclampsia?**
   a) HELLP
   b) Cerebrovascular accident
   c) Ruptured uterus
   d) Pulmonary oedema

ANSWERS:

1. abcde 2. ac 3. abd

SECTION 9 Quiz 14

1) **In severe pre-eclampsia which of the following levels of BP need antihypertensive drug treatment?**
   a) 180/110
   b) 200/100
   c) 160/100

2) **When managing a mother with eclampsia please put the following treatments in order of their priority that is 1 first and 5 last**

Breathing high level O_2	
IV access/fluid restriction < 100 ml/hour	
Call for help and do not leave alone	
Treat hypertension if > 170/110 to levels of around 130 – 140 systolic	
Magnesium sulphate	
Airway including recovery position	
Deliver the baby	

ANSWERS:

1. ab 2. sequence is 3,6,1,5,4,2,7

SECTION 9 Quiz 15

1) **When treating eclampsia or imminent eclampsia with Magnesium sulphate which of the following are true?**
   a) Magnesium is second line treatment after Diazepam
   b) can be given IV or IM (IM is safer in poorly resourced settings)
   c) should be discontinued if patella reflexes are absent or respiratory rate < 15/min or urine output < 30 ml/hour over previous 4 hours

2) **Which of the following are side effects of Magnesium sulphate treatment?**
   a) warmth – flushing
   b) headache
   c) absent tendon reflexes
   d) respiratory depression

ANSWERS:

2. bc 2. acd

Meningitis

Signs and symptoms:

- Headache
- Vomiting
- Neck stiffness
- Opisthotonus
- Photophobia
- Rash
- Altered consciousness

A lumbar puncture may be dangerous in the presence of raised intracranial pressure. High dose IV antibiotics will be needed for at least 10 days.

Severe complicated malaria, *usually falciparum* (WHO Pregnancy S-39, S-52 and S-103)

This results in fever, extreme weakness, headaches, vomiting, jaundice, drowsiness, convulsions and coma. Malaria in pregnancy may be misdiagnosed as eclampsia; always measure the BP and look for protein in the urine.

Pregnant mothers with severe malaria are particularly prone to hypoglycaemia, pulmonary oedema, anaemia, convulsions and coma.

Malaria is especially dangerous during the last trimester.

Drug treatment

Quinine dihydrochloride

LOADING DOSE

Infuse quinine dihydrochloride, 20 mg/kg body weight (usually 1.2 grams for the average 60 kg pregnant woman) (max 1.4g) in 1 litre of IV fluids (5% or 10% dextrose or 0.9% saline plus 5 or 10% glucose or Hartmanns plus 5 or 10% glucose) over 4 hours. Do not allow the infusion to go in too quickly. Quinine is usually available in 2 ml ampoules of either 150 mg/ml where 1.2 g is thus 8 ml OR 300mg/ml where 1.2 g is thus 4ml.

Never give an IV bolus injection of quinine

If it is definitely known that the mother has taken an adequate dose of quinine (1.2 g) within the preceding 12 hours, do **not** give the loading dose. Proceed with the maintenance dose only (see below).

If the **history of treatment is not known or is unclear**, give the loading dose of quinine;

Always wait 4 hours before giving the maintenance dose.

MAINTENANCE DOSE

Infuse quinine dihydrochloride 10 mg/kg body weight (usually 600mg) (max 700mg) in 1 litre of 5 or 10% glucose in 0.9% saline 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.).

Note: Monitor blood glucose levels for hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) every hour while the mother is receiving quinine IV.

Continue the maintenance dosing schedule until the mother is conscious and able to swallow and then give: quinine dihydrochloride or quinine sulfate 10 mg/kg body weight (usually 600mg) by mouth every 8 hours to complete 7 days of treatment. Ask the mother to swallow tablets quickly with milk.

Alternatively, in areas where sulfadoxine/pyrimethamine is effective, give sulfadoxine/pyrimethamine-Fansidar 3 tablets as a single dose.

Caution!

- Watch for hypoglycaemia **(less than 2.5 mmol/litre (45mg/dl):** always give IV quinine in a 5-10% glucose solution as described above.
- Make sure plenty of fluids are given so that the urine output is adequate. Keep a strict fluid balance chart and do not overload with fluid.

If the Hb falls below 6 g/dl give a blood transfusion with 40mg IV frusemide immediately before the blood starts. When the mother is improving give iron and folate tablets.

Intramuscular quinine.

This is given 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 to a concentration of 60 mg/ml. (For example 600 mg of quinine in 10 ml of saline). If you don't dilute quinine, the mother may get an injection abscess. Use the same dose as you would give IV. Give half the dose into each anterior thigh. (WHO does not recommend dilution)

Caution!

- When giving quinine by IM injection, regularly draw back to ensure the needle is not in a vein.
- If you know that the mother has had an adequate dose of quinine in the previous 12 – 24 hours, don't give a loading dose. If you don't know what quinine treatment she has had, if any, give a loading dose.

IV artesunate

This can be a good alternative to quinine.

LOADING DOSE

Give artesunate 2.4 mg/kg IV as a single bolus slowly over 5 minutes on the first day of treatment.

MAINTENANCE DOSE

At 12 and 24 hours, give a maintenance dose of 1.2 mg/kg IV over 3 minutes. Then give artesunate 1.2 mg/kg daily until conscious and able to swallow. When able to swallow give artesunate 2 mg/kg by mouth once daily to complete 7 days of treatment.

IM Artemether

This is a safe alternative to quinine.

LOADING DOSE

Artemether IM 3.2 mg/Kg

MAINTENANCE DOSE

Artemether IM 1.6mg/Kg once daily for 3 days

COMPLICATIONS OF SEVERE MALARIA

Life threatening anaemia

This common complication is very dangerous for the mother and baby.

Monitor Hb levels daily.

Transfuse as necessary. If the Hb is 5 g/dl or less or there is pulmonary oedema, transfusion is urgent.

Monitor fluid balance very carefully.

Give frusemide 40mg IV with each unit of blood.

Give iron 120 mg by mouth plus folic acid 5mg (WHO 400 micrograms) by mouth daily upon discharge for 3 months.

Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl)

This can occur on admission or after quinine. Often it causes no symptoms until it results in coma and death. Watch for abnormal behavior, sweating, and sudden coma. Always give glucose with quinine. If drowsy, delirious or unconscious, don't assume the mother has cerebral malaria: she is probably hypoglycaemic. Check blood glucose every hour if possible, especially if on quinine.

Treat suspected hypoglycaemia with IV 50 ml of 50% glucose, **OR**, 100 ml of 25% glucose, **OR** 250 ml of 10% glucose. 50% glucose is very irritant to veins and harmful if extravasated, so dilute it with sterile water or 0.9% saline to make a 25% solution. Subsequently give 250ml of 10% glucose over 8 hours.

If you don't have IV glucose, give sugar water by mouth or by nasogastric tube. Dissolve 4 level teaspoons (20 g) in 200 ml of clean water.

Fluid imbalance

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 clinical status regularly.

If urine output is poor (< 30 ml per hour):

Re-hydrate with IV fluids (0.9% saline, Hartmanns).

If urine output does not improve, give frusemide 40 mg IV as a single dose and monitor urine output.

Pulmonary oedema

This is very dangerous. The mother may have it on admission, or it may come on after several days. Fast difficult breathing is the first sign. Frothy (bubbly) fluid may be coming from the mouth. It causes hypoxia, fits, coma and death. It can also be caused by too much IV fluid. Sometimes it is caused by malaria and too much IV fluid, so monitor the central (JVP) venous pressure regularly.

- Keep upright, so prop up with pillows in the left lateral tilt position and lower the foot of the bed.
- Give high concentrations of oxygen using face mask and reservoir.
- Give frusemide 40 mg IV. If there is no response (no increase in urine output) increase the dose progressively, every 4 hours, to a maximum of 200 mg.
- If the mother might be getting too much IV fluid, stop all IV infusions.

Convulsions

If there are fits, has the mother got eclampsia? Test the urine for protein and measure her blood pressure.

If she is not suffering from eclampsia, prevent her having more fits with a loading dose and subsequent maintenance doses of phenytoin.

LOADING DOSE

Infuse phenytoin 1 g (approximately 18 mg/kg body weight) in 50–100 ml 0.9% saline over 30 minutes (final concentration not to exceed 10 mg per ml):

Note: Only 0.9% saline can be used to infuse phenytoin. All other IV fluids will cause crystallization

Flush IV line with 0.9% saline before and after infusing phenytoin.

Do not infuse phenytoin at a rate exceeding 50 mg per minute due to the risk of arrhythmias, 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.

If **convulsions occur** despite the above give diazepam 10 mg IV slowly over 2 minutes, **OR** if no IV access give rectal diazepam 10mg **OR** rectal paraldehyde 10ml. (see CD/DVD rom).

If **eclampsia is diagnosed**, prevent subsequent convulsions with magnesium sulfate.

SECTION 9 Quiz 16

1) When treating severe malaria in pregnancy with quinine which of the following are true?

a) a bolus of IV of quinine can be very dangerous or even fatal
b) in poorly resourced hospitals IM quinine can be safer
c) hyperglycaemia can develop
d) blood glucose levels should be regularly measured during treatment

2) The following are complications of severe malaria

a) severe anaemia
b) hyperglycaemia
c) pulmonary oedema
d) generalised convulsions

ANSWERS:

1. abd 2. acd (hypoglycaemia is a very important complication)

Diabetes mellitus in pregnancy (IMEESC 13.8)

This is associated with increased perinatal mortality and congenital malformations. Pregnancy causes changes in the maternal physiology to make it a diabetogenic state so that women who have pre-existing or undiagnosed diabetes will have a problem with glucose control which has important effects on their management. Before the discovery of insulin, perinatal maternal mortality was 40% and diabetics need special care during pregnancy. In certain races, including Asians, there is a higher incidence of Type 2 diabetes and they are likely to need insulin therapy.

Insulin has led to a dramatic improvement in maternal survival but in comparison to non-diabetic pregnancy there is still a 5 times increase in perinatal death and a 10 times increase in congenital malformations. These risks can be reduced by strict attention to the control of the diabetes before and during pregnancy.

Management

Before pregnancy

- Advise any diabetics of reproductive age of the importance of close monitoring and modified treatment in pregnancy
- Obesity – dietary advice
- Tight control of diabetes –aim for blood glucose levels of 4-6 mmol/L
- Folic acid 5mg daily 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. Inform patient and others about the signs of hypoglycaemia
- Convert mothers treated with oral hypoglycaemic agents to insulin
- As soon as possible assess gestational age. Early Ultrasound scan to detect fetal abnormalities

During pregnancy

Insulin dependent mothers (Type 1 Diabetes)

Close control of diabetes is needed. Expect insulin requirements to increase 50% or more above pre-pregnant levels. There is an increased risk of congenital abnormalities, macrosomia, polyhydramnios, pre-term labour and pre-eclampsia. Plan delivery with care. The risks of infection and development of diabetic keto-acidosis 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 are usually of rapid onset with sudden onset of unconsciousness, particularly if the mother has taken insulin but has not taken her usual food.

Type 2 diabetes

Convert treatment to insulin and monitor as above

Gestational Diabetes

Often undiagnosed and suspect if:

- Family history of diabetes
- Past history of a large baby, stillbirth or gestational diabetes
- Recurrent glycosuria

Diagnosis of Diabetes with a Glucose Tolerance Test

75 g oral glucose loading dose

Plasma glucose	Fasting (mmol/L)	2 hr measurement (mmol/L)
Diabetes	>8	>11
Gestational impaired glucose tolerance	6-8	9-11
Normal	<6	<9

Delivery

For spontaneous labour, induction of labour and elective Caesarean Section

1. Measure glucose on admission and hourly in labour
2. Site IV line with 500 ml 10% dextrose containing potassium chloride 10mmol and give at 60 ml /hour

.

Blood glucose mmol/l	**Hourly subcutaneous injections of insulin**
<2	No insulin –dextrose only
2 to 4.0	1 unit
4.1 to 9.0	2 units
9.1 to11.0	3 units
11.1 to16.9	4 units

If the glucose level is >17 mmol/l expert advice should be sought

Aim for glucose levels of 4 – 9 mmol/l

Reduce insulin by half at delivery and aim to resume pre-pregnancy insulin dosage 24 hours after delivery. If the mother is breast feeding, her insulin requirement may be lower.

SECTION 9 Quiz 17

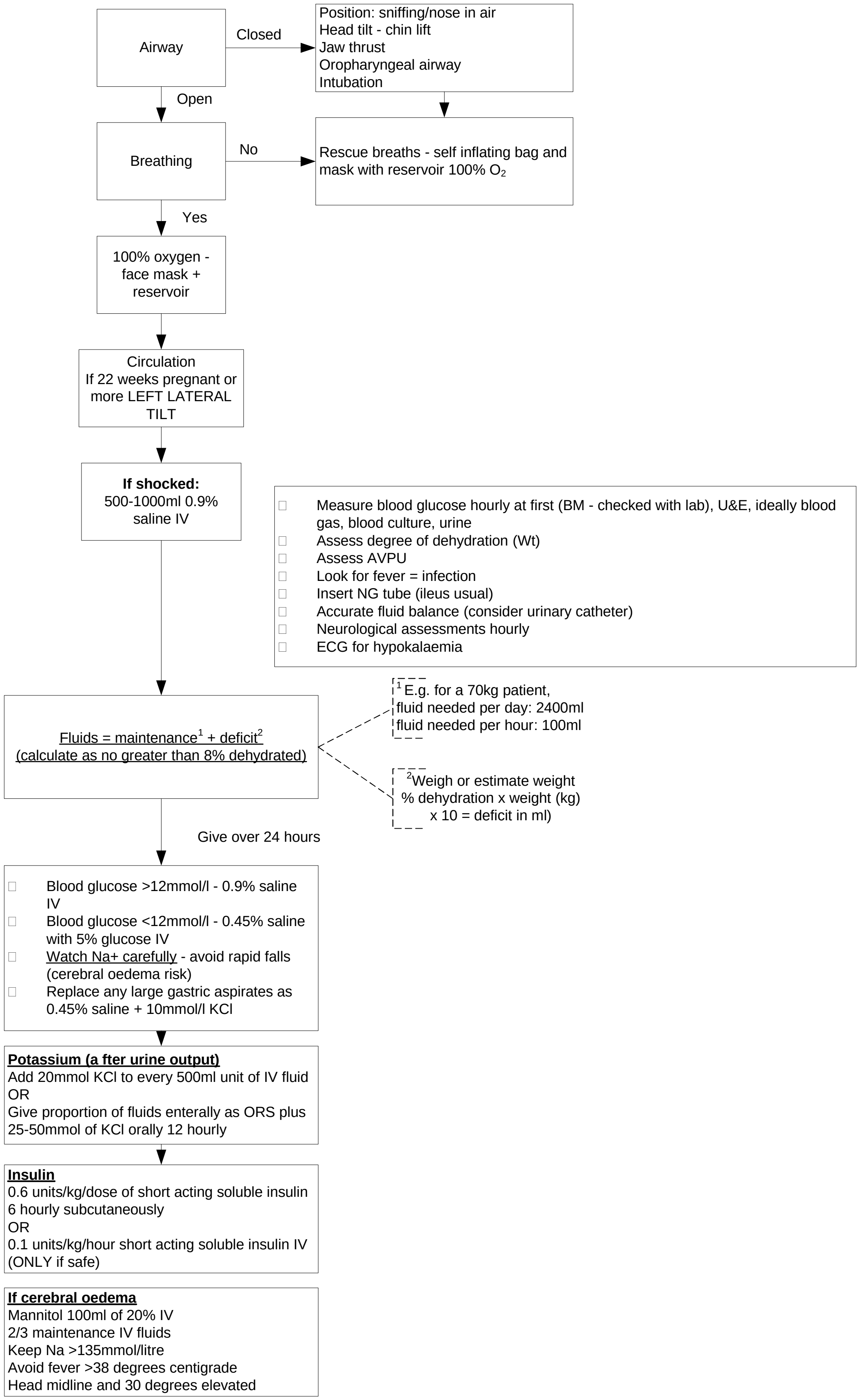
1) When managing a mother with severe diabetic ketoacidosis during pregnancy put the following treatments in order of their priority that is 1 first and 5 last.

1 litre 0.9% saline IV if shocked	
Left lateral tilt if > 22 weeks gestation	
Airway	
Calculate fluids as maintenance + deficit (max 8%)	
Breathing and high flow oxygen	
Potassium chloride 20 mmol/500 ml IV fluid after urine output has occurred	
Insulin 0.6 units/kg/dose 6 hourly subcutaneously	

ANSWERS:

1. Correct sequence is 4,3,1,5,2,7,6

Pathway of care: severe diabetic keto-acidosis in pregnancy



SECTION 10 COMPLICATIONS OF LABOUR AND DELIVERY (IMEESC Chapter 11 and Best Practice Protocol)

All mothers in labour should be nursed upright or in a lateral position, not on their back. A **partogram** to assess maternal progress should be used. This will document:

- Maternal well-being: pulse (heart rate) every half an hour, BP and temperature 4 hourly, urine output and dipstick testing for protein and glucose after voiding, record of fluids and drugs administered (if findings become abnormal increase frequency of testing).
- Fetal well-being: fetal heart rate for one minute every 15 minutes after a contraction in first stage and every five minutes in second stage. If abnormalities noted consider urgent delivery.
- Liquor (clear, meconium stained, bloody or absent)
- Progress of labour: vaginal examination every 4 hours to assess cervical dilatation, descent of the fetal head (fifths on abdominal palpation 4 hourly) and moulding of fetal skull bones. Abdominal examination to assess descent and position of the fetal head, frequency and strength of uterine contractions (number by palpation in 10 minutes and duration of each. Record every 30 minutes).

Fetal heart rate:
a) Baseline: Normal baseline fetal heart rate is 110 to 160 beats per minute. Each baby's baseline heart rate should remain stable. Heart rates outside this range, or large changes within this range (over 30 beats per minute difference) may indicate fetal compromise
b) Decelerations:
Slowing of the heart rate during a contraction that does not recover immediately afterwards, or slowing after a contraction has ended require urgent attention
Liquor and Meconium
If the liquor is absent or if there is meconium draining, attention to fetal heart rate is needed as fetal distress is more likely and fetal deterioration more rapid

Urgent help may be required to diagnose and manage cord prolapse, placental separation or ruptured uterus.

Abnormal patterns of labour
Normal labour is characterised by regular uterine contractions, effacement and dilatation of the cervix and descent of the presenting part.

Stages of labour (WHO Pregnancy S-57)

First stage

Latent phase of labour (0-4cm cervical dilatation) should be complete by 8 hrs. In the latent phase of labour regular painful uterine contractions become established. The accelerative phase of the first stage of labour commences when the rate of cervical dilatation increases.

If prolonged there may be:

- Malpositions or malpresentations
- Pelvis too small or head too big
- Contractions too weak
- Membranes need rupturing (only if no malpresentations or malposition)
- Dehydration, ketosis and/ or exhaustion

Active phase of labour

Here the cervix should dilate at a rate of at least 1 cm /hour to full dilatation (10cm). Slow progress should be corrected by rupture of the membranes. It is important that obstructed labour is excluded before oxytocin is administered. If the poor progress is felt to be due to lack of uterine activity, oxytocin should be commenced at 2 milli-units per minute increasing every 30 minutes up to a maximum of 16 milliunits per minute. Ten units of oxytocin in 500 ml of 0.9% saline results in 2 milliunits of oxytocin per ml. (one unit = 1000 milli-units).

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

- malpositions/malpresentations
- obstructed labour
- an increased risk of shoulder dystocia

Second stage

Early phase

Cervix fully dilated, fetal descent but no urge to push

Late (expulsive) phase

Fetal head reaches pelvic floor and urge to push.

Delivery of the baby usually 1 hour in primagravida and 30 minutes in multigravida.

Management of the second stage of labour

If there is anxiety about the fetal heart or delivery has not occurred, operative vaginal delivery should be considered with a ventouse or forceps, provided the head is not palpable per abdomen. The cervix must be fully dilated. During delivery trauma to the perineum should be minimised. In women who have been circumcised there is a place for anterior division of the labia as well as an episiotomy, but otherwise routine episiotomy is not recommended.

If the head retracts onto the perineum after delivery (turtle sign) this may indicate shoulder dystocia.

After delivery of the baby 10 units of oxytocin should be given IM to aid delivery of the placenta and reduce the risk of haemorrhage, provided the possibility of a second twin has been excluded by earlier ultrasound examination or abdominal palpation (especially if no antenatal care had been given).

Complications of labour

Obstructed labour: recognition and early referral (WHO Pregnancy S-37)

Prevention

- Good antenatal care so that the position and presentation of the fetus is known before the onset of labour (ideally confirmed by ultrasound examination): IF ABNORMAL MUST TRANSFER TO HOSPITAL AS SOON AS THEY ENTER LABOUR

- Use of the modified WHO partograph

- Good nutritional state in the mother
- Absence of anaemia in the mother

- Adequate fluids and glucose during labour

Dangers of slow progress of labour

For mother:

- Infection
- Uterine rupture
- Fistulae
- DEATH

For baby

- Infection
- Lack of oxygen to the brain and traumatic injury
- Stillbirth
- Neonatal death
- Permanent brain damage

Main causes of slow progress of labour

1. Poor quality uterine contractions
2. Mal-presentations and mal-positions
3. Disproportion between the size of the baby and of the pelvis**

** Exclude 1 and 2 before diagnosing this

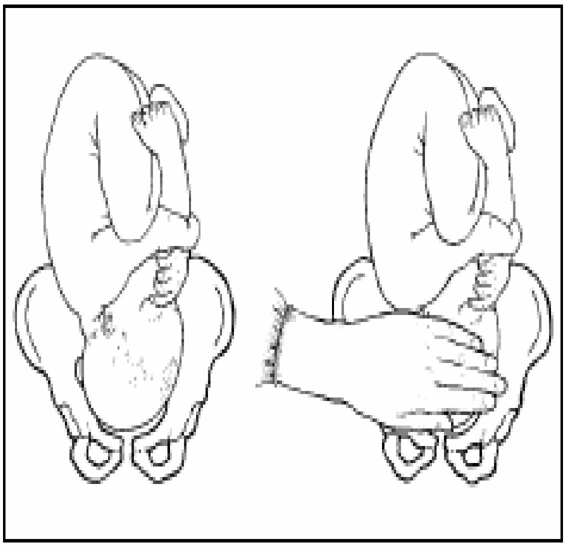
1. Mother may be dehydrated, ketotic, infected, exhausted

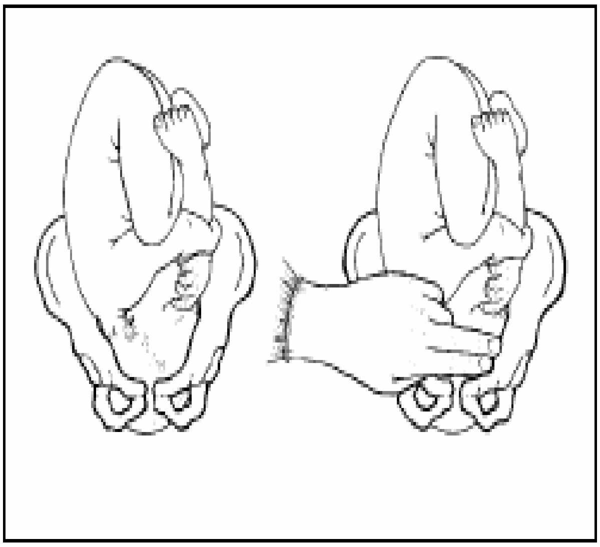
ALL NEED URGENT TRANSFER TO HOSPITAL

Fetal descent

By abdominal palpation

Fifths of the head palpable above the symphysis:
5/5 head entirely above inlet of pelvis
0/5 head deep in pelvis



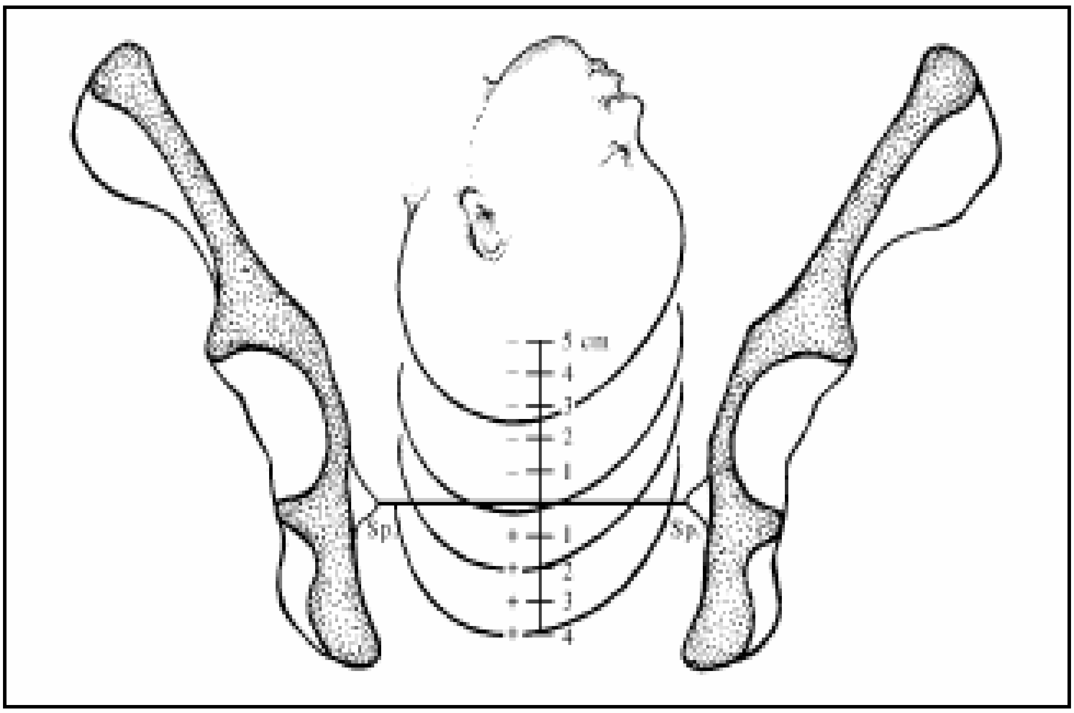


From ESS WHO

Fetal descent

By vaginal examination

Level of fetal head with respect to the ischial spines = 0 level



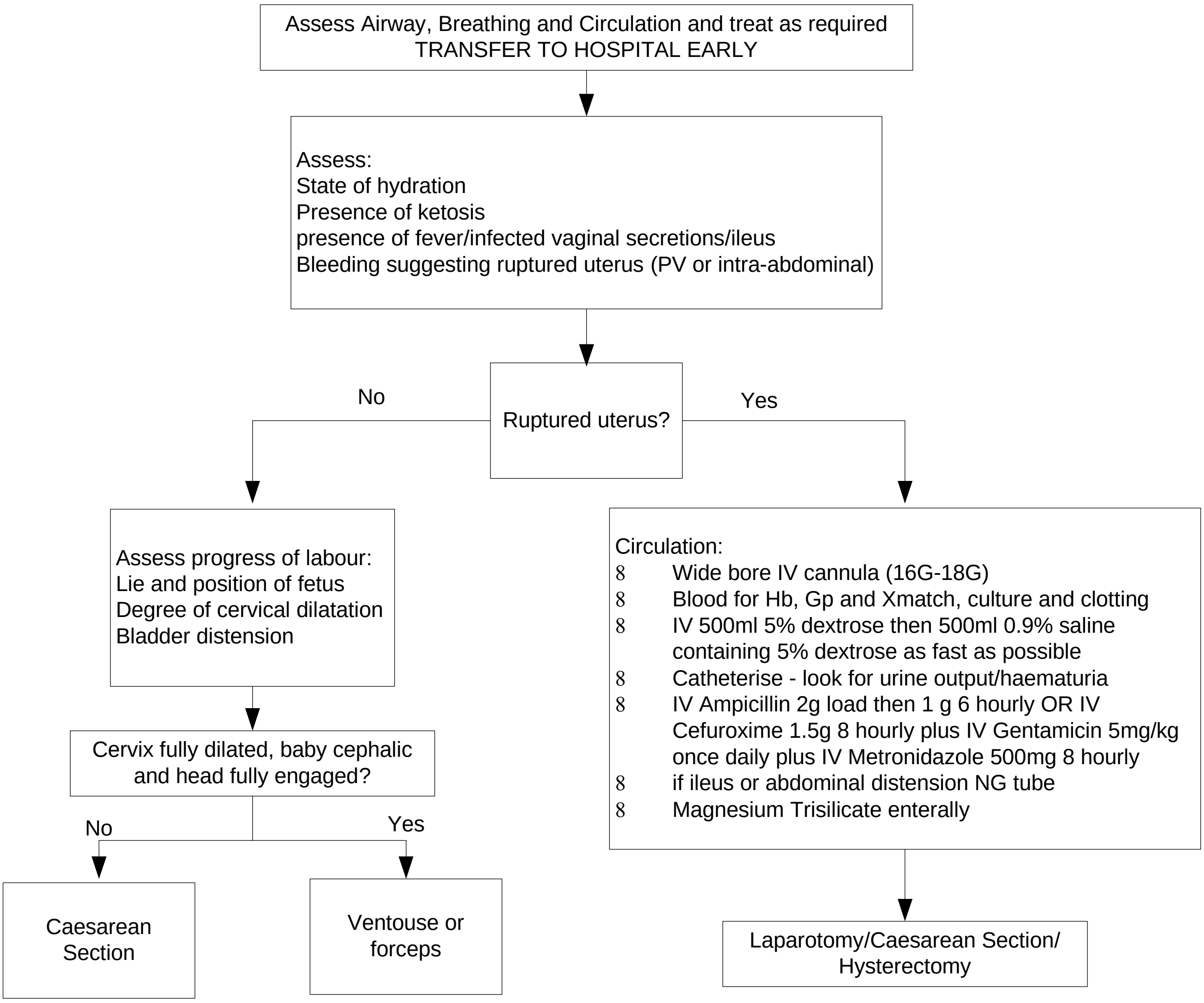
Obstructed labour emergency management

The mother may be dehydrated, ketotic, septic, and especially if the uterus is ruptured – shocked.

Undertake primary assessment of **Airway, Breathing, Circulation and Disability**
Depending on the condition of patient, a focused history may be helpful in making a diagnosis (for example, prolonged labour, vaginal bleeding, a previous Caesarean section for obstructed labour).

Emergency resuscitative measures are needed before treating the cause.

Pathway of Care obstructed labour



Note: also give ampicillin 2g load and 1 g 6 hourly IV if labour > 24 hours (WHO)

SECTION 10 Quiz 1

1) Which of the following are measured by the partogram?
- a) maternal heart rate, BP, temperature, urine output and urine for protein and glucose
- b) maternal breathing rate
- c) fetal heart rate and its relationship to contractions
- d) liquor (clear, meconium, bloody or absent)
- e) progress of labour in terms of cervical dilatation, descent of the presenting part and moulding of the head, frequency and strength of contractions

ANSWERS:
1. acde

SECTION 10 Quiz 2

1) Which of the following statements are true regarding the latent phase of the first stage of labour?
- a) is 0 – 6 cm cervical dilatation
- b) should be complete by 8 hours
- c) is prolonged by malpositions, malpresentations, small pelvis, large fetal head, weak contractions

2) In the active phase of the first stage of labour which of the following statements are true?
- a) the cervix should dilate at least 1 cm/hour
- b) slow progress can be corrected by rupture of the membranes
- c) slow progress due to obstructed labour can be overcome with an oxytocin infusion
- d) if progress is good initially then slows there may be malpositions/malpresentations, dehydration, ketosis and/or exhaustion, small pelvis

ANSWERS:
1. bc 2. abd (oxytocin is dangerous in obstructed labour)

SECTION 10 Quiz 3

1) Which of the following statements are true regarding the second stage of labour?
- a) It includes an early phase and a late (expulsive phase)
- b) It usually lasts 30 minutes in a primagravida and 1 hour in a multigravida mother
- c) When accompanied by retraction of the head onto the perineum after its delivery suggests shoulder dystocia
- d) Is usually completed by giving oxytocin 10 units IM to aid delivery of the placenta and minimise PPH but it is essential before oxytocin to exclude a second twin that might be in the uterus

ANSWERS:
1. acd

SECTION 10 Quiz 4

1) Which of the following are important in preventing slow progress in labour?
- a) knowing the presentation of fetus before the onset of labour
- b) the use of the WHO partograph
- c) knowing the blood group and having X matched blood
- d) the administration of adequate fluids/glucose during labour

2) Complete the following table concerning the specific dangers of a slow progress in labour

Danger	For Baby	For Mother
Death	Yes	Yes
Uterine rupture	No	Yes
Infection	a)	b)
Fistula	c)	d)
Brain damage	e)	f)

ANSWERS:
1. abd 2. a. Yes b. Yes c. No d. Yes e. Yes f. No

SECTION 10 Quiz 5

1) **Which of the following are causes of a slow progress in labour?**
   a) poor quality uterine contractions
   b) malpresentations
   c) disproportion between sizes of baby and pelvis
   d) differences in blood group between mother and baby
   e) malpositions
   f) infection in the mother

2) **When treating obstructed labour which of the following actions are essential?**
   a) ABC assess and treat
   b) look for and treat ruptured uterus
   c) look for and treat infection
   d) transfer to hospital early

ANSWERS:

1. abcef 2. abcd

Shoulder dystocia (WHO Pregnancy S-83)

This is difficulty achieving spontaneous delivery of the baby due to impaction of the shoulders against the bony pelvis. Special manoeuvres are required to deliver the shoulders following an unsuccessful attempt to achieve normal delivery by gentle downward traction. The reported incidence is between 0.15% and 2% of all vaginal deliveries. It carries a significant risk to the baby due to hypoxia, fractures of the clavicle and humerus and injuries to brachial nerves.

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.

Delivery should occur within five minutes of the delivery of the head and hypoxic injury to the baby is increasingly likely the longer the delay.

Post-partum haemorrhage is common after shoulder dystocia and there is a risk of serious vaginal and perineal lacerations.

Risk factors for dystocia

Antepartum
Fetal Macrosomia
Maternal Obesity
Diabetes
Prolonged pregnancy
Advanced maternal age
Male gender
Excessive weight gain
Previous shoulder dystocia
Previous big baby

Intrapartum
Prolonged first stage
Prolonged second stage
Oxytocin augmentation of labour
Assisted delivery

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

Slow progress in labour, particularly in the multiparous patient or a woman with a past history of a big baby or difficulty delivering the shoulders, should alert one to the possibility.

During delivery signs include difficulty delivering the face and chin, head retractions between contractions, head bobbing or 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

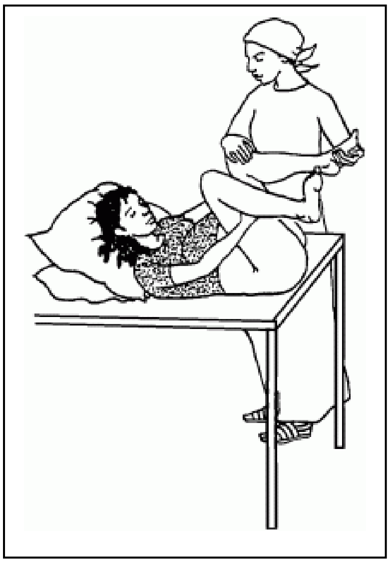
If risk factors are present, have experienced obstetrician present in 2nd stage
Be prepared for the problem including the PPH that may follow
CALL FOR HELP

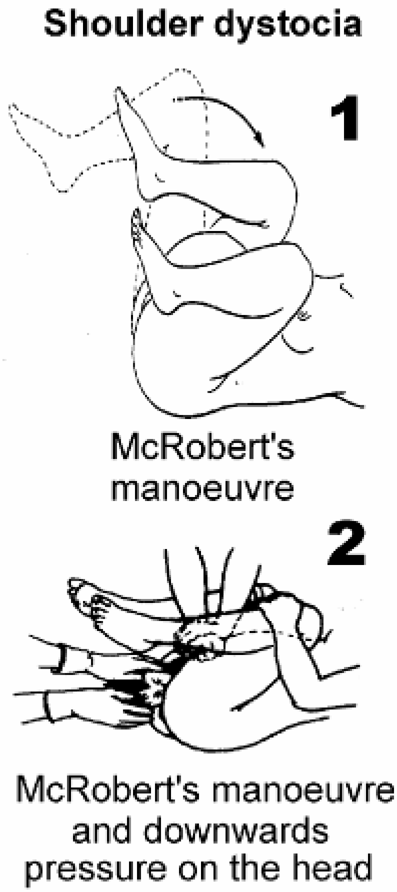
1 Episiotomy (WHO Pregnancy P-71**)**

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.

2 **McRobert's Maneuver**

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 free the impacted shoulder. If two assistants are not available the mother may be laid on her left side in the knee to chest position.





3 **Suprapubic pressure with moderate traction**

Suprapubic pressure is applied to reduce the diameter between the shoulders and push the anterior shoulder underneath the symphysis pubis. It is important to know where the fetal back lies so that pressure is applied in the right direction (that is from the fetal back forwards). Pressure should be applied to the back of the shoulder with the heel of the hand

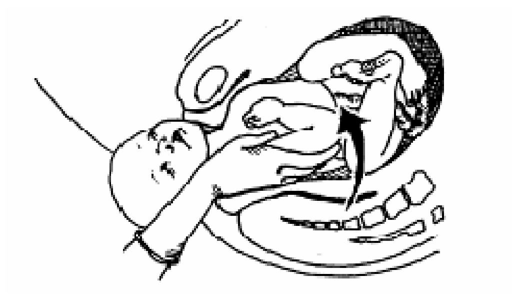
and sometimes a rocking movement may be helpful. Strong traction and fundal pressure should be avoided.

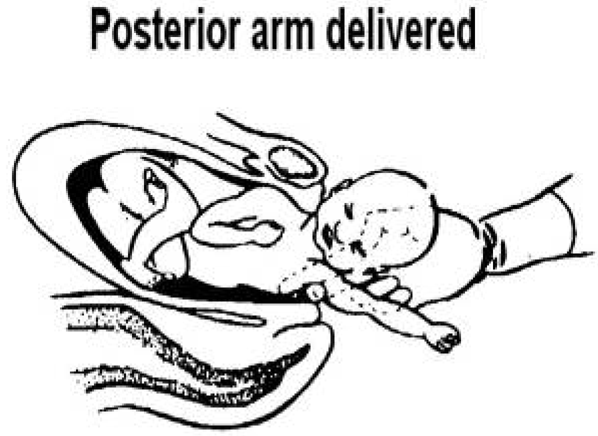
4 Apply moderate traction

Once both McRobert's and suprapubic pressure are in place, moderate traction can be applied while discouraging maternal efforts (which can increase the impaction of the shoulders).

5 **Deliver Posterior Arm and Shoulder**

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: backward pressure on the cubital fossa will disengage the arm which can then be brought down (get hold of the hand and sweep it across the chest).



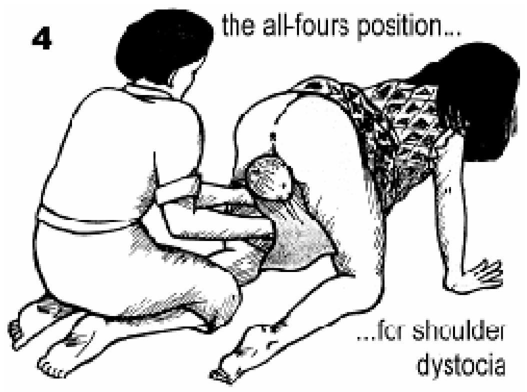


6 **Internal rotational Manoeuvres eg Wood's screw**

These measures are rarely required. Under full asepsis, 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. If this 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 whence 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 maneuver.

7 **All fours position**

This is another procedure which can be useful if no help is available. The mother positions herself evenly on hands and knees. The above manoeuvres can be performed with the mother in this position.



This is the method to use if you are alone

8 **Symphysiotomy (WHO Pregnancy P-53)**

If the baby is still undelivered symphisiotomy should be considered.

9 Check vagina and perineum for trauma and repair accordingly

SECTION 10 Quiz 6

1) **Which of the following statements regarding risk factors for shoulder dystocia are true?**
   a) advanced maternal age
   b) maternal obesity
   c) female gender of fetus
   d) short first stage
   e) risk factors are reliable predictors for individual cases of shoulder dystocia.

2) **Which of the following represent risks to the baby of shoulder dystocia?**
   a) hypoxia
   b) fractures of clavicle and humerus
   c) nerve injuries

3) **Management of shoulder dystocia includes which of the following?**
   a) episiotomy
   b) traction on the head as soon as turtle sign is seen
   c) suprapubic pressure
   d) McRobert's maneuver
   e) Anticipation of post partum haemorrhage

ANSWERS:

1. a,b 2. a,b,c 3. a,c,d,e

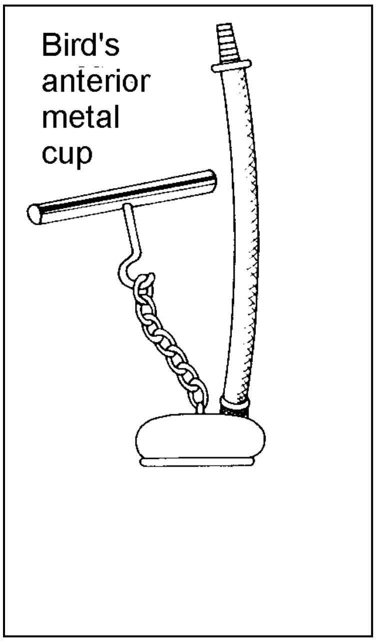
Instrumental vaginal delivery

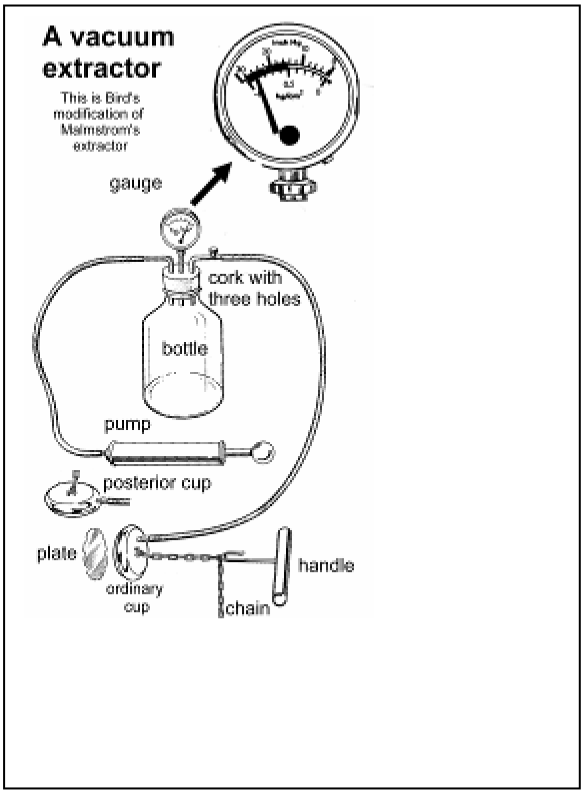
1. Ventouse (WHO Pregnancy P-27)

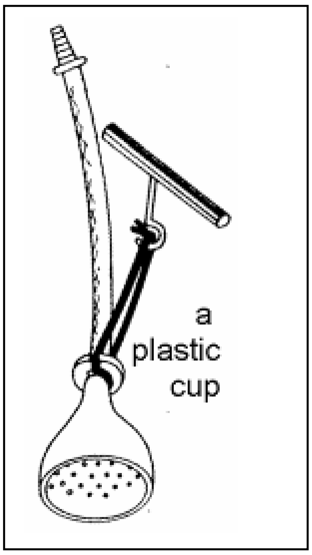
Indications:
- Delay in the second stage
- Fetal distress in the second stage
- Maternal conditions requiring a short second stage, for example: cardiac failure, diastolic blood pressure > 110 mm mercury.

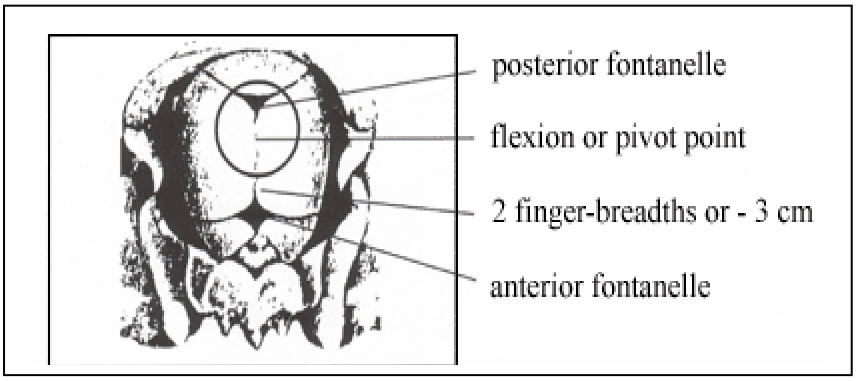
Contra-indications:
- Cervix not fully dilated
- Face presentation
- Severe clotting disorder
- Gestation below 34 weeks

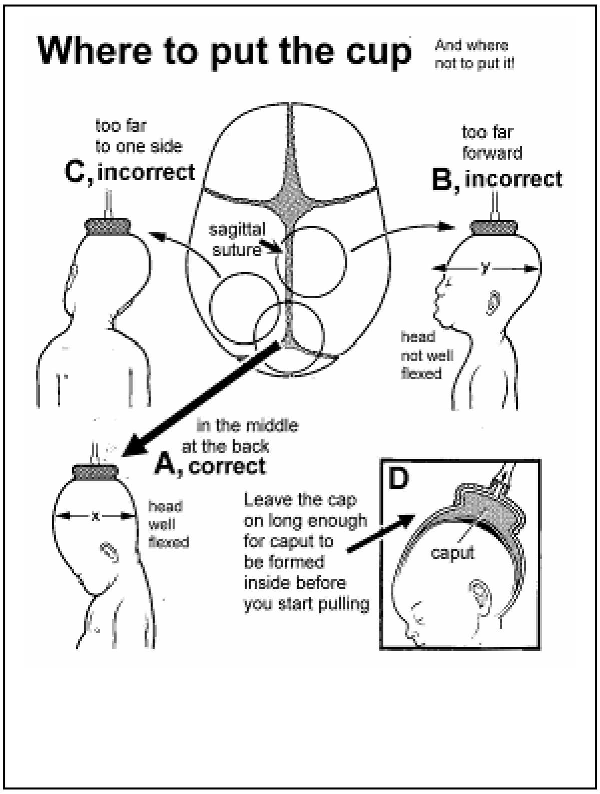
Delivery with the ventouse: basic rules
- Full dilatation of the cervix and full engagement of the head (less than $^1/_5$ palpable per abdomen)
- Cleansing of the vulva and vagina with disinfectant solution and sterile drapes
- Position of the baby's head must be known
- Good contractions
- Lithotomy is the position of choice (with a wedge under the right hip for left lateral tilt).
- Place accurately over the flexion point
- The head (not just caput) should descend with each pull. There should be no need for more than 3 pulls
- Careful examination of the perineum and appropriate repair of trauma afterwards
- Detailed documentation including counting of swabs



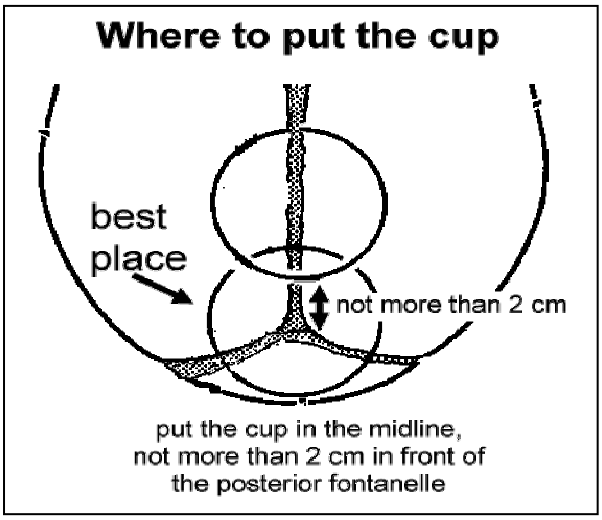


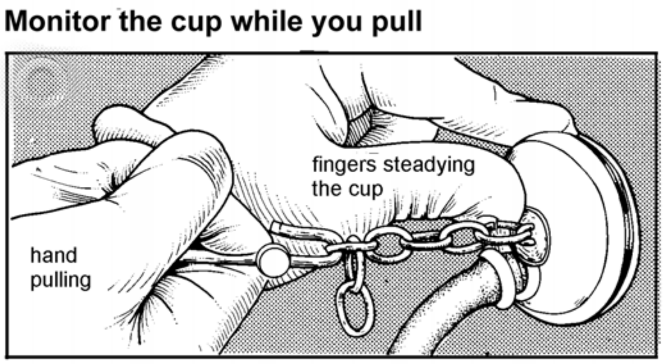

a
plastic
cup

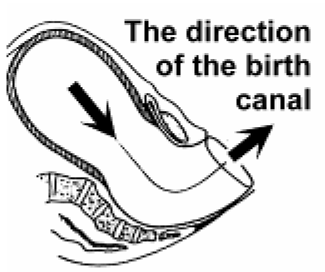

posterior fontanelle
flexion or pivot point
2 finger-breadths or - 3 cm
anterior fontanelle

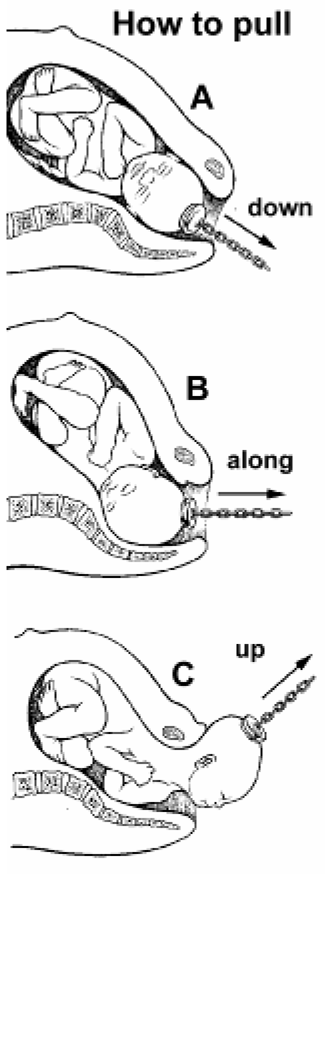

Where to put the cup
And where not to put it!
too far to one side
C, incorrect
too far forward
B, incorrect
sagittal suture
head not well flexed
in the middle at the back
A, correct
head well flexed
Leave the cap on long enough for caput to be formed inside before you start pulling
D
caput

THE PLACE WHERE YOU PUT THE CUP is important. Try to place the cup over the baby's posterior fontanel, because this will flex the head. If you put it more towards the front it will 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). C, if you put the cup to one side, the head will bend to one side

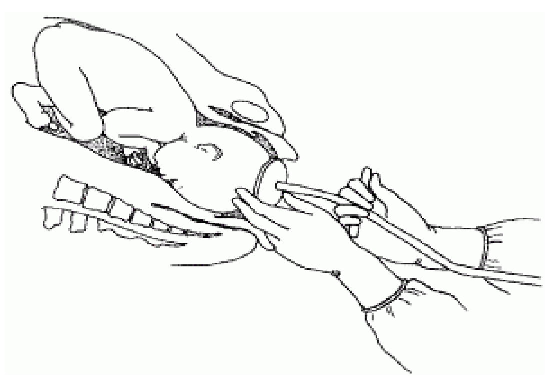








PULL IN THE DIRECTION OF THE BIRTH CANAL. First pull downwards towards the floor, until the head is below the ischial spines.
Then pull outwards until the head is stretching the perineum.
Finally, pull upwards until the baby is delivered.



Reasons for failure

1. Incorrect initial assessment (head too high or misdiagnosis of position/attitude of head)
2. Incorrect cup placement with the ventouse lateral or too anterior on baby's head.
3. Failures due to traction in the wrong direction (keep hands low).
4. Cephalo-pelvic disproportion (true failure) is rare.

Cup technique

- The appropriate cup should be chosen
- The silicone rubber cup can be used with any well flexed cephalic presentation, provided the baby is average size and there is minimum caput
- The anterior metal cup should be chosen if the baby is big, if the second stage is prolonged or there is a moderate degree or more of caput
- The posterior metal cup should be used for occipital-posterior positions, particularly those with significant deflection of the head
- The cup should be connected to the pump and a check made for leakages prior to commencing delivery. Ensure that the equipment is working properly.

Types of ventouse cup
Silicone cup

The silicone cup is folded and inserted into the vagina. The cup is positioned against the posterior fontanel. The pressure is then taken up to 0.2 kg per square cm and a check made to ensure that no maternal tissue has been caught. The pressure can then be increased to 0.8 kg per square cm. Traction begins with the next contraction. The line of traction should be along the axis of the pelvis. One hand remains in the vagina against the cup to detect if it becomes detached. The hand in the vagina can help with the flexion of the fetal head. As the head crowns, the angle of traction changes to a more upward position. An episiotomy may be required at this stage.

Anterior metal cup

The metal cup is lightly lubricated with sterile jelly and inserted sideways into the vagina. The chain of the cup should lie over the most posterior part of the baby's head. Management after this is as described for the silicone rubber cup.

Posterior metal cup

If the head is deflexed and in an occipital-posterior position the posterior metal cup should be applied. It is placed as far back on the head as possible, ideally in the midline. An episiotomy may be required to allow adequate access to place the cup and sometimes pressure on the front of the head to encourage flexion may be helpful to ensure proper application. The vacuum is obtained as described before. With the first pull the aim should be to increase the flexion of the fetal head and the procedure then continues as described previously.

Difficult ventouse

- Wrong diagnosis of the level of the fetal head
- Misdiagnosis of position

- Excess caput
- Incorrect placement of the cup
- Pulling in the wrong direction
- Poor instructions to mother
- Rarely an **experienced** operator may use the ventouse before full dilatation in an extreme situation of acute fetal distress.

2. Forceps (WHO Pregnancy P-33)

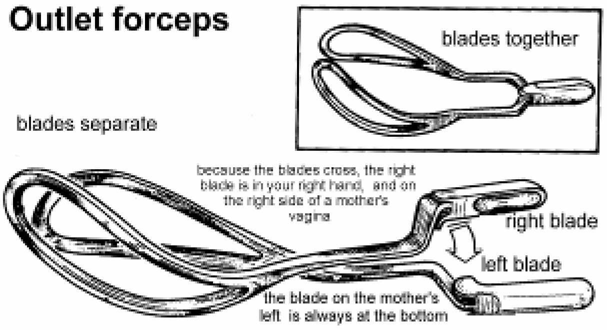
Only to be undertaken by an experienced operator who is comfortable with the equipment. The ventouse is associated with a lower risk of maternal trauma and should be the first choice. The forceps is the only instrument that can be used in the following circumstances:

- Delivery of the after-coming head of a breech
- Delivery of a mento-anterior face presentation
- Delivery before 34 weeks gestation

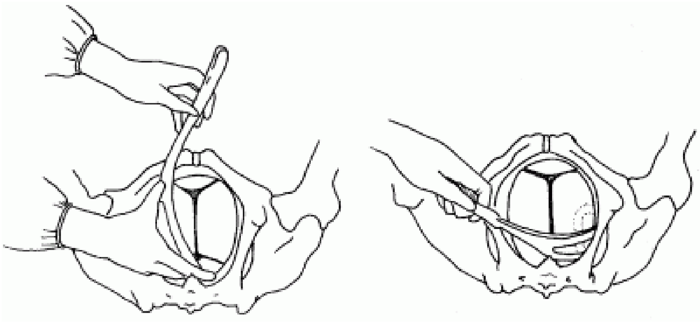
Procedure

- Abdominal examination to confirm that none of the head is palpable
- Clean the vulva and vagina with disinfectant and apply sterile drapes
- Urinary catheterisation
- A pudendal block and perineal local anaesthesia (see CD/DVD rom) is ideal
- Careful vaginal examination to confirm the position of the head
- Check the pair of forceps to ensure they are a matching pair
- The right hand blade is inserted first by passing the right hand into the vagina to lie against the left vaginal wall
- The forceps blade is then passed between the fetal head and the hand to avoid trauma to the maternal vaginal tissues
- After the blade is inserted the handle will lie horizontally at the perineum
- The left blade is inserted by a similar technique and the blades are then locked
- Downward traction should be applied with the next contraction
- The head should descend with each pull and no > 3 pulls should be undertaken
- An episiotomy is usually required as the head crowns
- After delivery of the placenta, the vagina and the perineum should be checked and repaired
- Care should be taken that all swabs and instruments are correct and a rectal examination should be performed to ensure that rectal tears are recognised and that if there has been a repair that sutures have not been placed into the rectum
- The technique for rotational forceps is outside the requirement of this manual and should only be undertaken by an expert in the field

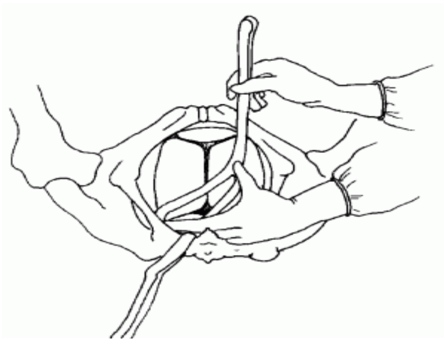
OUTLET FORCEPS are very useful for delay in the second stage when a baby's head is near the outlet. The blade on the mother's left always goes in first, and the right blade fits on top of it.



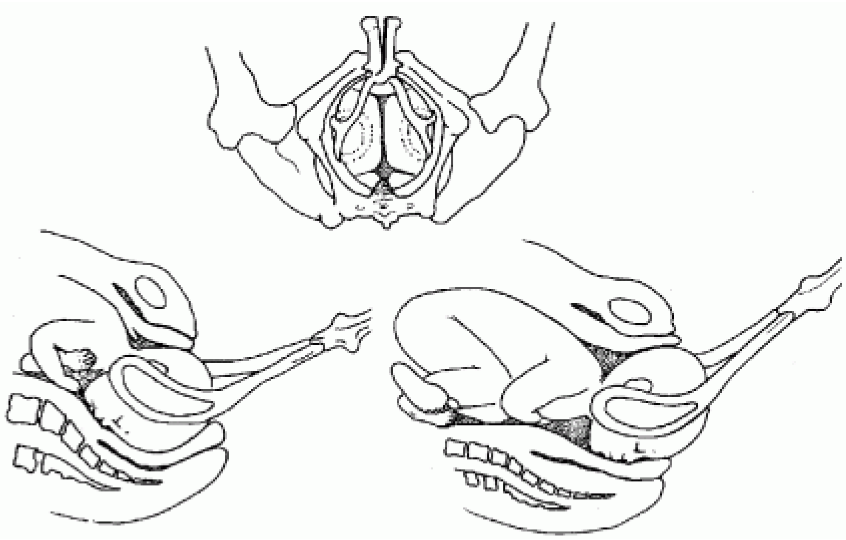
Applying the left blade of the forceps



Applying the right blade of the forceps



Locking and applying traction



SECTION 10 Quiz 7

1) Which of the following are indications for ventouse delivery?
- a) delay in the second stage
- b) face presentation
- c) delivery of after-coming head in breech delivery
- d) maternal cardiac disease

2) Which of the following must be present before ventouse delivery?
- a) full engagement of head
- b) known position of baby's head
- c) good contractions

3) Contraindications for a ventouse delivery include which of the following?
- a) Cervix not fully dilated
- b) Gestation below 38 weeks
- c) Severe clotting disorder

ANSWERS:
1. a,d 2. a,b,c 3. a,c

SECTION 10 Quiz 8

1) Which of the following statements about forceps delivery are correct?

a) It is generally the first choice of delivery following delay in 2^{nd} stage
b) when compared with ventouse, it is the choice of delivery method prior to 34 weeks gestation
c) It is the only instrument that can be used to deliver mento-anterior face presentation
d) It is easy to use by someone with no prior experience
e) Delivery requires no analgesia

ANSWERS:

1. b,c

Twin pregnancy (WHO Pregnancy S-87 and S-89)

In the West this occurs in approximately 1 in 80 pregnancies. Non-identical twin rates vary depending on age, parity and racial background: they are higher in Africa. The incidence of monozygous (identical) twins is relatively constant worldwide at 3.5 per 1,000 births.

Multiple pregnancies are associated with greater risks for both the mother and fetus. Ultrasound scanning should be undertaken if the uterine size is larger than expected or abdominal examination of fetal parts leads to suspicion of multiple fetuses. If ultrasound scan is not available, abdominal examination after delivery of the first baby should be performed to exclude a second twin before oxytocin or syntometrine is given to aid delivery of the placenta. If labour hasn't commenced by 39 weeks gestation consider induction.

Maternal risks associated with multiple pregnancy

- Miscarriage
- Anaemia
- Pre-term labour
- Hypertension
- Excess liquor (polyhydramnios)
- Operative delivery
- Post-partum haemorrhage

Fetal risk associated with multiple pregnancy

- Stillbirth or neonatal death
- Pre-term delivery
- Intra-uterine growth restriction
- Congenital abnormalities
- Cord accident
- Specific complications of twin pregnancies, e.g. twin to twin transfusion syndrome
- Difficulties with delivery

If a twin pregnancy is diagnosed additional care should be provided. Iron and folate treatment must be given due to the increased risk of anaemia. Pre-term labour and delivery presents the greatest risk of fetal illness and death. If the mother develops premature labour, one course of ante-natal steroid injections (betamethasone 12 mg IM repeated once after 24 hours) may improve the maturity of the fetal lungs and reduce the risk of respiratory distress syndrome in the newborn.

Twin delivery

Vaginal delivery is usually safe, but consideration may need to be given to Caesarean Section if conjoined or mono-amniotic twins are suspected. If the first twin is a breech or either twin has severe growth restriction, Caesarean Section may be appropriate.

The management of labour

On admission an IV line should be inserted. Blood should be obtained for a full blood count and blood group. A blood sample should be kept for cross-match. Ultrasound assessment of presentation will help with management. The anaesthetist, paediatrician and neonatal unit should be informed of admission.

The first stage of labour is managed as a singleton pregnancy.

Management of second stage

Prepare oxytocin 20 units in 500ml 0.9% saline for possible later use. Deliver first twin as normal. Examine abdomen to determine lie of second fetus and monitor fetal heart closely. If the lie is transverse, attempt external cephalic version to turn the baby to cephalic presentation. If unsuccessful attempt internal podalic version by grasping the fetal foot and pulling along the birth canal, leaving the membranes intact as long as possible.

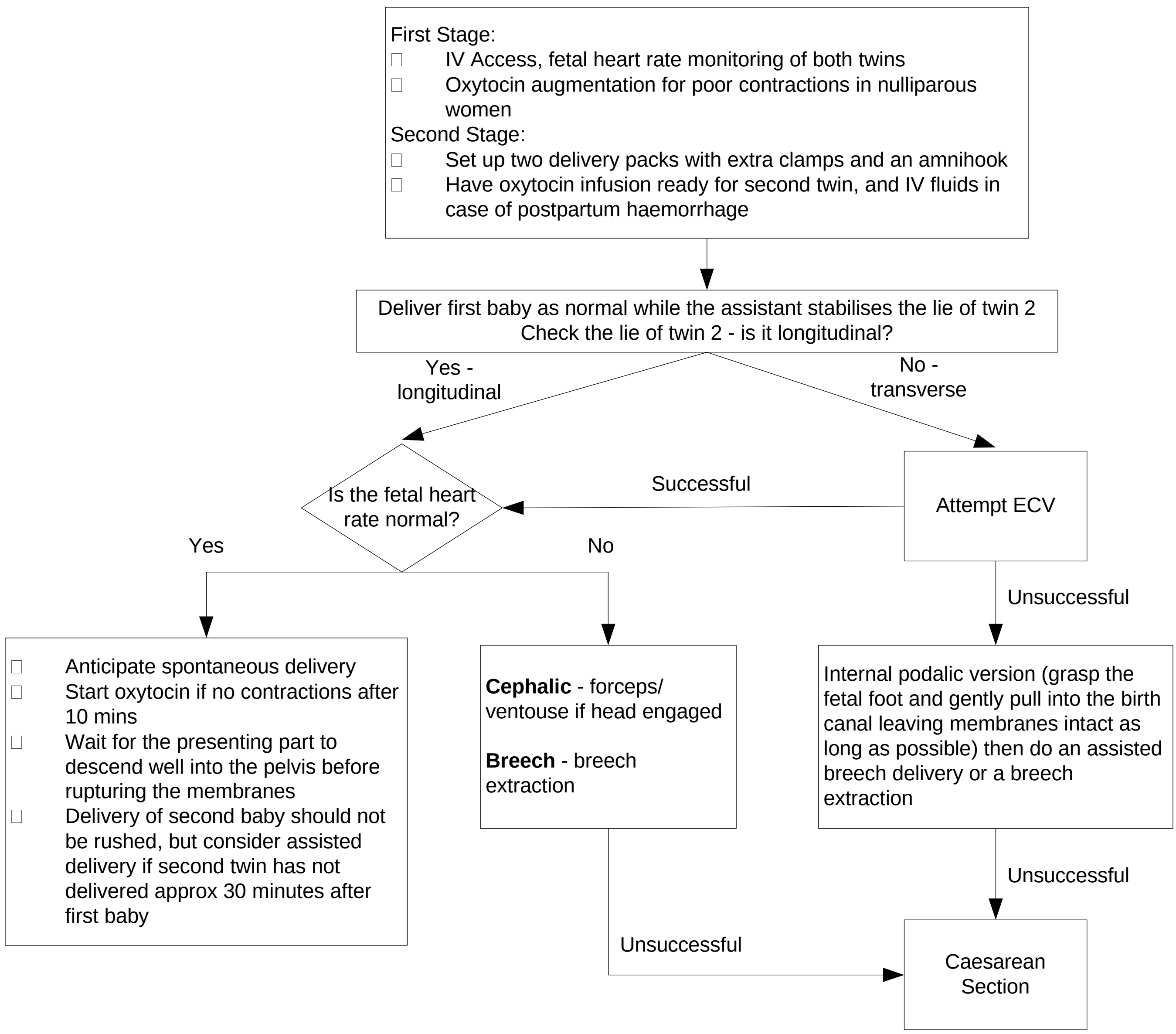
If no contractions have re-started within ten minutes of delivery of the first baby and the baby is lying longitudinally, an oxytocin infusion of 20 units in 500ml of 0.9% saline should be started at a rate of 2 milli-units/ minute (2ml/minute) increasing to achieve adequate contractions. When the presenting part is well into the pelvis, rupture of membranes can be performed during a uterine contraction. Delivery of the second baby should not be rushed but assisted delivery should be considered if the baby has not been delivered by 30 minutes after delivery of the first. (WHO gives no time scale for the delivery of the second baby)

After delivery of the second baby syntometrine IM (5 units oxytocin plus 500 micrograms of ergometrine) should be administered. (WHO 10 IU oxytocin IM after ensuring that there is no other baby in the uterus). If the mother has hypertension 5 units of oxytocin should be given IV instead. After placental delivery commence infusion of oxytocin 40 units in 500 ml. 0.9% saline over 4 hours to improve uterine contraction after delivery and reduce the risk of postpartum haemorrhage.

Check the placenta and membranes for the number of amnions and chorions which will reveal whether the babies are identical or not. Also check for completeness.

Check and repair any vaginal and perineal damage. Monitor carefully for post-partum bleeding over the next few hours. Provide extra support to assist with the care of the babies.

Pathway of Care for Delivering Twins



Third Stage

Syntometrine IM (5 units oxytocin plus 500 micrograms ergometrine) or if pre-eclampsia oxytocin 5 units IV then CCT for delivery of placenta (WHO 10 units oxytocin IM)

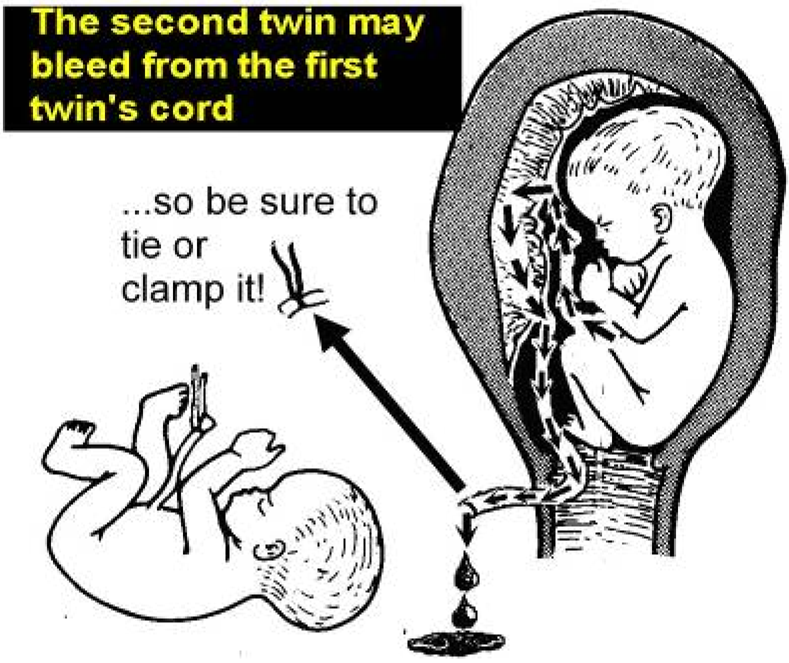
Check placenta and membranes for chorionicity

SECTION 10 Quiz 9

3) **In the pathway of care for twin delivery and after delivery of the first babywhich of the following statements is true?**
   a) if the lie of the 2nd twin is longitudinal and there is no fetal distress, oxytocin should be started if there are no contractions after 30 minutes
   b) if the lie of 2nd twin is longitudinal, head is engaged and there is fetal distress, delivery should be by immediate Caesarean section
   c) if the lie of 2nd twin is transverse the only option is delivery by Caesarean section

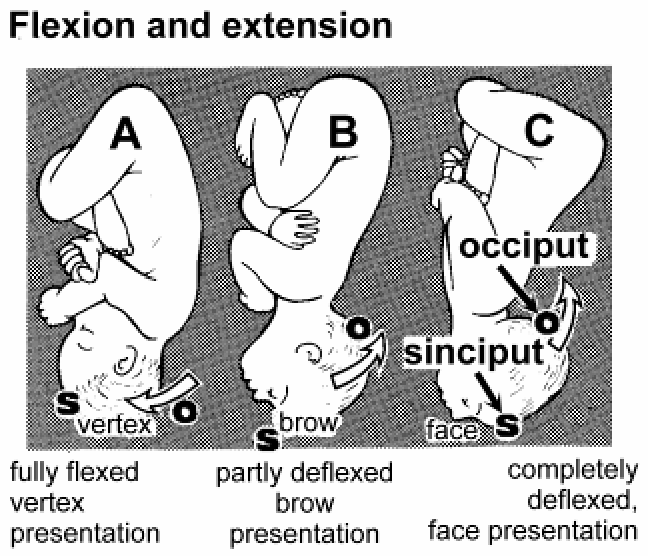
4) **Twin pregnancy is associated with increased risk when compared with single pregnancy of which of the following complications?**
   a) miscarriage
   b) anaemia
   c) decreased liquor (oligo-hydramnios)
   d) post partum haemorrhage
   e) stillbirth or neonatal death
   f) cord prolapse
   g) pre-term labour

ANSWERS: **1. none correct** **2. a,b,d,e,f,g**



Malpresentations and malpositions (WHO Pregnancy S-69)

These can be due to fetal or maternal pathology, which ideally should be diagnosed antenatally if possible.



FLEXION AND EXTENSION. Baby A's head is fully flexed on the chest so that the vertex is presenting. Baby B's head is partly deflexed so that the brow is presenting. Baby C's head is fully deflexed so that the face is presenting. Deflexion is another word for the first part of extension. Only A is normal, all the others are abnormal and difficult to deliver unless the baby is very small, especially B.

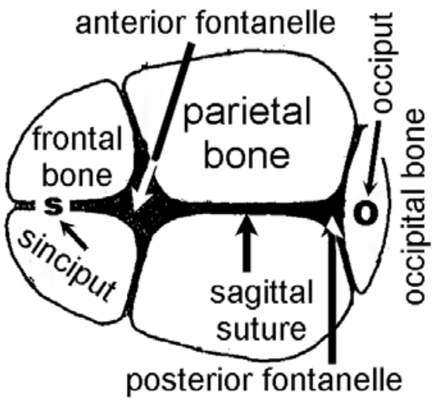
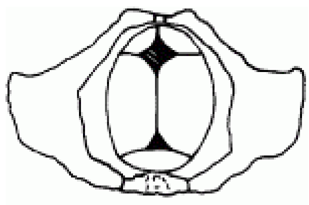
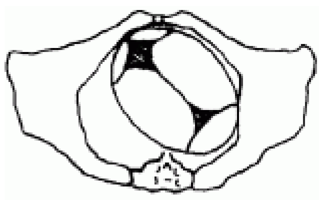
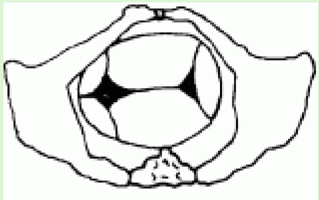
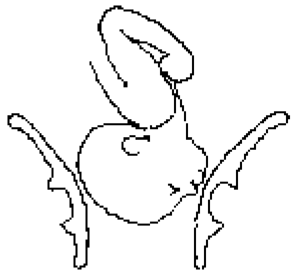
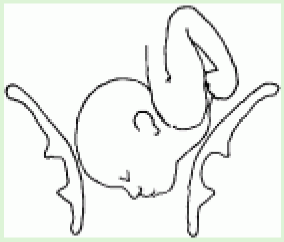
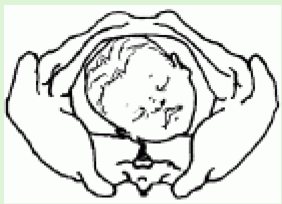
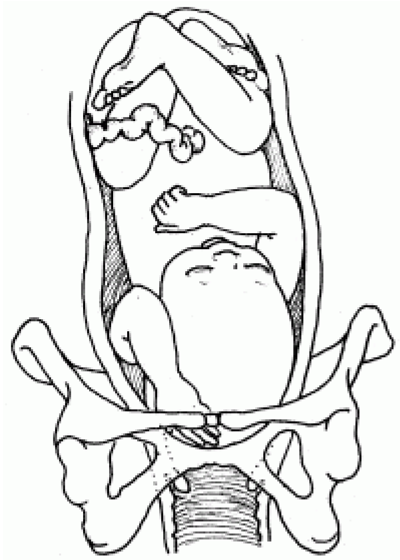


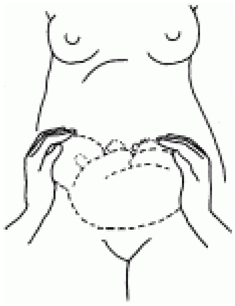
Table: diagnosis of malpositions

Symptoms and Signs	Figure
OCCIPUT POSTERIOR POSITION occurs when the fetal occiput is posterior in relation to the maternal pelvis On **abdominal examination**, the lower part of the abdomen is flattened, fetal limbs are palpable anteriorly and the fetal heart may be heard in the flank. On **vaginal examination**, the posterior fontanellele is towards the sacrum and the anterior fontanellele may be easily felt if the head is deflexed.	 Occiput posterior  Left occiput posterior

Symptoms and Signs	Figure
OCCIPUT TRANSVERSE POSITION occurs when the fetal occiput is transverse to the maternal pelvis. If an occiput transverse position persists into the later part of the first stage of labour, it should be managed as an occiput posterior position.	 Left occiput transverse
BROW PRESENTATION is caused by partial extension of the fetal head so that the occiput is higher than the synciput On **abdominal examination**, more than half the fetal head is above the symphysis pubis and the occiput is palpable at a higher level than the synciput. On **vaginal examination**, the anterior fontanel and the orbits are felt.	
FACE PRESENTATION is caused by hyper-extension of the fetal head so that neither the occiput nor the syncipt are palpable on vaginal examination. On **abdominal examination**, a groove may be felt between the occiput and the back. On **vaginal examination**, the face is palpated, the examiner's finger enters the mouth easily and the bony jaws are felt.	 

Symptoms and Signs	Figure
COMPOUND PRESENTATION occurs when an arm prolapses alongside the presenting part. Both the prolapsed arm and the fetal head present in the pelvis simultaneously.(WHO Pregnancy S-74 and S-78)	
BREECH PRESENTATION occurs when the buttocks and/or the feet are the presenting parts. (WHO Pregnancy S-74 and S-79) 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 with a vertex presentation. On **vaginal examination during labour**, the buttocks and/or feet are felt; thick, dark meconium is normal. **COMPLETE (FLEXED) BREECH PRESENTATION** occurs when both legs are flexed at the hips and knees. **FRANK (EXTENDED) BREECH PRESENTATION** occurs when both legs are flexed at the hips and extended at the knees. **FOOTLING BREECH PRESENTATION** occurs when a leg is extended at the hip and the knee.	 

TRANSVERSE LIE AND SHOULDER PRESENTATION occur when the long axis of the fetus is transverse. The shoulder is typically the presenting part. (WHO Pregnancy S-75 and S-81)

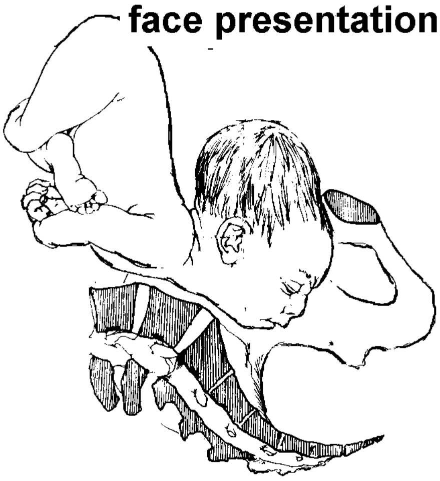


On **abdominal examination**, neither the head nor the buttocks can be felt at the symphysis pubis and the head is usually felt in the flank.

On **vaginal examination**, a shoulder may be felt, but not always. An arm may prolapse and the elbow, arm or hand may be felt in the vagina.

Face presentation (WHO Pregnancy S-73 and S-77)

This is due to extension of the fetal neck, either from a fetal abnormality or progression from a deflexed occipital posterior position in labour. Diagnosis is important as it may be mistaken for breech presentation.



a face presentation

Risk factors
Multi-parity, prematurity, multiple pregnancies, loops of cord around the neck, neck tumours, uterine abnormalities, cephalo-pelvic disproportion, fetal macrosomia

Diagnosis
On abdominal examination a large amount of the head is felt on the same side as the back.

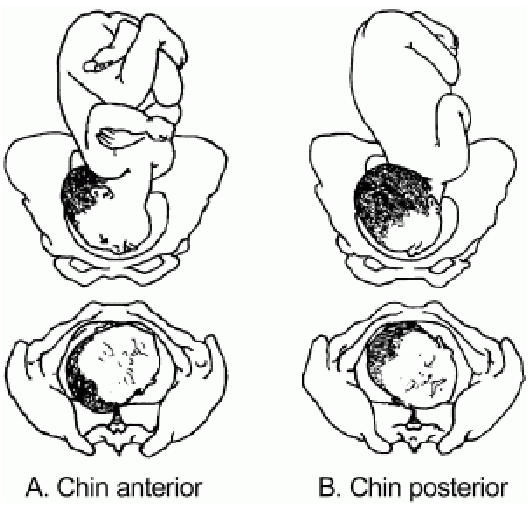
Vaginal examination
In early labour the presenting part will be high. Landmarks are the mouth, jaws, nose, malar and orbital ridges. The presence of alveolar margins distinguishes the mouth from the anus. The mouth and the maxilla (upper jawbone) form the corners of a triangle, while the anus is on a straight line between the fetal pelvic bones. Avoid damaging the eyes by trauma or the use of antiseptics. Ventouse must not to be used.

In early labour, particularly with the occipital-posterior position and multiparous patient deflection is common, but in such cases uterine contractions often cause increased flexion and delivery will proceed as normal. If extension occurs however, a brow presentation and finally the fully extended face will result. Most face presentations therefore only become obvious late in labour. If the chin is towards the pubis (mento-anterior) then the baby can often be delivered normally although an episiotomy is usually necessary. If the chin lies towards the back then delivery will not occur and a Caesarean Section will be required.
The widest biparietal diameter is 7cm 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 VE suggests, even allowing for gross oedema. The head is always higher than you think.

Abdominal examination is vital.

The head is born by flexion, risking considerable perineal trauma – consider an episiotomy.

If spontaneous delivery of a mentoanterior face does not occur a “lift out” forceps delivery can be performed (see section on forceps delivery)



SECTION 10 Quiz 10

1) Which of the following are normal fetal presentations?
a) Fully flexed vertex
b) brow
c) face

ANSWERS:
1. a

SECTION 10 Quiz 11

1) Regarding face presentation which of the following statements are correct?
a) it may be mistaken for breech
b) is most often obvious early in labour
c) if the chin is towards the pubis a Caesarean section will always be needed
d) episiotomy is usually needed for vaginal delivery
e) if spontaneous delivery of a mento-posterior face does not occur, a 'lift out' forceps delivery can be performed.

ANSWERS:
1. a,d

Occipito-posterior (OP) position (WHO Pregnancy S-70 to S-72 and S-75)

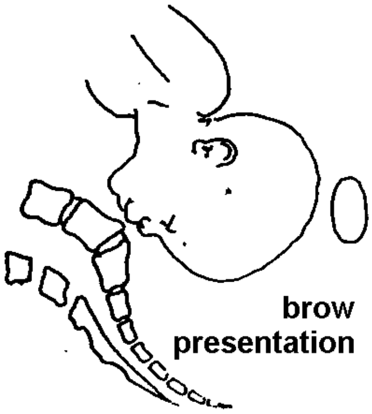
This is common, occurring in up to 20% of laboring mothers.

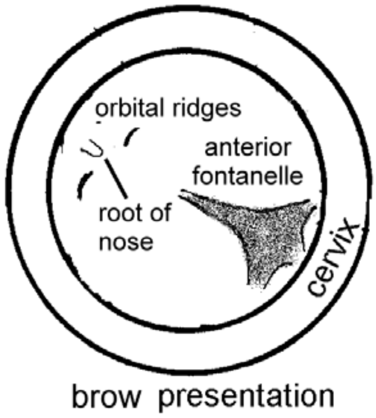
Diagnosis

Abdominal examination may show flattening of the abdomen, difficulty feeling the back, the limbs may be felt anteriorly. Vaginal examination reveals a high deflexed head and the posterior fontanel of the fetal skull is felt towards the sacrum. In mothers with an anthropoid pelvis, for example those from Africa, the OP may be normal and delivery may occur in the OP position. The first stage of labour in mothers with a gynaecoid pelvis (the more common female pelvis shape), may be prolonged and an oxytocin infusion may be required. Assisted delivery is often required. If there is delay in the second stage of labour ventouse is the preferred method of delivery and if available the OP cup should be used. A rotational forceps delivery with the Kiellands forceps should only be undertaken by someone with extensive experience of the procedure. The OP position may cause a positional cephalo-pelvic disproportion and Caesarean Section may be required, particularly if cervical dilation stops.

Brow presentation (WHO Pregnancy S-73 and S-76)

This is usually caused by partial extension of the fetal head and may be suspected on abdominal examination as more than half the head is felt above the symphisis on the side of the fetal back. Vaginal examination will reveal the anterior fontanel and bony ridges above the eyes. Unless the head extends further to face presentation, vaginal delivery is not possible and Caesarean Section will be required.





SECTION 10 Quiz 12

1) **Which of the following statements are true regarding the occipital-posterior position?**
   a) It occurs in up to 20% of laboring mothers
   b) may be suspected on abdominal examination when the lower part of abdomen is flattened and the fetal limbs are palpable anteriorly
   c) on vaginal examination the anterior fontanel may be felt easily
   d) may lead to a prolonged first stage of labour
   e) is more likely to lead to assisted delivery than the occipital-anterior position

ANSWERS:

1. a,b,c,d,e

SECTION 10 Quiz 13

1) **Which of the following statements are true regarding the brow position?**
   a) is caused by partial extension of the fetal head, so the synciput is higher than the occiput
   b) may lead to face presentation later in labour
   c) will allow the anterior fontanel and supra-orbital ridges to be felt on vaginal examination
   d) will lead to Caesarean delivery if presentation remains brow

ANSWERS:

1. b,c,d

Compound presentation (WHO Pregnancy S-74 and S-78)

Here more than one part of the fetus is facing the cervix, for example an arm prolapsing alongside the presenting part. It is more common in prematurity. It can be managed expectantly in the early stages of labour in the multiparous patient, with active treatment only being required if there is a delay in the first or second stages of labour.

Breech presentation (WHO Pregnancy S-74 and S-79)

At 28 weeks, 20% of babies present by the breech, but most fetuses will turn spontaneously so that only 3-4% will remain breech at term. There is a higher risk with prematurity. Vaginal delivery (although safer for the mother than Caesarean section) carries higher risk of perinatal and neonatal mortality and morbidity due to birth asphyxia and trauma.

extended legs

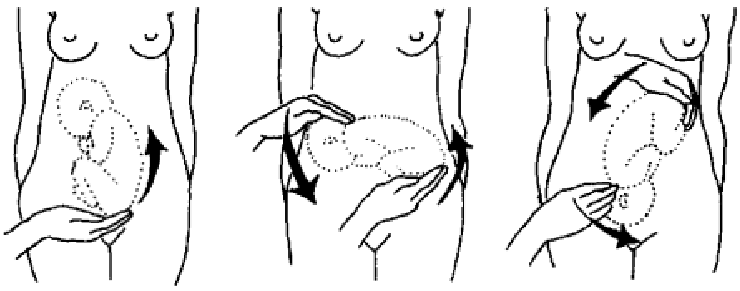
flexed legs

footling

a single footling presentation

External cephalic version

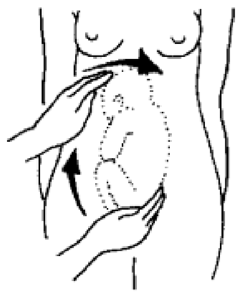
This may be performed between 37 and 42 weeks if there is a single uncomplicated breech pregnancy. There should be no previous uterine scars, previous ante-partum bleeding, fibroids or a placenta praevia. On admission the fetal heart should be monitored. If available, ultrasound should be performed to demonstrate the fetal position, a good amount of liquor, a flexed fetal head and the position of the fetal legs. The mother should be awake and consent to the procedure.



A. Mobilization of the breech

B. Manual forward rotation using both hands, one to push the breech and the other to guide the vertex

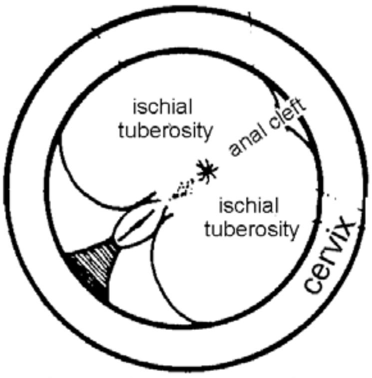
C. Completion of forward roll



D. Backward roll

Procedure: External cephalic version (WHO Pregnancy P-15)

Tilt the bed head down to allow gravity to assist in disengaging the breech. The mother lies on her side to allow a forward somersault. The abdominal wall should be covered with talcum powder, almond or vegetable oil or ultrasound gel to help to turn the baby. The breech should be disengaged with one hand and an attempt made to turn the baby with the other. No more than three attempts should be made. Whether or not the procedure is successful, the fetal heart should be listened to every 5 minutes for an hour. If the mother is rhesus negative a Kleihauer test should be performed and 500 international units of anti-D administered to the mother IM.



breech presentation

All mothers should be warned about the risks of reduced fetal movements, bleeding, rupture of the membranes or onset of labour. If successful the pregnancy can be managed as a cephalic presentation. If unsuccessful, future management should be discussed and a decision made regarding elective Caesarean Section or trial of vaginal breech delivery.

Trial of vaginal breech delivery

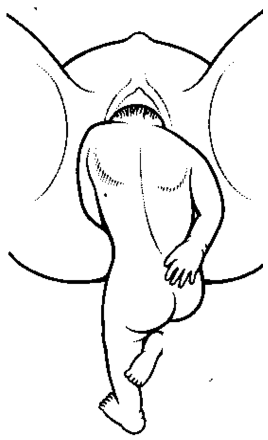
This is appropriate if:

- mother **and** baby are of normal proportions
- presentation of breech is frank (hips flexed, knees extended) or complete (hips flexed, knees flexed but feet not below the fetal buttocks)
- no evidence of fetal-pelvic disproportion: adequate pelvis - using clinical judgment and estimated fetal weight <4000g (clinical measurement)
- no evidence (on ultrasound) of hyper-extension of the fetal head.
- The mother should be counseled and given informed choice
- Inform theatre and the on-call anaesthetist
- Careful fetal monitoring and documentation of the partogram
- Amniotomy may be used to accelerate labour and careful use of oxytocin may be used to correct poor uterine activity if the mother is having her first baby. Oxytocin should not be used for poor progress in a mother who has previously given birth
- Caesarean Section should be considered if there is poor progress or fetal distress
- Ensure an obstetrician with adequate experience in delivering breech babies vaginally is present during the second stage

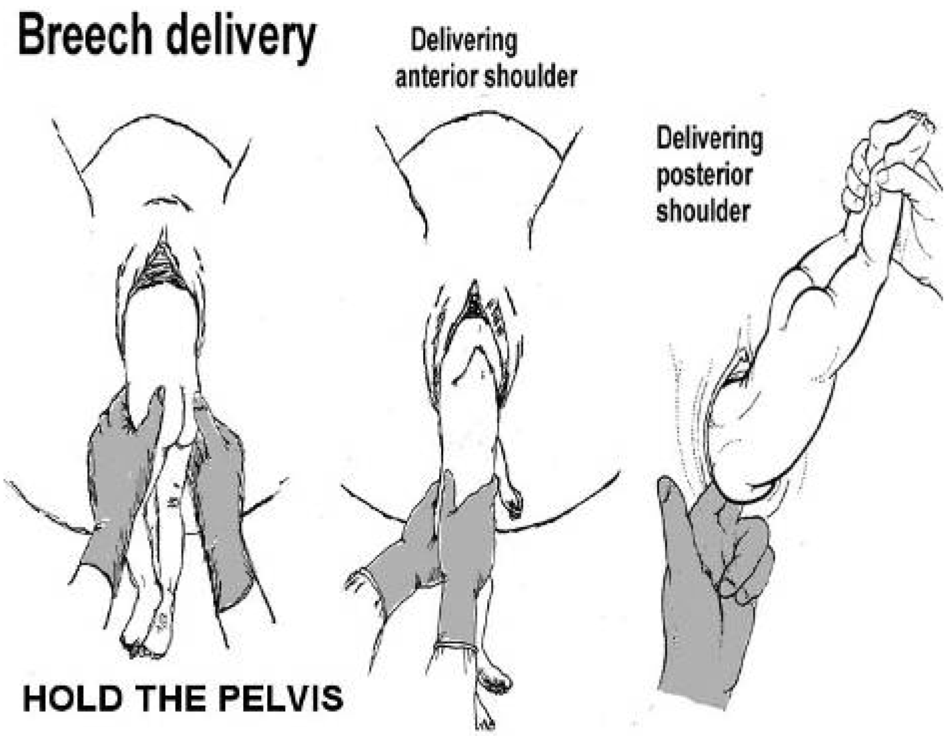
The basic principles of delivering a breech are those of not interfering

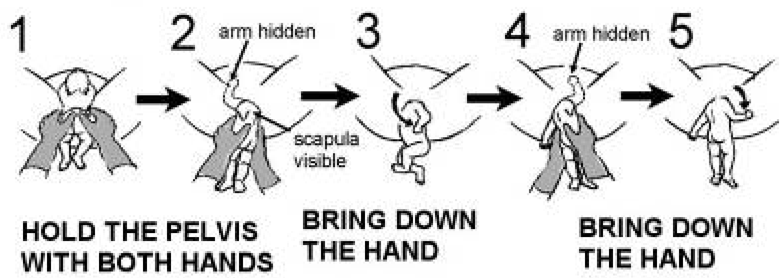
- Active pushing should not be encouraged until the breech has descended to the pelvic floor. Sitting the patient up at this stage may help to encourage descent of the breech. An **episiotomy** may well be required, but should not be performed until the anus is visible.(WHO until baby's buttocks are distending the perineum)
- The breech will usually rotate spontaneously to lie with the sacrum anteriorly. It must be prevented from turning posterior. Extended legs are delivered by flexing the knee joint of the baby and then extending at the hips
- The baby is supported only when the arms are delivered and the nape of the neck becomes visible (avoid holding the baby's abdomen - the pelvis can be held gently)

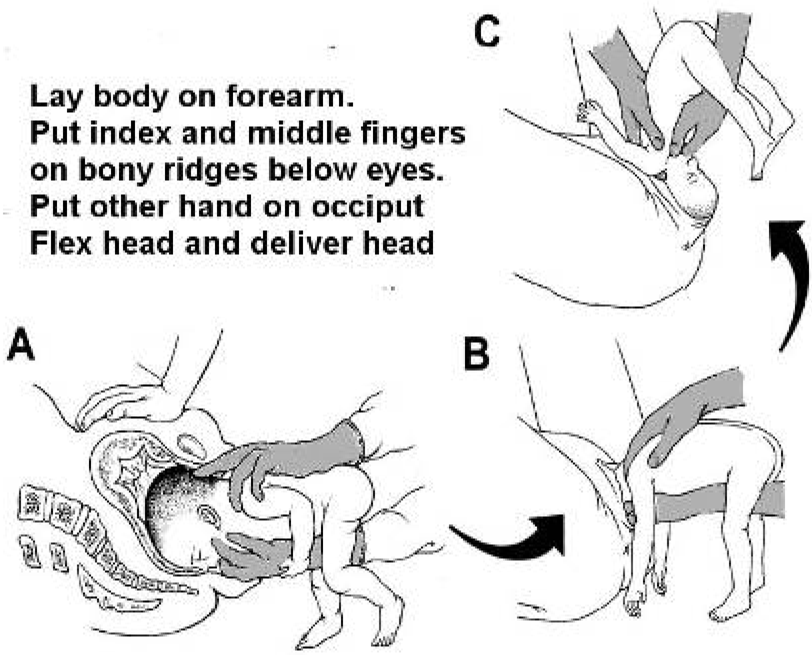
- As the mother pushes, the anterior shoulder tip will become visible. A finger is run over the shoulder and down to the elbow to deliver the arm. The other shoulder will rotate anteriorly spontaneously to allow similar delivery of the other arm
- The baby lies supported as the head engages and the neck comes into view. Delivery of the head may then be performed by the Maurice-Smellie-Veit manouvre. The right hand is placed into the vagina, the fetus is supported on the right forearm, the middle finger of hand is passed into the baby's mouth and the first and third fingers are placed against the cheekbones. Pressure is applied on the tongue to flex and deliver the head. The left hand is used to press upwards and posteriorly on the back of the fetal head to encourage flexion. Alternatively forceps may be used to achieve the controlled delivery of the 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. If the head fails to descend into the pelvis, that is the nape of the neck does not appear, a symphysiotomy should be considered.



The baby should be left to hang until the nape of the neck is seen







Mauriceau-Smellie-Veit maneuver

Elective Caesarean section

The woman must understand the risks of Caesarean section and the concept of trial-of-scar in a future pregnancy

- Ensure presentation remains breech before anaesthetising the patient.

- Take great care on entering the uterus, the breech is much more likely to be cut than a cephalic presentation
- Make the uterine incision of good size (if too small there can be difficulty delivering the head

SECTION 10 Quiz 14

1) **Which of the following statements are true regarding external cephalic version for breech presentation?**
   a) it is contraindicated if there has been previous APH
   b) 3 attempts should be made at between 34 and 36 weeks gestation
   c) should not be performed for 2nd twin if transverse lie
   d) anti D should be given to the mother if she is rhesus negative and a Kleihauer test is positive
   e) if unsuccessful, Caesarean section is the only option

2) **A Trial of vaginal breech delivery is appropriate under which of the following conditions?**
   a) Mother and baby are of normal proportions
   b) presentation of breech is footling
   c) oxytocin is not used for poor progress in a mother who is having her first baby
   d) an obstetrician with adequate experience in vaginal breech delivery is present at 2nd stage

3) **When delivering a breech which of the following statements are true?**
   a) active pushing should be encouraged to aid descent of the breech to the pelvic floor
   b) the baby must be prevented from turning posteriorly
   c) the baby is only supported when the arms are delivered and nape of neck is visible
   d) the anterior shoulder is delivered by the Mauriceau-Smellie-Veit procedure
   e) if the nape of the neck does not appear, a symphysiotomy may be considered

ANSWERS:
1. a,d (perform between 37 and 42 weeks) 2. a,d 3. b,c,e

Transverse and Oblique Lies (WHO Pregnancy S-75 and S-81)

Background

These are particularly 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.

The resulting presentation of shoulder, limb or cord 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 (see CD/DVD rom)

Practical points to remember

- Try to identify the cause of the abnormal lie (ultrasound)
- Positively exclude placenta praevia with ultrasound before conducting digital vaginal examinations
- Caesarean section can be extremely difficult:
  - The lower segment will be poorly formed
  - Fibroids when present can distort anatomy and inhibit access
  - Placenta praevia is associated with severe haemorrhage

- A vertical uterine incision may be most appropriate for above reasons
- Keep the membranes intact while making and extending the uterine incision as this helps with manipulating the fetus into a longitudinal plane for delivery
- If there is any difficulty in delivering a fetal head or breech then find, grasp and bring down a foot (recognisable by the heel) into the wound.
- If delivery is still impossible the uterine incision can be extended.

SECTION 10 Quiz 15

1) Transverse and oblique lies are associated with which of the following?

a) a high maternal morbidity
b) a high fetal morbidity
c) uterine fibroids
d) placenta praevia
e) Caesarean section, as this is the only option for delivery of a live and well infant

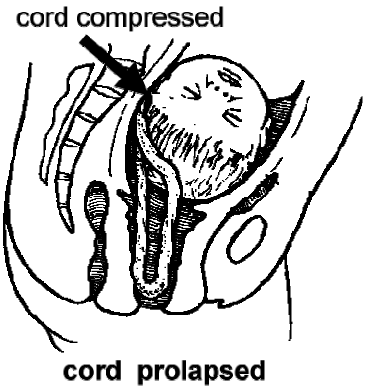
2) When performing Caesarean section for transverse lie which of the following statements are true?

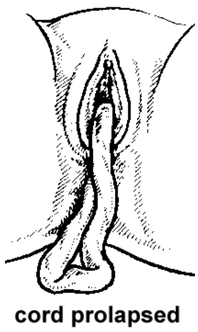
a) a vertical uterine incision may be more appropriate than a transverse
b) placenta praevia is associated with severe haemorrhage
c) it is often easier to manipulate the fetus into a longitudinal plane for delivery after the membranes have been ruptured
d) bringing a foot into the wound can help to deliver the baby

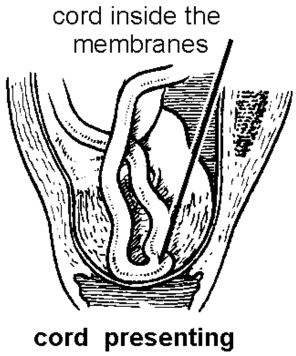
ANSWERS:

1. a,b,c,d,e 2. a,b,d

Prolapsed umbilical cord (WHO Pregnancy S-97)







Incidence

This occurs in approximately 0.2% of all 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 exposed to cold.

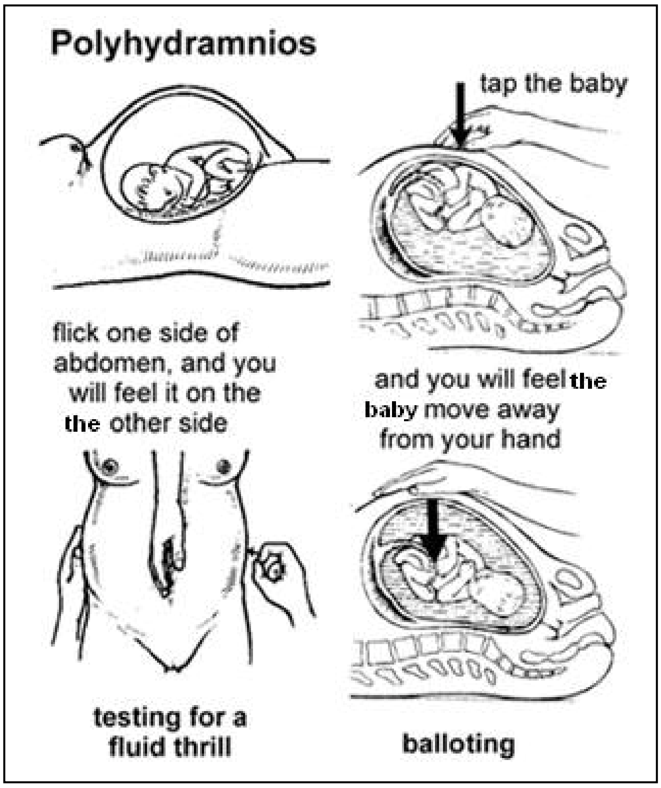
Risk factors for prolapsed cord

The presenting part does not remain in the lower uterine segment due to:

Fetal Causes
- Malpresentations: for example: complete or footling breech, transverse and oblique lie.
- Prematurity or low birth weight
- Polyhydramnios
- Multiple pregnancy
- Anencephaly

Maternal Causes
- Contracted pelvis
- Pelvic tumours

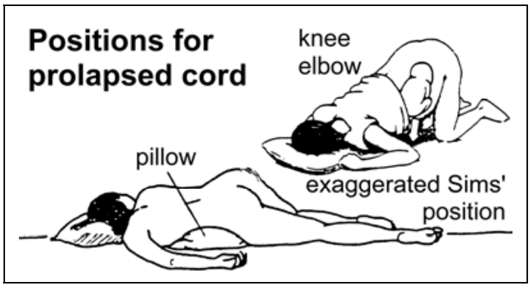
Other Predisposing Factors
- Low grade placenta praevia
- Long cord
- Sudden rupture of membranes in polyhydramnios



Management

1 ASSESS VIABILITY

If the baby is alive and of a viable gestation (the cord will be pulsating and the fetal heart sounds heard), elevate the presenting parts and ensure rapid delivery. Give the mother 100% oxygen to breathe and place in the knee elbow or left lateral tilt position.

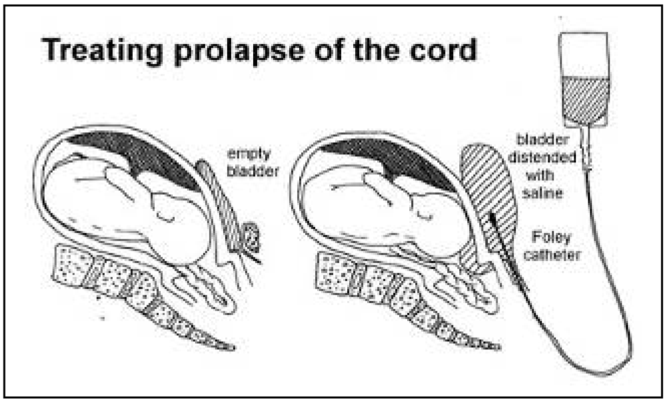


The interval between diagnosis and delivery is significantly positively correlated with still birth and neonatal death. If the baby is dead, deliver in the safest way for the mother.

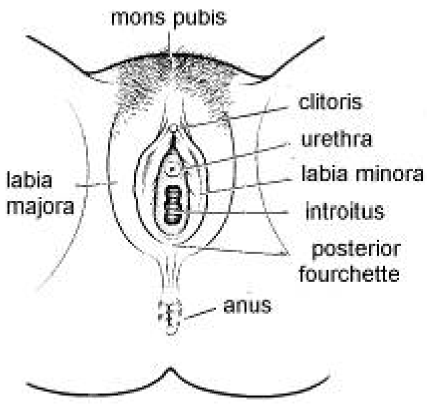
2 RELIEVE COMPRESSION

a) knee chest or Trendelenburg positioning and manual elevation (using high level sterile gloves) of the presenting part above the pelvic inlet to relieve compression. Ensure sterile procedures including cleaning the perineum.
b) prepare for emergency Caesarean section, assuming that this can safely be undertaken
c) fill the bladder to raise the presenting part off the compressed cord for an extended period of time, allowing the operator to remove his or her fingers from the presenting part. Insert sufficient 0.9% saline so that the distended bladder

appears above the pubis: 500 ml is usually sufficient. Inflate the balloon of the foley catheter, clamp it and attach drainage tubing and urine bag. The full bladder may also decrease or inhibit uterine contractions. The bladder must be emptied by unclamping the catheter before opening the peritoneal cavity for Caesarean section. Mark the abdomen to show the bladder is inflated.



Urethral Catheterisation



Methods:

Use appropriate size of catheter i. e. one that is smaller in diameter than the external urethral meatus (to minimise risk of subsequent urethral stricture formation). Do not attempt to use a tube larger than the meatus. Sterile lubricant should be used.

Use sterile precautions (gloves etc), wash area with antiseptic, catheter bag if available, syringe of 0.9% saline to inflate balloon if is Foley balloon catheter and an assistant to hold legs apart. No need for force. Catheter is in sufficiently far when urine is seen in tube.

3 SUPPORT MOTHER AND BABY

a) give mother 100% oxygen to breath (face mask and reservoir)
b) discontinue any oxytocin infusion
c) ensure IV access

4 DELIVER BABY

a) Cord prolapse at full cervical dilatation with a live viable fetus is an indication for using a ventouse with an un-engaged head. If ventouse is not available and the head is engaged forceps may be used.
b) if the cervix is not fully dilated Caesarean section if safe will be required. At skin incision the bladder clamp must be released and the bladder emptied.

SECTION 10 Quiz 16

1) Risk factors for cord prolapse include which of the following?

a) prematurity
b) low grade placenta praevia
c) polyhydramnios
d) long cord
e) small pelvis

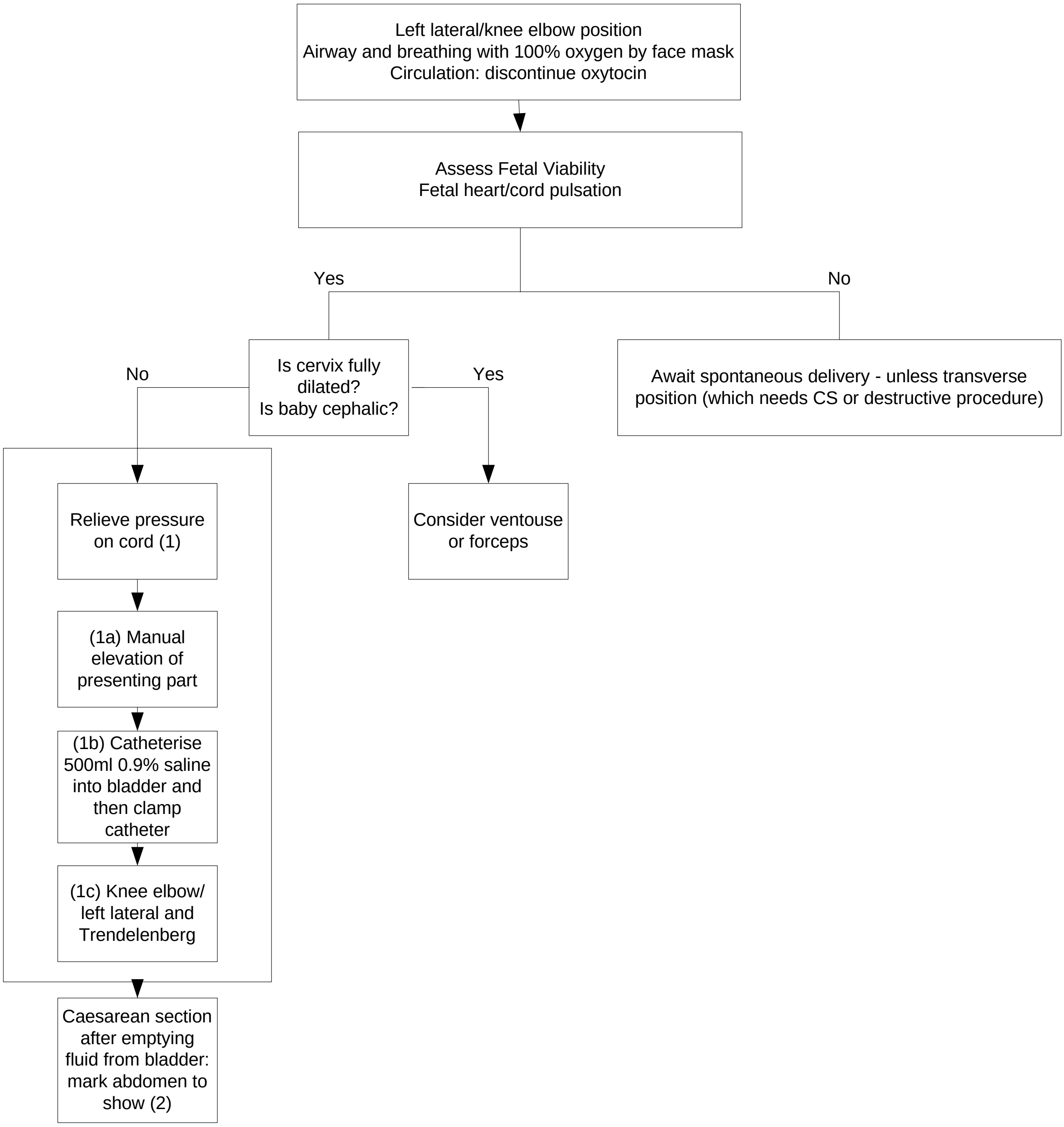
2) Management of cord prolapse includes which of the following?

a) assessing fetal heart and/or cord pulsation
b) giving mother 100% oxygen to breathe
c) considering assisted vaginal delivery if cervix is fully dilated
d) Catheterisation of the bladder and instilling 500 ml of 0.9% saline into bladder
e) Caesarean section after releasing bladder clamp at skin incision
f) Left lateral tilt position

ANSWERS:

1. a,b,c,d,e 2. a,b,c,d

Pathway of Care Prolapsed Cord



Symphisiotomy

This procedure may aid with difficult deliveries and avoid the risk of Caesarean Section and its associated risks of uterine rupture in a further pregnancy. Indications for symphisiotomy include:

- a trapped after-coming head of a breech
- severe cases of shoulder dystocia that have not been helped with routine manoeuvres
- cephalo-pelvic disproportion with a vertex presentation and a living fetus when at least one-third of the fetal head has entered the pelvic brim and where Caesarean Section is not possible. Forceps or ventouse deliveries are not suitable in this circumstance.

The cervix must be fully dilated

Technique

- Place the mother in the lithotomy position with her legs supported by two assistants. It is important that the legs should be well supported and not allowed to move too far apart, (an angle of not more than 80 degrees between the legs) to avoid strain to the joints between the sacrum and the pelvic bones
- Local anaesthetic is injected into the skin and the symphysis pubis. This helps to identify the joint space and the needle can be left in place to guide the rest of the procedure
- Insert a urinary catheter
- Push the catheter and urethra aside to the mother's right with the index and middle fingers of the left hand in the vagina. The index finger pushes the catheter and urethra to the side and the middle finger remains on the back of the pubic joint to monitor the scalpel
- Incise the symphysis pubis in the midline at the junction of the upper and middle thirds. The point of the scalpel will be felt impinging on the vagina by the underlying finger of the left hand. 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. The scalpel is then removed and rotated through 180º and the remaining upper third of the symphysis is cut.
- Beware as the symphysis joint cuts very easily
- Take great care not to go too deep which can damage the vagina or urethra
- After the symphysis has been cut, the joint should open as wide as the operator's thumb
- After perineal local anaesthetic cut a generous episiotomy to relieve tension on the front wall of the vagina
- If further assistance is needed to deliver the head, use a vacuum extractor.
- Deliver the **head and trunk** of the baby in a **downwards** direction (take care not to lift the baby up until it is completely delivered, and keep the legs supported).
- After delivery of the baby and placenta, press the joint between the thumb above and first and second fingers below for some minutes to express blood clots.
- Repair the episiotomy and any other tears with the legs still supported
- Leave the urinary catheter in place for 3 to 5 days and give prophylactic antibiotics to prevent urinary tract infection.
- The patient should be nursed in bed on her side as much as possible with her knees strapped loosely together for three days. After this, mobilisation can begin. Prophylactic LWMH heparin should be considered (see CD/DVD rom).

SECTION 10 Quiz 17

1) Regarding symphisiotomy which of the following statements are true?

a) it is indicated early in the management of shoulder dystocia
b) the cervix must be fully dilated
c) the mother's legs should be as widely apart as possible
d) damage to the urethra is a risk
e) the symphysis joint is difficult to cut
f) an episiotomy should also be used to aid delivery
g) a urinary catheter should remain in place for 3 – 5 days and prophylactic antibiotics given

ANSWERS:

1. **b,d,f,g**

Destructive procedures (IMEESC 11.4)

These have a role in cases of obstructed labour, particularly if there has been poor or absent care antenatally or in labour. They may be particularly useful in the management of a dead baby if the risks to the mother of Caesarean Section are thought to be too great. Maternal mortality after destructive operations is low but there is a high maternal death rate if Caesarean Section is undertaken in a woman with severe sepsis, shock or anaemia. Before the procedure is undertaken, it must be explained to the mother and if possible it is kinder to administer a spinal or general anaesthetic. As urinary and genital tract infections are common, antibiotic prophylaxis should be used. The genital tract and rectum must be carefully examined after the procedure to ensure that no injury has occurred from the trauma of delivery, the use of sharp instruments, or spikes of bone. The three most common destructive procedures are:

1. Craniotomy (WHO Pregnancy P-57)

Indications

For the delivery of a dead fetus in situations of obstructed labour resulting from cephalo-pelvic disproportion and hydrocephalus

Method

- Place a urinary catheter and administer a suitable analgesic
- The fetal head should be no more than 3/5 above the pelvic brim and the cervix should be at least 4cm dilated. In cases of hydrocephalus, the procedure is suitable even if the head is very high
- Under most circumstances it is better to deliver through a fully dilated cervix to prevent tears.
- Ask an assistant to steady the head from above the symphysis pubis
- Perforate the skull, preferably by the anterior fontanel, using a Simpson's perforator with the instrument at right angles to the surface of the skull. The perforator can be inserted through bone if necessary
- Push the blades as far as their shoulders and separate, first in one direction. Turn the instrument through 90° and open the blades again.
- Evacuate the brain and allow drainage of cerebro-spinal fluid in cases of hydrocephalus. Deliver the fetal head by pulling on the skull by using volsellum forceps

and counter-traction. The volsellum may be attached to a weight for example a 1 litre bag of IV fluid using a bandage to allow a slower delivery.

- Occasionally with a large baby, division of the clavicle may also be required

In the **after-coming head of a breech** this should only be performed if the baby is already dead or not expected to survive because of congenital anomalies e.g. spina bifida and hydrocephalus. A similar procedure can be performed by inserting the Simpson's perforator through the posterior fontanelle or perforation of the base of the skull.

2. Decapitation

Indications

For cases of neglected obstructed labour with a shoulder presentation AND an oblique or transverse lie and the fetus is already dead.

Method

- If the fetus is small and the neck can be easily felt, it may be severed with stout scissors. If the neck is not easily accessible, the Blond-Heidler decapitation tool is the safest instrument.
- The cervix should be at least 7cm dilated and the fetal neck accessible on vaginal examination.
- If possible, an arm is grasped and brought down to be held by an assistant to make the neck more accessible.
- Thread the saw around the fetal neck and keep the handles attached to the ends of the saw close together. The neck is severed after a few firm strokes. Deliver the trunk by traction on the arm with the operator's hand protecting the vagina from cuts from spikes of bone.
- Deliver the after-coming head by grasping the stump with a heavy volsellum. The head can then be brought down and delivered by the Mauriceau-Smellie-Veit manoeuvre as previously described for a breech delivery.
- Skin sutures should be used to restore the anatomy before the baby is wrapped to be shown to the parents.

SECTION 11: Care of The Newborn at Birth And Emergencies in the First Month of Life (IMEESC 3.2 and Integrated Management of Pregnancy and Childbirth. Managing Newborn Problems: a guide for doctors, nurses and midwives. WHO 2003 ISBN 92 4 154622 0 "WHO Newborn")

See "Saving Newborn Lives" Initiative at
www.savethechildren.org/mothers/learn/newborn.htm
See "Safe Motherhood" Initiative at www.safemotherhood.org
See also "Managing Newborn Problems" at www.who.int/reproductive-health/docs/mnp.pdf/

Aims

- Understand the need for preparation, prior to delivery of the baby
- Identify the baby at risk of developing problems at birth
- Recognise the need for resuscitation of the neonate
- Understand the principles of neonatal resuscitation
- Develop the skills needed for effective neonatal resuscitation
- Recognise and manage common problems presenting in the first month of life

Introduction

Infant mortality in under resourced countries runs at an unacceptably high level – the World Health Organisation (WHO) estimates that, worldwide, there are 12000 neonatal deaths per day. Of these, one third are as a result of neonatal infections.

If deaths and long-term or permanent disability are to be avoided, the management of neonatal emergencies must be both coordinated and effective. The care delivered in the first few minutes and hours of life is a major determinant of outcome. The majority of births do not occur in hospitals, so it is important that birth attendants and community nursing teams have the skills to recognise the vulnerable baby prior to delivery, and have the skills to deliver effective care.

Babies are particularly vulnerable during the first month of life, and this section will focus on resuscitation of the newborn and the management of potentially life threatening conditions during the first month of life.

[1] Recognising the baby at risk of developing problems at birth

a. Preterm births

Defined as: less than 37 weeks gestation (or less than 259 days from the first day of the mother's last menstrual period). Maturity matters more than birth weight.

Preventative Strategies may include:

Minimising the risk of surfactant deficiency

- Can be halved if the mother is given a short course of high dose steroid treatment before delivery.
- Give two 12 mg doses IM or oral betamethasone or dexamethasone 24 hours apart, although it may be just as effective to give 6 mg twice a day for 48 hours.

Stopping premature uterine contractions

- Crush a 10 mg nifedipine capsule between the teeth to achieve sublingual absorption. Up to three further doses can be given at 15 minute intervals if uterine contractions persist.
- If this stops labour give between 20 mg and 50mg of a slow release tablet three times a day for the next three days.

Other problems associated with preterm birth

- Even very small babies can survive preterm birth successfully once the early problems associated with surfactant deficiency have been overcome and as long as they are nursed in a **clean environment** and **not allowed to get cold.**
- The main challenge is to give these babies enough milk for them to start growing again as soon as possible without allowing them to choke and inhale milk into the lung. Here too maturity is more important than weight. Babies born before 36 weeks of gestation nearly always need some help with feeding.
- Breast milk is ideal, and everything possible should be done to help the mother 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 of gestation but it remains unpredictable, unreliable and uncoordinated until 36 weeks gestation. In the event that feeding cannot be initiated immediately after birth mothers should be encouraged to start expressing breast milk.

- Partial breast feeding can also help the mother to sustain her lactation but in any event the mother should regularly express milk. Expressing breast milk may be difficult for some mothers.

b. Infection

- Symptomatic ascending infection needs urgent treatment. If this is overlooked, both the mother and the baby's life will be in danger.
- Asymptomatic ascending infection is however a much commoner problem. This occasionally progresses so rapidly once labour starts that, unless treatment is started at once, the baby will die even if the most appropriate antibiotic is given immediately after birth.

- Because a range of bacteria can be involved, treatment needs to protect against group B streptococcal, coliform and Listeria infection, making a **combination of ampicillin and gentamicin** the best strategy.
- Because such infection is, by definition, silent, treatment needs to be considered in any **mother** going into active spontaneous labour before 35 weeks gestation. It should also be considered at *any* gestation if the mother's membranes rupture more than six hours before other signs of overt labour develop (because membrane rupture can be both a sign of, and a risk factor for, ascending bacterial infection). If premature rupture of membranes occurs before the onset of premature labour contractions then infection is more likely.
- What most people mean by premature rupture of membranes (PROM) is really preterm prelabour rupture of membranes (PPROM) where the membranes rupture before there is any overt sign of uterine activity or any detectable uterine contractions. When *this* happens in the preterm baby if is often a sign of the start of some sort of ascending infectious process – a process that has already weakened the amniotic membranes and will, as like as not, eventually stimulate the onset of preterm labour.

[1] In mothers with PPROM who show signs of being clinically infected you give antibiotics.
[2] In PPROM where there is no evidence of infection and no evidence of labour you can delay delivery by a week or more (on average) by giving the mother amoxicillin or, better still, erythromycin.
[3] In mothers who are in active labour five or more weeks before term and who give a clear history that the membranes had ruptured before they were able to detect any uterine contractions the risk of the baby becoming infected during delivery can be reduced substantially by giving antibiotics (ideally probably both penicillin and gentamicin) during labour. The question "how many hours before" does not arise here – you treat every mother coming under your care in active labour five or more weeks before term if it is clear that the membranes had ruptured before there was any other symptomatic evidence that labour had started.

- A maternal temperature in excess of 38°C during labour is an important but uncommon sign of early ascending infection.
- Many of the babies who become infected during delivery develop respiratory symptoms very soon after birth, but in a few the features are those of neonatal sepsis.

c. Hypothermia

Seriously increases the risk of surfactant deficiency and hypoglycaemia and must be avoided.

2. PREPARATION FOR BIRTH

For the majority of deliveries, a minimum amount of equipment is needed. If all the equipment in the box is available, the vast majority of neonates can be successfully resuscitated.

EQUIPMENT NEEDS FOR CARE OF THE NEWLY BORN AND OLDER NEONATES

A clean dry towel
A firm working surface
A good soft well-fitting face mask (size 0/1 and 00)
T piece and manometer/pressure gauge or self inflating bag and reservoir
A source of air or oxygen (it does not need to be oxygen)
A pressure limiting device at 30 cm H_20
A stethoscope
Laryngoscope and set of suitable sized ET tubes (2.5, 3.0 and 3.5mm)
Suction devices: ideally mechanical plus wide bore suction tubes and those suitable for ET tubes
Umbilical venous catheter plus 0.9% saline
Clock
Roll of zinc oxide tape for name-band
Pulse oximeter (ideal)
Heat source

Most babies need very little help to achieve initial lung aeration at birth. A clean dry **towel**, a firm **working surface**, a good soft well-fitting **face mask** (see below), and a source of **air**

or oxygen (it does not need to be oxygen) is all that most full-term babies need. A **pressure limiting devise** is extremely helpful, and can help to ensure that mask pressure can be raised to and held at 30 cm H_20, without inadvertently rising higher than that.

About one term baby in a thousand does not respond to lung aeration with an immediate and easily detectable rise in heart rate. Here a **stethoscope** makes it very much easier to assess whether chest compression is called for.
An estimated one baby in every five thousand will have started to gasp due to hypoxia before birth and inhaled so much particulate matter into the trachea that it has impacted there. Resuscitation here is only possible if the accumulated debris can be removed. The easiest way to do that is to pass an **endotracheal tube** and then remove the debris by direct suction. Blind intubation is possible using a finger but a **laryngoscope** makes it easier to get the tube passed without trauma through the larynx. Nothing tenacious enough to block the trachea will ever be sucked out through such a tube, but suction on the end of the tube will nearly always serve to draw the debris into the tube. The tube can then be removed and the debris blown clear.

A range of simple suction devices can be used if mechanical **suction** is not readily available. Mouth suction can be very effective if no other option exists. A double mucus trap is used for this to prevent infected material being accidentally drawn into the mouth. Suction also occasionally makes it easier to achieve a good view of the larynx during intubation.

An **umbilical vein catheter** and the means to catheterise the umbilicus, together with **saline** or a plasma expander, may make the difference between life and death in one baby in six thousand on the verge of death from acute hypovolaemia. The same catheter can also be used to administer drugs but babies as ill as this seldom make an intact recovery.

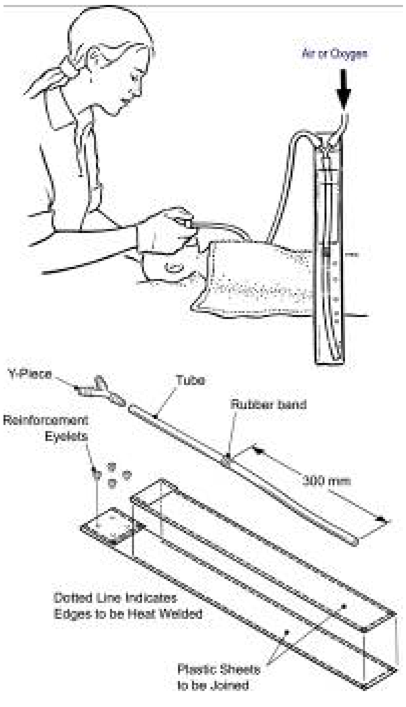
A **clock** will help you document how long resuscitation took.

A roll of **zinc oxide** tape half an inch wide can be used to make a simple name band for babies not delivered in their own homes. Take 6 inches of this tape, write the date and the mother's name at one end, turn the last 2 inches of the other end back on itself (so the tape does not stick to the skin), and then turn this into a simple bracelet round the child's wrist.

Nothing else is really critical, but a **pulse oximeter** can be of great help in picking out the occasional child with sub-clinical cyanosis in need of further evaluation.

Masks

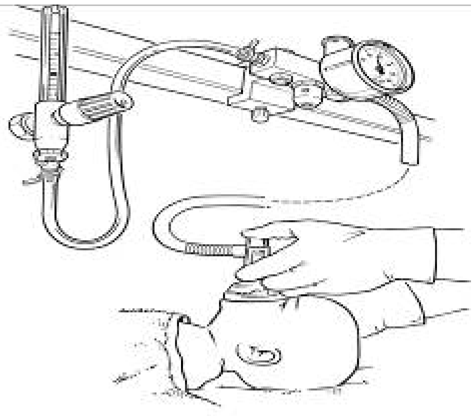
A soft close fitting face mask is *essential.* The Laerdal mask in by far the best studied device (*Lancet* 1985;**i**:207-10), but some other masks brought onto the market since then are probably equally effective. Access to a Laerdal size 0/1 and size 00 mask makes it possible to manage babies weighing as little as 500g or as much as 5000g at birth. The arrival of this mask on the market in 1984 probably did more to simplify neonatal resuscitation than any other single invention in the last twenty years. It provided a near air tight seal between mask and face in a way that had, until then, only been possible by using an endotracheal tube to achieve a seal between tube and larynx. With such a device it finally became as easy to use a mask as an endotracheal tube to administer a *sustained* inspiratory pressure of 25-30 cm H_2O to the fluid-filled lung of a baby in terminal apnoea.



Pressure limiting devices

Pressure to inflate the lung can be provided by squeezing a bag, or by making use of a cylinder (or a piped supply) of air or oxygen. Bag-and-mask devices have been widely used for forty years, and many now come with a pressure over-ride valve. They work very well when used to stimulate the breathing of a baby in primary apnoea, or to ventilate an already aerated lung. They cannot be used with as much confidence to aerate the fluid-filled lung of a baby in terminal apnoea because, unless they are fitted with a pressure manometer, it is difficult to assess just how much inspiratory pressure is being applied.

'Bagless' resuscitation has become increasingly popular in the last 15 years. All that is required is a supply of gas under pressure, a pressure limiting device, and a face mask with T-connector. Such a system leaves both hands free to keep the head optimally positioned, and to hold the mask in place.



Various pressure limitation devices have been used. The simplest is no more than a water column. This simple, easily constructed, device provides both a visual display of the pressure being applied and, at the same time, a safety 'blow off' valve. A weight controlled or magnetised valve works very well, but the use of an adjustable spring-loaded vent and the incorporation of a pressure manometer makes it possible to adjust inspiratory pressure flexibly as required. At least two commercial devices working on this principal are now widely available. The addition of an adjustable flow restrictor into the mask T-piece also makes it possible to control end expiratory pressure – a refinement of particular value when managing the initial stabilisation of a preterm baby.

3. MANAGEMENT AT DELIVERY

Summary of management of the healthy baby at birth

1. Clamp cord when pulsation stopped
2. Prevent hypothermia
3. Early feeding
4. Minimise risk of infection
5. Injection Vitamin K

- Most babies do not need any resuscitation at birth. Mouth suction, face mask oxygen, and vigorous stimulation in order to provoke a first gasp or cry are all pointless rituals that lack any clinical justification.
- Even in a baby born covered in meconium there is no evidence that carefully cleaning of the nose and mouth reduces the risk of meconium being drawn down into the lung. In the few babies where this does happen it almost always occurs before birth as a result of the fetus starting to gasp in response to a period of stress before or during delivery.

Preventing heat loss after birth

- As long as the baby becomes pink, and starts to breathe without distress, most babies must be with their mothers and have a first feed at the breast within minutes of birth.
- Colostrum is extremely nutritious and all mothers should be informed that it is ideal for their baby to feed on this as soon after birth as possible.
- Babies very easily get cold immediately after birth, and using water or oil to clean the skin within four hours of birth before body temperature has stabilised can make the baby dangerously hypothermic (a problem that may well be missed if a low reading thermometer is not used). Nothing is a more effective source of warmth than the mother's own body as long as the baby is first gently dried to minimize evaporative heat loss and mother and baby are then both protected from draught.
  - Heat and water loss through the skin can be a particular problem in babies born before 32 weeks of gestation. This can be limited by wrapping all but the face in a plastic drape for a few hours after birth.
  - Covering the head with a shawl or blanket also reduces heat loss from the head (babies have relatively big heads). Remember, however, that plastic over the face can cause death from suffocation.
- A larger sheet or blanket can be used to protect both mother and child from the convective heat loss caused by draughts.
- Heat supplementation can be provided by locally built and maintained incubators, overhead heating systems and by Kangaroo care.

Managing the placenta, cord and umbilical stump

- Babies often become relatively anaemic 4-6 months after birth because red cell production does not keep pace with body growth. This problem can be minimised by ensuring that blood intended for the baby is not left in the placenta at birth. If the baby is held higher than the placenta while the cord is still pulsating, blood will drain out of the baby and into the placenta. If the cord is clamped before it stops pulsating this will also reduce the normal 'placental transfusion' at birth, especially if the uterus has not yet contracted.
- If, however, blood is artificially 'milked' from the placenta into the baby at birth, it is possible to leave the baby with so many red cells that the blood becomes thick and

polycythaemic. This can put the circulation under strain, make the capillary circulation very sluggish, and increase the risk of jaundice.

- **Wait a minute before cutting the cord if it is still pulsating unless there is an overriding need to start stabilising the baby.**
- Prevention, rather than treatment, is the key. The cord must be cut cleanly in a way that avoids even the slightest risk of tetanus developing, and the cut stump secured in such a way that minimises the risk of late haemorrhage.
- A supply of fresh, disposable, razor blades is one widely adopted strategy in some communities where home birth is the norm. The umbilical stump will shrink as it dries out.
    - Some have tried to minimise the risk of bleeding by leaving a relatively long length of cord attached to the baby and securing this with two tape ligatures.
    - Plastic clamps that shut down further as the cord starts to shrink are very effective. They are relatively inexpensive, and they do make it possible to cut the stump short (about a centimeter from the skin). An elastic band, if carefully applied, is a cheap, and well tried, alternative (*Arch Dis Child* 1964;**39**:630.).
    - A stump that is left long provides a reservoir where bacteria can breed and multiply with great speed.
    - A short stump does not need to be covered except to keep it from snagging on clothes and blankets. It will also wither and fall off quicker if kept dry, left exposed and not routinely treated with any antiseptic lotion or powder.
- A little 'stickiness' is of no concern but a local antiseptic should be applied if a red skin flare suggests early spreading staphylococcal cellulitis. Some of these babies also merit an oral anti-staphylococcal antibiotic. Oral cloxacillin or oral flucloxacillin (25 mg/kg three times a day (<7 days BD, 7-21 days TDS)) is usually the most logical choice. Babies who become systemically unwell need urgent broad-spectrum antibiotic treatment, IV or IM, for incipient polymicrobial septicaemia. Choose a strategy from among the products listed in the short Formulary at the end of the sepsis section.
- Any residual risk of neonatal tetanus can be eliminated by ensuring that all mothers are themselves immunised against tetanus before delivery.

The risk of cross-infection during or after birth

- Puerperal infection ('child-bed fever') is an illness that killed thousands of recently delivered women for more than two centuries. That this could be eliminated if birth attendants washed their hands thoroughly ***every*** time they moved from one woman to the next was shown many years before it was ever realised that this lethal illness was caused by group B streptococcal infection. The coming of antibiotic treatment has reduced the risk of death, but it has not lessened the need for meticulous hand washing. Failure to observe this simple but important precaution also puts the baby at risk of cross-infection, especially if the baby is being cared for in a hospital setting.

- Rotavirus diarrhea in the neonatal period is seldom lethal, but it can be very debilitating.
- The World Health Organisation estimates that infection is responsible for a third of all neonatal death (over 4000 deaths a day).

Hazardous birth rituals

- One misguided tradition that lasted for much of the twentieth century was a policy of separating mothers from their babies, and of herding all the babies into a single small side room for several hours each day and for most of the night as well. The Baby Friendly Initiative of UNICEF and WHO encourages the keeping of babies with their mothers at all times.
- Another is the discarding of colostrum with the view that is harmful for the baby. A failure to permit the baby to drink colostrum can lead to hypoglycaemia.

Effect of normal, vaginal delivery on a normal, term baby

- At the onset of labour, the lungs are full of fluid
- Labour encourages reabsorption of lung fluid. About 35 mls of fluid are expelled from the lungs during labour
- The first spontaneous breaths generate relatively high pressures to inflate lungs
- These first breaths establish the baby's functional residual capacity
- Surfactant is produced in the alveoli to prevent them collapsing during expiration. Production starts at 20 weeks gestation, and increases rapidly from 30-34 weeks.
- Caesarean section delays clearance of pulmonary fluid and reduces the initial functional residual capacity
- Surfactant production is reduced by hypothermia, hypoxia and acidosis

4. STABILISING THE TERM BABY AFTER BIRTH

Very few term babies need active 'resuscitation' at birth. Most will rapidly cry and expand their lungs without any help at birth, and attempts to clear the airway, to stimulate breathing, or to give facial oxygen do not really serve any useful purpose. Babies also make all the circulatory adjustments required at birth without external intervention. All that the birth attendant has to do is to optimise the conditions needed for these changes to occur smoothly. To call such support and assistance 'resuscitation' risks leaving parents with the mistaken belief that their baby was in serious difficulty at birth.

The same is not true of the occasional shocked, limp, hypotonic baby. Here the tongue and jaw may well fall back, close off the back of the mouth, and obstruct breathing. The airway then needs to be managed in much the same way as it is in any unconscious or anaesthetised patient.

More seriously, one term baby in every three thousand has become so stressed during delivery that the heart and circulation will not pick up, even after air has been going into the lungs, without further help.

BABIES ARE NOT SMALL ADULTS

- Babies and adults have different needs during resuscitation. They also respond differently. In babies it is the 'pump' responsible for getting air in and out of the lung that usually fails first, while the pump responsible for sending blood round the body is still active.
- The lung is also initially full of fluid.
- In adults it is the heart that almost always fails first. As a result resuscitation has to concentrate on restarting the circulation, although breathing may also need attention as well if anoxia has affected the medullary centre in the brain responsible for respiration. The adult brain is very sensitive to lack of oxygen, and is generally held to suffer damage within 4 minutes if completely deprived of oxygen. The heart is also more vulnerable to lack of oxygen because it lacks the stores of glycogen always present at birth.
- Sudden collapse in adult life is usually due to some heart problem – commonly myocardial infarction, or pulseless arrhythmia, or both. Breathing then stops because oxygen is no longer being delivered to the brain. As a result any resuscitator has to try and mimic the action of both the heart and the lungs, preserving blood flow to the brain and to the heart. Once these immediate needs have been met it is then necessary to diagnose and treat the underlying heart problem. Defibrillator treatment can be critical, and drug treatment may also be important. None of this true in the newborn baby, where significant arrhythmia is never a problem, and the heart is never the first 'pump' to fail.

- Effective chest compression is also much easier to achieve in a baby than in an adult. The relative size of the heart, and the more pliable nature of the cartilaginous rib cage, both help to make compression more effective. Less also needs to be achieved. During adult cardio-respiratory resuscitation there is a need to continue delivering oxygen to the brain as well as the heart. In the baby it is only necessary to ensure that oxygenated blood gets to the coronary arteries and to the muscle of the heart.

SECTION 11 Quiz 1

1) With regard to newborn babies which of the following statements are true?

a) birthweight matters more than maturity as a risk factor for developing problems at birth
b) premature babies are more vulnerable to hypoglycaemia
c) antibiotics should not be given to newborn babies unless there is proven infection in them
d) most newborns need drying and keeping warm – only a few will need resuscitation
e) waiting to clamp the cord until it stops pulsating may reduce the risk of anaemia in the baby when 4 – 6 months old

ANSWERS: 1) b,d,e

Resuscitation Council (UK) RESUSCITATION GUIDELINES 2005

Main changes that have been made to the Neonatal Life Support (NLS) guidelines

- The use of food-grade plastic wrapping is recommended to maintain body temperature in significantly preterm babies.
- Attempts to aspirate meconium from the nose and mouth of the unborn baby, while the head is still on the perineum, is no longer recommended.
- Ventilatory resuscitation may be started with air. However, where possible, additional oxygen should be available if there is not a rapid improvement in the infant's condition.
- Adrenaline should be given by the intravenous or intraosseous route, as standard doses are likely to be ineffective if given via a tracheal tube.
- If there are no signs of life after ten minutes of continuous and adequate resuscitation efforts, then discontinuation of resuscitation may be justified.

Sequence of actions during resuscitation of the newly born

FIRST Keep the baby warm and assess

Babies are born small and wet. They get cold very easily, especially if they remain wet and in a draught.

- Whatever the problem, first make sure the cord is securely clamped and then dry the baby, remove the wet towels, and cover the baby with dry towels.
- For significantly preterm babies (30 weeks and below), there is now good evidence that placing the baby under a radiant heater and, without drying the baby beforehand, immediately covering the head and body, apart from the face, with food-grade plastic wrapping, is the most effective way of keeping these very small babies warm during resuscitation or stabilisation at birth.
- Drying the baby will provide significant stimulation and will allow time to assess colour, tone, breathing, and heart rate.

Reassess these observations regularly (particularly the heart rate) every 30 sec or so throughout the resuscitation process. The first sign of any improvement in the baby will be an increase in heart rate.

Consider the need for help; if needed, ask for help immediately.

- A healthy baby will 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 newborn baby is about 120-150 beats min1), and will rapidly become pink during the first 90 sec or so. A less healthy baby will be blue at birth, will have less good tone, may have a slow heart rate (less than 100 beats min-1), and may not establish adequate breathing by 90-120 sec. An ill baby will be born pale and floppy, not breathing and with a slow or very slow heart rate.
- The heart rate of a baby is best judged by listening with a stethoscope. It can also be felt by gently palpating the umbilical cord but a slow rate at the cord is not always indicative of a truly slow heart rate - feeling for peripheral pulses is not helpful.

Second Airway management A Keep the airway open

- Before the baby can breathe effectively the airway must be open.
- The best way to achieve this is to place the baby on his/her back with the head in the **neutral position**, i.e. with the neck neither flexed nor extended. Most newborn babies will have a relatively prominent occiput, which will tend to flex the neck if the baby is placed on his/her back on a flat surface. This can be avoided by placing some support under the shoulders of the baby, but be careful not to overextend the neck.

- If the baby is very floppy it may also be necessary to apply chin lift or jaw thrust.

Notes:

The best way to stabilise a baby's condition at birth is to ensure that the upper airway remains unobstructed. The child will then have little difficulty in drawing air into its lung for itself 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 baby is going to find it difficult to breathe unless all the fluid and mucus is first sucked out of the way. There is almost no evidence that this is ever necessary. **Moreover, blind deep suction of the nose or mouth can stimulate the vagus nerve leading to bradycardia and laryngospasm.**

However, the upper airway of any baby who is born limp and hypotonic certainly needs to be maintained and secured 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 patients are laid on their back the tongue also falls back, further obstructing the airway. The three key ways to counter this are to:

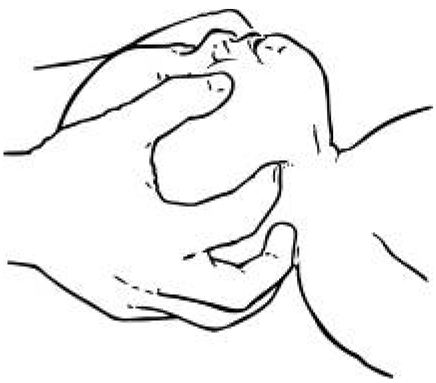
- hold the head in the neutral position and
- support the chin or
- push the jaw forward.

NEUTRAL POSITION

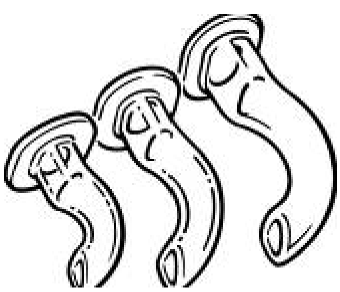
Because of molding, most babies have quite a prominent occiput at birth. Lying supine (on their back) on a flat surface, the neck becomes flexed, and the airway becomes obstructed. Exactly the same thing can happen if the neck is over-extended. The aim is to ensure that the head is in a 'neutral' position – a posture most easily achieved by placing a small (2cm) pad under the baby's shoulders.

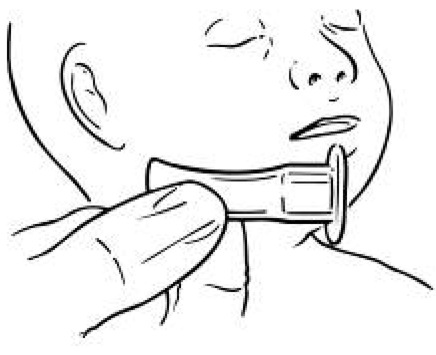
If tone is poor it may also be necessary to support the chin. It is important to support the bony part of the chin. Pressure anywhere else may merely push the base of the tongue backwards, making matters worse.

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, in order to push the jaw forwards and outwards ('jaw thrust').



JAW THRUST





Correct Size

A Guedal oro-pharyngeal airway (Mayo tube) may be of help, especially if the jaw is small or there is some other oro-facial abnormality. Choose an airway that reaches the angle of the jaw when the flange is under the nose, and make sure it passes over the tongue and does not merely push the tongue further back. Put the airway into the mouth in the way you want it to lie after insertion – do not turn it round during insertion as is generally done when using such an airway in an adult.

Although it is rare for debris to totally block the trachea such a problem should be suspected if a baby tries to breathe but remains cyanosed and bradycardic, with laboured breathing and marked inter-costal and/or sub-costal recession. This is one of the few situations where tracheal intubation can be life saving at birth.

Meconium A large multicentred, randomised, controlled study1 has shown that attempts to aspirate meconium from the nose and mouth of the unborn baby while the head is still on the perineum (so-called intrapartum suctioning) does not prevent meconium aspiration syndrome and this practice is no longer recommended.

Another large multicentred randomised, controlled study2 has shown that attempts to remove meconium from the airways of vigorous babies after birth also fail to prevent this complication.

However, if babies are born through thick meconium and are unresponsive (or ‘not vigorous’) at birth, the oropharynx should be inspected and cleared of meconium. If intubation skills are available, the larynx and trachea should also be cleared. It is acknowledged that no proof of the efficacy of this practice exists.

What to do if the trachea seems blocked

- If a baby passes meconium before birth and stress then also causes the baby to gasp, there is a risk of meconium being drawn down into the lung. This can certainly cause an inflammatory reaction, making the baby oxygen dependent for some days after delivery, but meconium itself seldom blocks the trachea, and elective intubation and direct tracheal ‘toilet’ at delivery does not seem to reduce the risk of a subsequent chemical pneumonitis.
- Thick particulate debris can, however, rarely cause tracheal obstruction. Greasy vernix, a lump of gelatinous postnasal mucus, a congealed blood clot, and thick particulate meconium, have all been found to cause laryngeal obstruction on occasion. Such debris is

never going to be drawn up any standard suction catheter threaded into an endotracheal tube. The best that can be done is to insert an endotracheal tube as far into the trachea as possible, apply mechanical suction to the end of this tube, draw some of the material into the tube, and then remove the tube and blow it clear. Such a manoeuvre may need to be repeated 2-3 times. Luckily, experience suggests that such a problem will only be encountered once in every 5000 births at most.

Third Breathing B

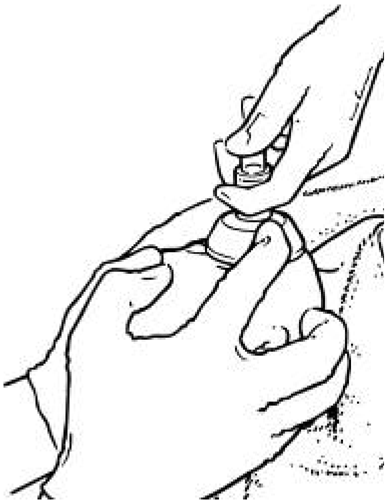
- If the baby is not breathing adequately by about 90 seconds **give 5 inflation breaths.** Until now the baby's lungs will have been filled with fluid. Aeration of the lungs in these circumstances is likely to require sustained application of pressures of about 30 cm of water for 2-3 sec – these are 'inflation breaths'.
- If the heart rate was below 100 beats min-1 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. If the heart rate increases but the baby does not start breathing, then continue to provide regular breaths at a rate of about 30-40 min-1 until the baby starts to breathe.
- If the heart rate does not increase following inflation breaths, then either you have not aerated the lungs or the baby needs more than lung aeration alone. By far the most likely is that you have failed to aerate the lungs effectively. If the heart rate does not increase, and the chest does not passively move with each inflation breath, then you have not aerated the lungs.

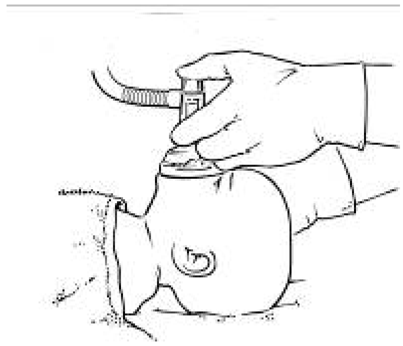
Consider:

o Is the baby's head and neck in the neutral position?
o Do you need jaw thrust?
o Do you need a longer inflation time – correct time is 2-3 sec inspiration?
o Do you need a second person's help with the airway?
o Is there an obstruction in the oropharynx (laryngoscope and suction under direct vision)?
o What about an oropharyngeal (Guedel) airway?

Mask inflation of the lung

Having positioned the baby correctly it is then usually quite easy to use mask pressure to encourage lung aeration, and then control breathing – should that be necessary.





If the baby is unusually limp the help of a second person may make management easier. Aerating the fluid-filled lung at birth is usually achieved by the *negative* pull of the child's rib cage. It takes a *positive* pressure of about 30 cm H_2O sustained for 2-3 seconds to achieve much the same thing, and it may take 4-5 such breaths to achieve reasonably even aeration. In that brief time much of the 100 ml of fluid that the average 3 kg baby has in its lung at birth is transferred into the lung's lymph channels and the interstitial tissue spaces.

Bag-and-mask pressure can achieve the same thing as mask pressure delivered using a constant flow of gas and a variable pressure valve. However it is not possible to control the pressure applied with anything like the same precision with a bag-and mask-device unless the bag is fitted with a pressure manometer. *Remember that you cannot breathe through the bag valve mask system and so do not leave the mask sealed to the face and expect the baby to breathe from the bag. The valve between the bag and mask prevents this.*

Most babies will respond to any inflationary maneuver of this type by gasping and then coming round 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 per minute as soon as it has. If lung aeration has been achieved and the baby does not quickly start to breathe proceed to circulation C

There is incontrovertible evidence that even babies in terminal apnoea can be resuscitated using mask resuscitation and chest compression without any need for tracheal intubation. Staff should not worry, therefore, that they are not going to be able to manage a terminally ill baby on their own without further support, just because they have never been taught, or had a chance to undertake, tracheal intubation. The only real advantage of intubation in a situation as serious as this is that, once the trachea has been intubated, it is easier to ask a second person to continue to support respiration while the most experienced person present starts to deal with the C and the D of resuscitation.

Should one use air or 100% oxygen for resuscitation of the newborn?

Concern about possible injurious effects of excess oxygen, particularly in preterm infants, and the apparent effectiveness of air in some limited, randomised, controlled, human studies of resuscitation at birth, has resulted in a minor change in the guidelines.

There is no evidence to suggest that any one concentration of oxygen is better than another when starting resuscitation. Some clinicians may wish to start with air. However, where possible, it is recommended that additional oxygen should be available for use if there is not a rapid improvement in the infant's condition. Equally, hyperoxia should be avoided, especially in the preterm infant.

Mouth to mouth resuscitation

Most current guidelines on neonatal care steer clear of discussing the role of mouth-to-mouth resuscitation, and the risk of AIDS or hepatitis has further fueled that reluctance. However there is no doubt that this can be a very effective way of reviving an apparently lifeless baby. More importantly, unlike all the other strategies being discussed here, it requires no equipment. Just remember to –

- Keep the upper airway open by optimising the position of the head and jaw as described above.
- Cover the baby's nose and mouth with your mouth (or close the mouth of a big baby and just pinch the nose).

- Use the pressure you can generate with your cheeks, and try to aerate the lung by sustaining that pressure 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 baby).
- 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 a minute.

One possible way of using this approach and avoid the risk of infecting the healthcare worker is to train mothers prior to delivery in how to achieve this on a manikin.

Check progress before moving on

- If the heart rate has **not** risen to about 100 beats per minute within 20 seconds of initial lung aeration something is wrong. ***Never*** move on to deal with the issues covered under letter C of the resuscitation alphabet until you are quite sure you have achieved objective A and B. To do so is quite futile - chest compression will never restore the circulation until the blood being massaged from the lung to the heart contains oxygen.
- Look and see if the chest moves each time you apply mask pressure. Movement should not be difficult to see once the first few breaths have aerated the lung. It is usually easier to judge success with your eyes than with a stethoscope.
- Go back and check that the child's head is well positioned. Check chin support and jaw thrust. Ask a second person to help you position the baby optimally.
- Few babies 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 lung and then continue breathing adequately.
- A few may, however, benefit from further support if they do not start to breathe regularly, or only gasp occasionally. Some may be limp and hypotonic, 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 per minute) and that there is no central cyanosis (best judged by looking at the colour of the tongue).
- If breathing is laboured, or irregular, or the child's colour remains grey or blue, try and assess whether there is hypoxaemia with a pulse oximeter. The aspiration of liquor or meconium into the lung before birth can also render a baby oxygen dependent. Other

possibilities include intrapartum pneumonia, diaphragmatic hernia, choanal stenosis, pneumothorax, and, more rarely, pulmonary hypoplasia (possibly associated with a skeletal or renal abnormality). Cyanotic congenital heart disease is another possibility, although this usually takes a little time to appear. Hypoxaemia can also be the first sign of persistent fetal circulation. You should be able to achieve a saturation of at least 95% when the child is breathing 100% oxygen if there is no right-to-left shunt. Many babies continue to be given oxygen for a few minutes after birth when this is really not necessary. In contrast, many of the small number who really do need continuing supplemental oxygen are often only recognised to be in need of this when they have already become quite ill.

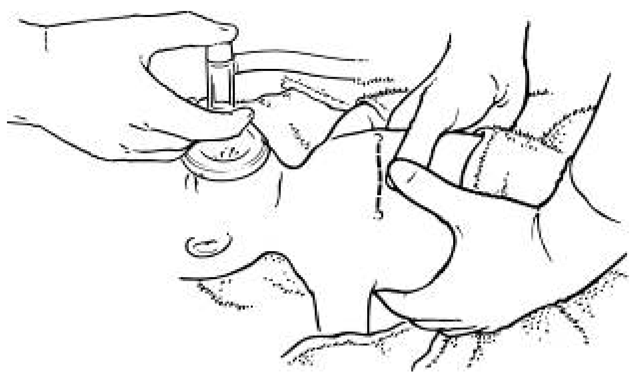
- If breathing does require continued support, try and reduce mask inflation pressures to little more than half of what was needed to aerate the lung in the first place. It is not difficult to over-ventilate a baby with healthy lungs and to wash out so much of the carbon dioxide that normally provides the main stimulus to breathing that all such activity stops for a while. There is also increasing evidence that sustained over-ventilation can seriously reduce cerebral blood flow.

Preterm babies

- Babies with surfactant deficiency may have difficulty in expanding their lungs, and in developing a normal ‘cushion’ of trapped lung gas (functional residual capacity, or FRC), at birth.
- The preterm lung is, however, quite a delicate structure with relatively little elastic support, and any use of undue pressure during resuscitation can initiate what later becomes a cascade of barotrauma.
- While an inspiratory pressure of 30 cm H_2O may well be necessary to aerate the lung at birth, such pressure is best not applied too abruptly, and should be reduced as rapidly as possible after that. 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 cm H_2O of positive end expiratory pressure (PEEP) consistently. Aim to achieve this, not only during initial stabilisation at delivery, but also during transfer to, and care in, the nursery. Where this can be achieved using nasal prongs or a nasal mask (nasal PEEP) it may be possible to avoid tracheal intubation altogether.

Fourth Circulation C Chest compressions

- If the heart rate remains slow (less than 60 min-1) or absent following 5 inflation breaths, despite good passive chest movement in response to your inflation efforts, start chest compression. Almost all babies 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 have been aerated successfully.
- In babies, the most efficient method of delivering chest compression 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.
- 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 ratio of compressions to inflations in newborn resuscitation is 3:1.**
- Chest compressions move oxygenated blood from the lungs back to the heart, into 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. Allow enough time during the relaxation phase of each compression cycle for the heart to refill with blood. Ensure that the chest is inflating with each breath.



- It is not possible to compress the chest effectively more than about 60 times a minute because sluggish venous return delays atrial filling.

Fifth Drugs D

In a very few babies inflation of the lungs and effective chest compression will not be sufficient to produce an effective circulation. In these circumstances drugs may be helpful.

Drugs are needed only if there is no significant cardiac output despite effective lung inflation and chest compression.

The drugs used are adrenaline (1:10,000), sodium bicarbonate (ideally 4.2%), and dextrose (10%). They are best delivered close to the heart, usually via an umbilical venous catheter or, failing that, by direct cardiac puncture (only by those trained in this). Unfortunately, most of the babies in whom cardiac output only returns after treatment with bicarbonate do not survive to discharge, and most of those who do survive later develop profound disabling spastic quadriplegia. Many would question the wisdom of persisting with resuscitation when the outlook is as bleak as this in many health care settings. It follows, therefore, that drug treatment has a very limited role during neonatal resuscitation.

Where the cause of the child's terminal apnoea is a sudden, and much more abrupt, asphyxial 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, if the circulation can be restarted, is much less bleak.

Acidosis not serious enough to precipitate circulatory standstill will nearly always correct itself spontaneously within 90 minutes once the circulation has been restored and the baby starts to breathe for itself. It does not, therefore, usually call for artificial correction. Indeed doing this only increases the amount of sodium that the potentially compromised kidney will need to excrete over the next few days.

- **Adrenaline:** The recommended dose for adrenaline is 10 microgram kg-1 (0.1 ml /Kg of 1:10,000 solution). If this is not effective a dose of up to 30 microgram/ Kg (0.3 ml/Kg of 1:10,000 solution) may be tried. *A solution of 1 in 10,000 adrenaline should* *be made up and available in all delivery areas.* Do not use a higher dose by these routes as it is harmful.

- **Sodium bicarbonate:** The dose for sodium bicarbonate is between 1 and 2 mmol /Kg (2 to 4 ml of 4.2% bicarbonate solution). **This *has* to be given intravenously; giving it into the trachea would cause a lethal chemical burn.** Indeed it really has to be delivered into the heart itself (either by direct puncture or through an umbilical catheter) to be effective when there is complete circulatory standstill.
- **Glucose**: The dose of glucose recommended is 200 mg/Kg (2 ml/Kg of 10% dextrose). Higher doses can lead to hyperglycaemia which is associated with cerebral oedema and cerebral haemorrhage. It is known that severe hypoglycaemia is rare immediately after birth, but tends to present after 1-2 days. However, hypoglycaemia **(less than 2.5 mmol/litre (45mg/dl)** is a potential problem for stressed or asphyxiated neonates, so its use should be considered in cardiac arrest, as the heart will not recover in the presence of hypoglycaemia. This should be followed by an infusion of 5ml/kg/hour of 10% glucose, until feeding is well established.
  The **route** of administration is IV, but glucose may also be given in the same dose via NG tube (10% solution) if the baby is not feeding well.
- **Naloxone** can be used to reverse profound opiate induced respiratory depression, but has no real role in neonatal resuscitation. If it does prove necessary, give it intramuscularly, and give a full 200 microgram 'depot' dose irrespective of body weight. If naloxone is given intravenously it is likely to be eliminated from the body six times as fast as the opioid drug causing the respiratory depression.

No other drug has ever shown itself to be of any use during neonatal resuscitation.

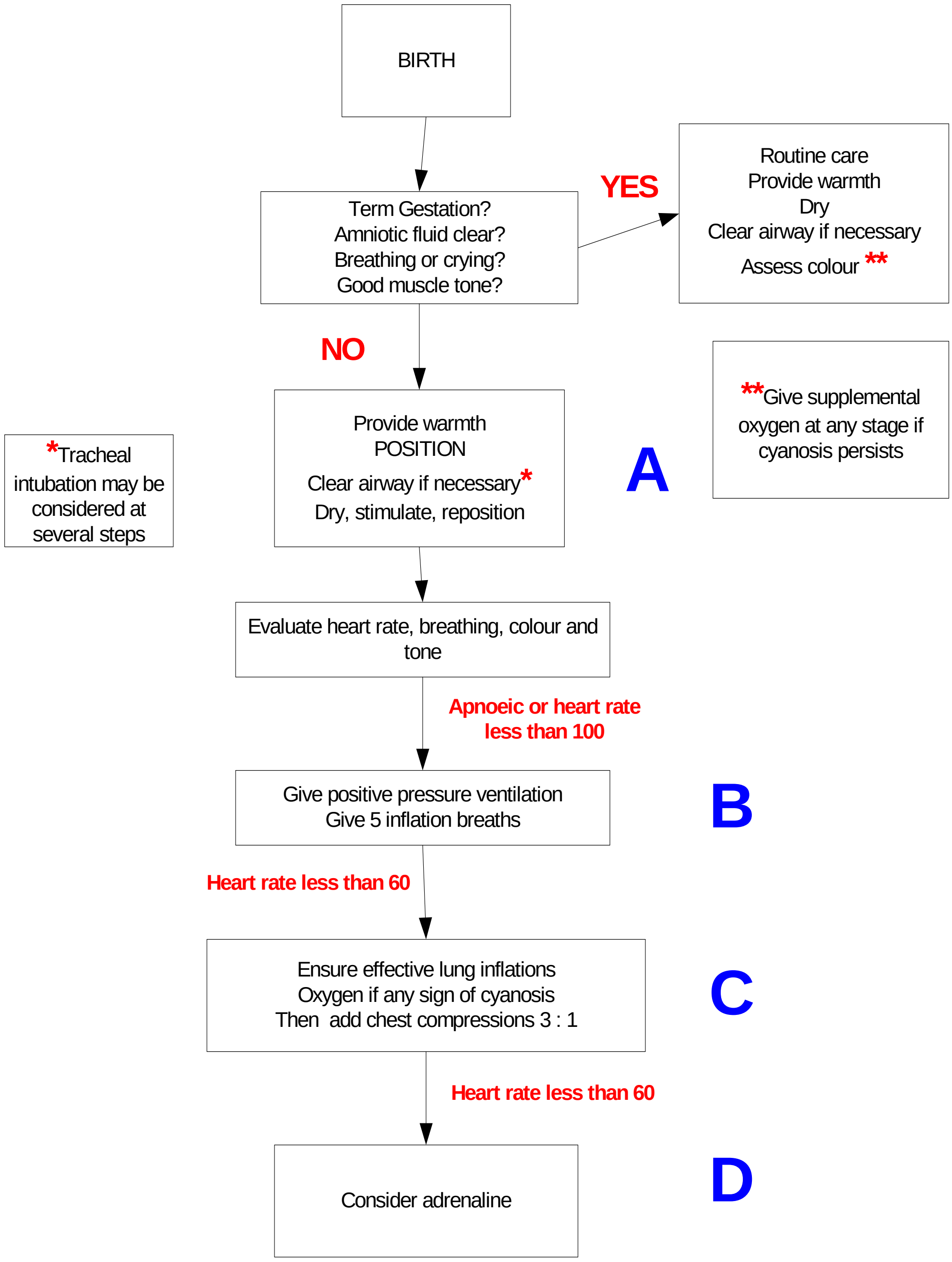
Acute blood loss as a cause of circulatory arrest (circulatory volume support)

- Sudden acute blood loss is rare, but often unrecognised, cause of acute circulatory collapse. Bleeding from an aberrant placental blood vessel (*vasa praevia*) can rapidly lead to hypovolaemic death. The response to a rapid, generous, infusion of any intravenous fluid can be equally dramatic. Speed is of the essence. Circulatory collapse probably does not occur until the baby has lost between 30 and 40 ml/kg of blood, but 20 ml/kg of 0.9% sodium chloride ('normal saline') will usually reverse the immediate critical hypovolaemia rapidly. The initial intravenous fluid bolus should be **10 ml/kg** of **0.9% saline**, and **this can be repeated ONCE** if there is no immediate response, or only minimal response. So can plasma albumin, or some artificial plasma expanding agent (such as gelatin). A packed red cell transfusion using group O Rh-negative blood can be given later to correct the associated anaemia.

- 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. There are reports suggesting that placental abruption can also occasionally cause fetal blood loss. Partial cord occlusion can occasionally obstruct the umbilical vein while blood flow from the baby to the placenta remains uninterrupted causing acute unrecognised hypovolaemia. The resultant circulatory arrest and bradycardia does not respond to any of the maneuvers commonly used during resuscitation, but does respond promptly to volume replacement.

Aside from these specific indications 'volume' should not be used during neonatal resuscitation. There is no evidence to suggest benefit from this, and routine use only compounds the problem of fluid balance that can develop over the next 2-3 days if severe intrapartum stress causes secondary renal failure.

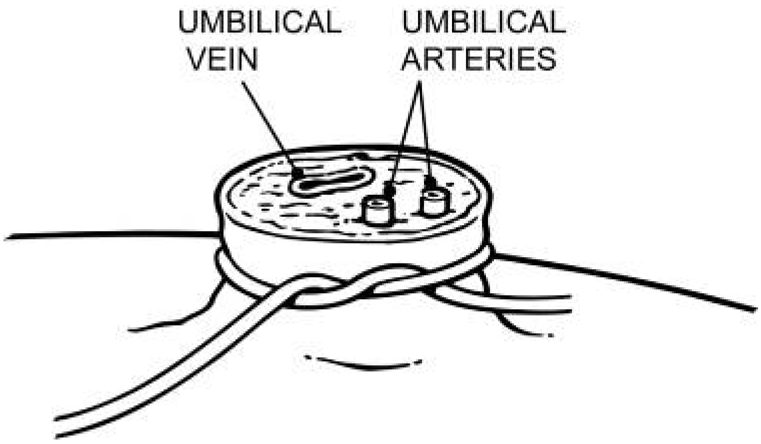
Newborn Resuscitation Algorithm (Resuscitation Council 2005)



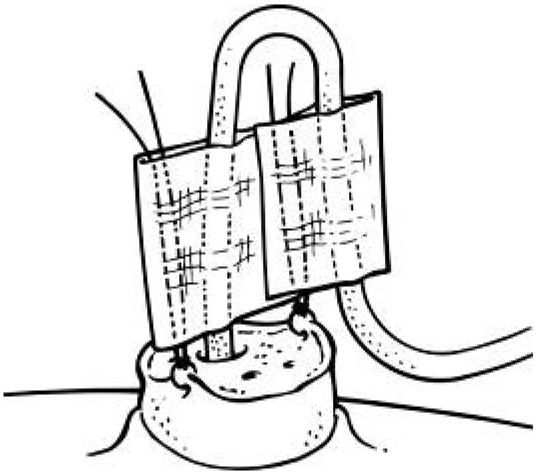
Umbilical catheterisation

The only quick way of correcting hypovolaemia in a shocked baby at birth is to catheterise the umbilical vein. When circulation is at a standstill such a catheter also provides a route for delivering drugs to the heart (although such a catheter does not always pass up through the *ductus venosus* to enter the right side of the heart). The essential steps are as follows –

- Place a loose cord ligature round the base of the cord (tightening and securing this later as necessary).
- Cut the cord about one centimetre from the skin in a single clean stroke using a sharp scalpel or a razor blade (a saw like action can leave the edge of the vein jagged and hard to cannulate).



- Identify the three cord vessels. The thin-walled vein is usually in the upper right quadrant (towards the head end of the baby). The two stiff, white, contracted, bloodless arteries (which pass down the abdominal wall to join the iliac arteries) are usually in the two lower quadrants.
- Take an end-hole umbilical catheter and attach it, via a 3-way tap, to an empty 2 ml syringe.
- Take hold the edge of the vein with fine artery forceps and thread the catheter in far enough for blood to flow back easily. If you are able to advance the catheter 10 cm in a 3 kg baby the tip has probably just entered the tight atrium (7cm is a more appropriate distance for a 1 kg baby). Never force the catheter if resistance is encountered in the first 2-3 cms. Ideally check position with Xray or ultrasound.
- Take a blood sample for haematocrit if facilities allow, and then give any emergency drug or fluid as required.



- Ensure that no air bubbles are present in the catheter by with drawing some blood. Then flush the catheter with saline to maintain patency, and secure the catheter in place with two sutures and tape as shown.

- The whole procedure should be done as cleanly as possible although, in a real emergency, there is no time to adopt a full aseptic technique.

Sixth ENVIRONMENT E

- This is always an issue at risk of being overlooked. It is really the ***first*** issue that ought to receive attention, both in those babies who are healthy, and in those in need of stabilisation, at birth.
- A CLEAN environment is the first objective.
- A WARM environment is the second. It only takes a few seconds to dry the baby and provide a clean dry blanket for warmth. If the room in which delivery occurs is clean, warm, and free of draughts this is also a great help.
- Small babies in particular rapidly become cold, especially if left wet, and cold stress can be lethal. Enclosing the trunk and the limbs in a clear plastic drape or bag can greatly reduce evaporative heat loss. Indeed, babies born more than 10 weeks early have skin that is so thin that it is not really 'waterproof' and this will cause excessive evaporative heat loss to persist for several days after birth.

Seventh FAMILY F

- If you are on your own, the mother's needs come first – most babies are quite good at looking after themselves.
- If you are not on your own things are much easier, and this 'ABC' summary really only comments on the care that should be given to the baby. Remember that parents need to be told what is happening. They will fear the worst, even if the baby was only taken away from them for a few minutes at birth.

- Some babies need to be stabilised at birth but few need to be resuscitated. If you tell parents that their baby needed 'resuscitation' at delivery, then they may well start to think that their child was in the process of dying. That may well make you feel that you have done something useful, and it may make the parents very grateful. However, it will also make them feel that something must have gone 'wrong' during delivery, and it may well lead them to worry that their child could be 'brain damaged' as a result. The words we use matter. Parents can easily read meanings into them that we never intended.
- Write down what you saw and did, distinguish fact from opinion, and make no assumption as to causation. Use adjectives with great care, and do not make judgmental comments on the actions of others.

Poor response to resuscitation

If the baby either fails to respond, or makes a poor response to resuscitation, the most likely problem is inadequate oxygenation. The following steps should be taken:

- Check the airway and ventilation
  - Check for technical faults if using equipment
    - Is the oxygen attached?
    - Is the airway blocked?
    - has the correct size of oropharyngeal airway been selected?
    - Is the endotracheal tube in the correct place?
  - Re-examine the chest to see if a pneumothorax has developed – this is not uncommon, but seldom causes a problem. Drain a tension pneumothorax with a small cannula over needle (21 gauge) in the second intercostal space in the mid-clavicular line
  - Consider the possibility of a congenital heart lesion if the baby remains cyanosed, despite breathing and a good heart rate
  - Consider the possibility of maternal opiates or anti-hypertensive sedation such as diazepam or phenobarbitone if the baby is pink, well perfused, but requires assisted ventilation
  - Severe anaemia, caused by blood loss, should respond to a rapid bolus of **10 to 20ml/kg of O-ve blood.**
  - **Consider hypoglycaemia**

Stopping resuscitation

Even with the most effective resuscitation, not all babies will survive. The prognosis is poor if the baby has been without a cardiac output after 10 minutes of resuscitation. If the baby does not respond in spite of effective ventilations and chest compressions, the outcome is unlikely to be altered by use of drugs, although these should be considered. The decision to stop resuscitation should be taken by the most senior health worker present, and the reason for the decision should be clearly documented.

Documentation

It is important to keep accurate records of the steps taken during resuscitation, so that the reason for any decision is clearly documented, including the decision to start as well as 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 timings and the impact they had on the baby's progress.

Remember to sign and date the record.

Vitamin K

Following resuscitation/stabilisation of the newborn ALL should receive 1mg Vitamin K intramuscularly (NOT INTRAVENOUSLY AS IM INJECTION PROVIDES A DEPOT OVER MANY WEEKS) to prevent possible haemorrhagic disease of the newborn.

SECTION 11 Quiz 2

1) Regarding resuscitation of the newborn which of the following statements are true?

a) the primary problem is usually of cardiac origin
b) most newborn babies need supplemental oxygen for the first few minutes of life
c) the principles of resuscitation differ depending on the cause of the problem
d) drugs are rarely needed
e) an airway containing mucus often causes a problem in the newborn unless cleared by suction

2) Put the following in the order 1 – 5 which you would resuscitate a newborn

a) give drugs
b) breathing
c) airway
d) dry and assess
e) circulation

3) If the newborn is not breathing on initial assessment which of the following statements are true?

a) the head should be placed in the neutral position
b) if airway opening manoeuvres have been ineffective, an oropharyngeal airway may help open the baby's airway
c) initial breathing support should include 5 inflation breaths each sustained for 2 – 3 seconds duration
d) inflation breaths can be assumed to be effective if the heart rate increases
e) chest compressions should be started at a rate of 5 chest compressions to 1 breath if the heart rate is less than 60 bpm

ANSWERS: 1) d 2) 1 =d, 2= c, 3 = b, 4 = e, 5 = a 3) a,b,c,d (e should be 3compressions to 1 breath)

5. COMMON EMERGENCY PROBLEMS IN THE FIRST MONTH OF LIFE

MANY EMERGENCIES CAN BE PREVENTED BY ATTENTION TO INFECTION PREVENTION, ADEQUATE WARMTH AND GOOD FEEDING PRACTICES.

The aim of this section is to

- Recognise and understand the principles of managing breathing difficulties in the newborn and be aware of the treatment of common causes of respiratory problems
- Recognise and understand the causes, effects and management of conditions causing circulatory problems in the new born
- Recognise and understand the causes and management of conditions affecting the conscious level of a newborn baby

Essential equipment list

Oxygen and low flow-meters Incubators or other forms of warming babies (kangaroo care blankets, over-head heaters) Head boxes Suction systems Self inflating bag and set of masks Phototherapy system (Pulse oximeter) (Nasal CPAP) Simple icterometer Blood glucose sticks WHO Hb sticks Sterile instruments for UVC catheter

DRUG USE IN THE NEWBORN BABY

Relatively few drugs are needed to deal with most common neonatal emergencies. All the products listed as capable of being given by intramuscular injection (IM) in this section can also be given intravenously (IV) unless otherwise stated. The IV route should always be considered if the child is already being given IV glucose or glucose with saline, because this can reduce the amount of pain to which the child is subjected. There are dangers associated with rapid administration however, and breaking into an existing IV line can increase the risk of sepsis. Erecting an IV line merely to administer drugs also risks exposing the child to a dangerous fluid overload unless a syringe pump can be used to control the rate at which fluid is infused.

BREATHING PROBLEMS

Breathing problems are particularly common in the period immediately after birth.

Features of respiratory distress in the newborn include

- Tachypnoea (rate > 60 /min),
- Recession of the chest wall and sternum
- Expiratory grunting
- Nasal flaring
- Prolonged apnoea
- Gasping
- Tachycardia
- SaO_2 < 94% in air
- Cyanosis is a relatively late presentation of a respiratory cause, but may reflect a cardiac cause

These signs are relatively non-specific and as well as conditions affecting the respiratory system can result from cardiac, neurological and metabolic abnormalities.

Causes of respiratory distress in the newborn

Common

- Lack of surfactant causing respiratory distress syndrome in the pre-term baby
- Infection acquired before or during delivery
- Transient tachypnoea of the newborn (wet lung)

Less common

- Meconium aspiration
- Persistent pulmonary hypertension of the newborn
- Pneumothorax

Rare

- Pulmonary hypoplasia
- Congenital abnormalities e.g. diaphragmatic hernia, choanal atresia, tracheo-oesophageal fistula
- Respiratory distress syndrome in the term baby
- Pulmonary haemorrhage

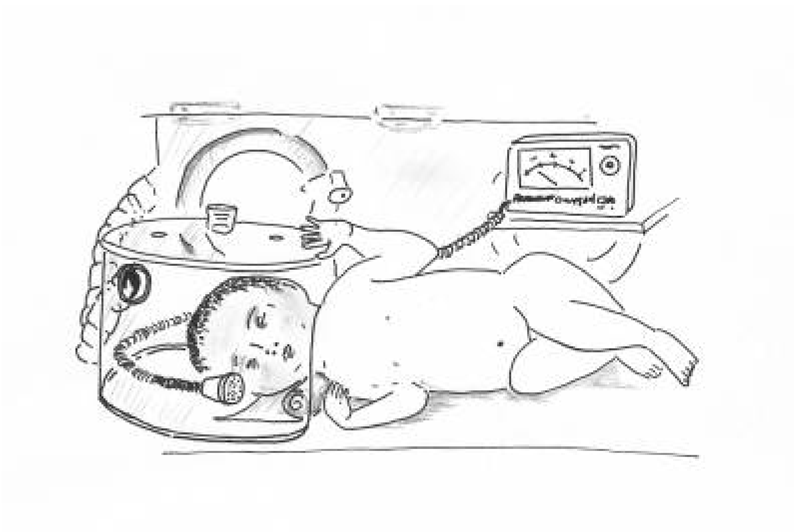
Non-respiratory

- Cardiac lesions
- Intra-cranial pathology
- Severe anaemia

General approach

Certain general principles underpin all management -

- Assess **Airway** and **Breathing**
- Babies should be offered enough supplemental oxygen to avert any suggestion of central cyanosis. Pulse oximetry offers an ideal way of assessing need and of rationalising use. It can be employed to assess initial disease severity, to monitor subsequent progress, and to ensure that such supplies of oxygen as are available are optimally used. Tents and incubators are not an efficient way of giving oxygen. Giving oxygen into a clear plastic hood (head box) placed over the head stops the oxygen supply from dropping every time a tent or incubator door is opened. A nasal catheter, or prongs, optimises the efficient use of the available supply. These devices also make it very much easier to move and handle the baby without disrupting that supply. However they make it rather more difficult to assess how much oxygen is needed to control cyanosis. For that purpose it can be useful to revert to head box use intermittently to determine what inspired oxygen concentration provides a comparable saturation reading.



- Babies should always have their actual oxygen needs monitored at regular intervals. Measuring the inspired concentration needed is one of the best ways of measuring of the child's changing condition. This can be done quite easily using one of a range of inexpensive fuel-cell probes.
- The level of SaO2 that is optimal in the neonate continues to be the subject of debate. ESS-EMCH advises that SaO2 be kept between 94% and 96% in babies cared for at sea level.
- Keep the baby warm, and keep handling to a minimum. Where it can be afforded, the semi-continuous use of a pulse oximeter makes it possible to leave the child clothed, to minimise handling, and to dispense with any other monitoring of pulse and respiration.
- Try to humidify the air the baby is breathing if the oxygen content needs to rise much above 40% (since piped and cylinder supplies of oxygen are very dry). A simple bubble humidifier will usually suffice. If the baby is receiving head box oxygen in an incubator, consider placing the bubble humidifier within the incubator to improve humidification by raising the temperature of the water in a simple and controlled, manner.
- Babies with serious respiratory distress should not be offered milk (or anything else by mouth) until their condition has stabilised and a probable cause for the distress has been established. Support expression of milk in the mother so that she is ready when her baby has recovered to provide breast milk.
- Babies less than 2-3 days old, and older babies who look fluid depleted, should always be started on an hourly IV infusion of 5 ml/kg/hour of 10% dextrose (or, for babies more than 3 days old, of 10% dextrose with 0.18 % sodium chloride). 5ml/Kg per hour of 10% glucose is the minimum amount of glucose (equivalent to 8mg/Kg/minute of glucose) needed to avoid hypoglycaemia in a baby who is not receiving any enteral glucose. Higher concentrations than 10% are sclerosing to veins and there is good evidence that the newborn can easily excrete 120ml/Kg/day. NOTE: 5ml/Kg per hour corresponds to 5

"standard infusion giving set" drops/minute in a 3Kg baby and 3.5 drops per minute in a 2Kg infant. Ideally in neonates should use an infusion set with a micro-dropper (where 1ml = 60 micro-drops). A standard infusion set gives 20 drops/ml and can lead to dangerous fluid overload if not carefully controlled. Older babies who seem relatively stable and only moderately ill can be offered small quantities of milk through a fine naso-gastric feeding tube.

- Give antibiotics, at least for the first 48 hours, if bacterial infection is a plausible reason for the child's respiratory distress either IM, or IV if there is an IV line in place. Take blood for culture first wherever possible. Remember, however, that excess antibiotic usage generates a lot of nursing work, as well as being costly. Excess use can cause overt *Candida* infection (thrush), and also risks the eventual emergence of multi-resistant organisms, especially in a hospital setting. The widespread use of ampicillin has caused many coliform organisms to become increasingly resistant to this antibiotic, while units using a lot of cefotaxime are starting to encounter serious *Enterobacter* sepsis.
- Take a chest x-ray where facilities allow, as long as this can be done without destabilising the baby, in order to get further insight into the probable cause of the problem.
- Take stringent steps to prevent nosocomial cross infection within the unit. This can be a particular problem, not only with some bacterial infections (such as *Listeria*) arising at birth, but also with some troublesome viral infections (such as Respiratory Syncitial Virus RSV bronchiolitis) more commonly seen later in the first month of life.

Specific management issues

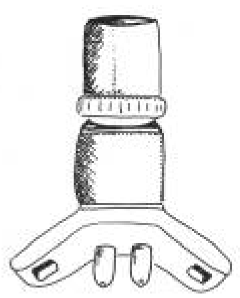
Some problems call for an individualised approach -

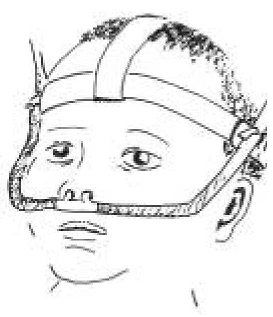
Primary surfactant deficiency ('RDS')

The principles of treating RDS are

- Minimal handling of the baby
- Supplementary oxygen
- IV fluids
- No oral feeding
- Increased end expiratory pressure
- Avoid hypothermia

- Surfactant deficiency is by far the commonest cause of respiratory distress in the preterm baby in the first three days of life. Luckily it is a self-limiting condition, because birth always triggers an immediate increase in surfactant production. The challenge is, therefore, to support the baby for the first two days of life without doing further damage to the lung until such time as the deficiency resolves itself.
- The key features of RDS (cyanosis, an expiratory 'grunt', tachypnoea, and intercostal and/or subcostal recession) all become clinically obvious within four hours of birth. Supplemental oxygen, minimal handling, IV fluid and 'nil by mouth' have been the standard ingredients of care for the last fifty years. Elective surfactant administration (which is expensive) and ventilation (which is complex) have become the standard approach to management in the last twenty years. However, it is now becoming clear that the very small baby can pay a high price for chronic tracheal intubation which, by interrupting cilial flow, can interfere with the way necrotic material is normally cleared from the lung.
- In fact, most babies will manage well for themselves as long as they are offered help to keep the lung from closing down and becoming airless for the 2-3 days it takes for surfactant production to 'switch on'. The expiratory grunt which is a characteristic feature of this condition is the baby's own method of sustaining positive end expiratory pressure (PEEP), and holding the alveoli open. Making the baby breathe against a constant positive airway pressure (CPAP) gradient achieves the same thing and, by applying this pressure at the nose (nasal CPAP), the complications associated with tracheal intubation can be avoided.
- To be maximally effective we now know that CPAP should be applied from birth, just as soon as the lung has first been aerated. Paired short prongs or specially made nasal mask are probably best because they minimise airway resistance.





Even the 3mm nasal cannulae normally used to provide supplemental oxygen have some effect. However pressures of 5 to 8 cm H_2O really require the use of a purpose made device. There are several to choose from. All that is then required is a controlled flow of blended, humidified, air and oxygen, and a simple device for producing controlled adjustable back pressure. Many commercial devices have been developed for doing this, but there is no evidence that they work any better than a simple water trap with a known height of water in it. Regular nursing attention is necessary to make sure that the device remains correctly positioned and does not cause necrotic pressure damage to the nose, but this is a skill that does not take long to acquire.

Transient tachypnoea of the newborn This is almost indistinguishable from RDS at birth. Unlike RDS however, the symptoms do not become more marked with time in the hours after birth. Most of these babies are born at, or near, term. All are tachypnoeic, and a few are overtly cyanosed for 6-12 hours after birth. The condition seems to be caused by some poorly defined difficulty with lung aeration and pulmonary adaptation at birth. All these babies will recover on their own as long as handling is kept to a minimum and as long as they are not fed until their symptoms have subsided. Some need supplemental oxygen, but few need it for more than 24 hours.

Aspiration pneumonia Aspiration of particulate matter can occasionally almost block the trachea. It can also, more commonly, cause a chemical pneumonitis. Meconium can be particularly irritant in this regard, making the term baby very oxygen dependent for the best part of a week. It may also trigger a persistent fetal circulation (see below). Nevertheless with minimal handling, IV fluid and generous supplemental oxygen, most of these babies can be expected to make a complete recovery as long as there has been no associated anoxic cerebral damage. Providing unnecessary respiratory support may actually make matters worse by increasing the risk of pneumothorax. Antibiotics should probably be given until it is clear there is no associated bacterial infection.

- Aspiration after birth can also cause a similar picture. Milk can block the trachea but it seldom causes much of an inflammatory reaction. Gastric acid can be much more damaging. Recurrent minor unrecognised reflux and aspiration is probably commoner than a single massive episode of aspiration and it can certainly, over time, render the baby quite oxygen dependent. Babies who are hypotonic, or have a poor cough reflex, are probably at particular risk in this regard.

Bacterial pneumonia This should be managed as outlined in the section on suspected infection, remembering that there may be septicaemia as well as pneumonia.

Persistent fetal circulation

- This is an uncommon, but potentially life threatening, condition caused by poor lung perfusion after birth. It may complicate birth asphyxia, meconium aspiration, early bacterial pneumonia, diaphragmatic hernia, RDS or – very occasionally – be a primary disorder.
- After birth the pressures in the pulmonary vessels remains high, so that the normal fall in pressure in the right atrium, right ventricle and pulmonary arteries, does not occur. As a result of this, the blood flows through the fetal circulation (the foramen ovale and ductus arteriosus), from the right side of the heart, to the left. This blood has not been oxygenated, so the baby soon becomes cyanosed. It is difficult to differentiate this from a congenital cardiac malformation. Serious cyanosis in a baby with a well aerated lung on chest x-ray and progressive acidosis can cause rapid self-perpetuating cyclical deterioration.
- The treatment in the first instance is oxygenation, minimal handling, IV fluids and avoidance of oral feeds. Metabolic acidosis should be vigorously and rapidly corrected, or even over-corrected.
- Survival is only likely however, once a well established problem has developed, in a unit capable of providing sustained respiratory support.

Pneumothorax This is present more frequently than expected, and may occur spontaneously in up to 2% of babies. It is often asymptomatic, and may be associated with meconium aspiration and respiratory distress syndrome. It does not automatically need to be treated, unless it causes progressive respiratory distress. Emergency treatment is by thoracocentesis followed by the insertion of a chest drain into the 4^{th} or 5^{th} intercostal space in the mid to anterior axillary line.

- **Lung hypoplasia due to oligohydramnios** Chronic loss of liquor for many days before birth can occasionally impede lung growth enough to jeopardise survival, but what looks like a serious problem at delivery can occasionally resolve quite quickly after 1-2 days. Where the oligohydramnios is due to bilateral renal agenesis or dysplasia, however, there is no hope for survival. The stiffness of the lung in these cases causes marked intercostal and subcostal recession, and there is unrelievable cyanosis. Chest x-ray will often reveal an untreatable pre-terminal pneumothorax.

- **Congenital malformation** The commonest congenital defect causing respiratory distress soon after birth is diaphragmatic hernia. This occurs in 1:4000 births and more commonly affects the left side. Clinical examination reveals reduced air entry on the affected side, and a displaced apex beat. The chest x-ray is diagnostic. It used to be thought that early surgery improved the chance of survival, but this now known to be untrue. The issue of transfer does not have to be considered, therefore, until it is clear that the child's initial respiratory problems have stabilised. An IV line should be erected in the interim, the gut kept as empty of gas as possible, and food withheld. Restricted lung growth means that only about half these babies have any chance of survival.

Management of diaphragmatic hernia

- oxygen supplements,
- minimal handling,
- IV fluids and withholding of oral feeds
- NGT to keep the stomach empty
- Stabilisation of respiration
- Transfer to surgical care if responds to treatment

A number of rare, generalised, skeletal abnormalities affecting rib growth also cause severe untreatable lung hypoplasia.

Congenital heart disease occasionally causes overt cyanosis from birth, but there are seldom any associated signs of respiratory distress.

Recurrent apnoea

- Irregular, and periodic, breathing is common in the preterm baby and often becomes more of a problem after the first few days of life before then becoming less common again. It usually stops being an issue at least 3-4 weeks before the baby was due to be born. Pre-term babies may suffer episodes of hypoxaemia with or without absent ventilation (apnoea). Sometimes recurrent apnoea is associated with gastric reflux, particularly in neurologically compromised babies with poor airway protective reflexes.
- It is important to check that the baby is not septic, or having subtle seizures both of which require specific treatment.

- Monitoring is needed if the baby becomes bradycardic and cyanosed - the best monitoring device is a pulse oximeter.
- Gentle stimulation is usually all that is required to start the baby breathing again.
- Mask resuscitation can occasionally be called for, and there should always be equipment to hand so that this is not delayed should it be necessary.
- Oral caffeine, if available, will nearly always reduce the number of episodes in the preterm baby, and caffeine seldom causes the tachycardia and the other side effects sometimes seen with theophylline **Caffeine citrate** Give a 20 mg/kg loading dose by mouth, followed by 5 mg/kg once every 24 hours. No commercial formulation is generally available, but an oral solution is not difficult to prepare.
- Stubborn recurrent apnoea occasionally requires management with a period of nasal CPAP.
- Sometimes a sudden cluster of apnoeic episodes can be an indication of early sepsis in a previous well baby. Skilled nursing staff will nearly always be able to recognise that the condition of such a baby has also changed in other ways.

SECTION 11 Quiz 3

1) **When considering management of breathing problems of babies in the first month of life which of the following statements are true?**
   a) it is recommended to feed babies by mouth if they have serious respiratory distress
   b) an IV infusion of 10% dextrose is recommended in babies during the first 48 hours of life
   c) enough supplemental oxygen to ensure oxygen saturations of 94% or more should be given
   d) frequent handling is helpful

2) **Which of the following are features of primary surfactant deficiency (RDS)?**
   a) a self limiting condition causing respiratory distress in the pre-term baby during the first 3 days of life
   b) cyanosis
   c) tachypnoea
   d) grunting

3) **Which of the following statements are true about recurrent apnoea in the first month of life?**
   a) is common in the pre-term baby
   b) may be related to recurrent seizures
   c) should be monitored with pulse oximetry if causing cyanosis and bradycardia
   d) may be an indication of early sepsis in a previously well baby

ANSWERS: 1) b c (frequent handling is dangerous) 2) a b c d 3) a b c d

SUSPECTED INFECTION

Babies are very prone to infection and can become ill very rapidly once infection takes hold. Antibiotic treatment is only likely to work if started early, but the recognition of early infection is not easy. A recent WHO study showed that more than a third of all death in the first month of life in most resource-poor countries was caused by infection. It also found (*Pediatr Infect Dis J* 2003;**22**:711) that more than 80% of these babies had one or more of the following eight signs or symptoms when first seen –

Signs associated with infection in the neonate

Child feeding less than well than before

Child lying quiet and making few spontaneous movements

Deep body temperature more than 38°C

Capillary refill time > 2 seconds

Respiratory rate 60 or more breaths a minute

Indrawing of the lower chest wall when breathing, *or* grunting

Cyanosis

History of a convulsion

All such babies deserve immediate admission and careful review. Suspect bacterial septicaemia with or without early meningitis and treat as such by –

- Secure the **airway** and ensure the baby is **breathing adequately**
- Give high flow **oxygen until stable**
- Insert an IV cannula, using full sterile precautions. Umbilical vein catherisation may be the easiest way to gain vascular access quickly in a shocked baby less than a week old. Otherwise it might be necessary to site an **intra-osseous** line or cannulate a **scalp vein**.

Take a sample of blood for culture if available and for blood glucose and other biochemical tests if available. Failure to sterilise the skin rigorously can render blood culture results uninterpretable. 0.5% aqueous chlorhexidine is the most effective antiseptic. Employ two different swabs, applying each for ten seconds, and then leave the skin to dry for 30 seconds. A key-hole drape and no-touch technique will reduce the risk of recontamination.

- Give 2 ml/kg of 10% glucose IV over 2–3 minutes, followed by a first dose of ampicillin and gentamicin (or chlorampheniocol) using the dose regime outlined at the end of this section of the handbook. If the child almost immediately becomes more alert and active then you know that hypoglycaemia was probably one of the child's problems, even before the laboratory report comes back saying the blood glucose was well below 2.5 mmol/l (36mg/dl). Further monitoring of the blood glucose level should not be necessary as long as this infusion is continued until it is clear that the child is well enough to be fed orally.
- If IV access is not immediately possible give initial antibiotic dose IM. Never wait for the results of cultures or microscopy before starting antibiotics. Any delay can reduce the baby's chances of survival as well as leading to permanent damage if meningitis is present.
- Start a sustained hourly IV infusion of 5 ml/kg of 10% dextrose (or 10% dextrose in 0.18% sodium chloride after 3 days) wherever possible in any child who is shocked, dazed or drowsy, and in any child less than a week old.
- If the baby is shocked, give an IV bolus of 10ml/kg of 0.9% saline
- If the child has any respiratory symptoms take a chest x-ray if facilities allow. Look regularly to see if cyanosis is developing and give supplemental oxygen using a nasal catheter or prongs or a head box as outlined on. Most of the babies who become infected during delivery develop respiratory symptoms and progressive signs of septic shock within a few hours of birth. Do not give anything by mouth to a child who is breathless, especially if there is additional evidence of oxygen dependency, until symptoms have stabilised.
- If there are any features suggestive of meningitis get a lumbar puncture done within 2 hours of starting antibiotic treatment because the blood culture is sterile in 15% of babies with early meningitis. **Do not delay antibiotic therapy pending the undertaking of a lumbar puncture.** See below for a discussion of the best antibiotic to choose if meningitis is a possibility.

- Microscopic examination of the CSF (meningitis = 20 or more cells/mm^3) can provide early confirmation of meningitis, but a differential white blood cell count does not help with the decision to initiate or continue antibiotic treatment.
- Surface swabs and gastric aspirate cultures are not of any diagnostic help, but urinary tract infection is occasionally the primary focus of what then becomes a Gram negative septicaemic illness. Check a clean catch or supra-pubic urine sample for infection (primarily by microscopy). Identification of a urine infection may suggest imaging of the renal tract and prophylactic antibiotics.
- **Watch for, prevent and correct any sign of, hypothermia.**
- Antibiotics can be stopped after 48 hours if the blood cultures are negative **and** the baby has improved. If blood cultures are not available, continue the antibiotics for the full course appropriate for the site of infection (meningitis 10-14 days).

Drugs used for severe infection in the neonate

- **Ampicillin (or amoxicillin)** Give 100 mg/kg per dose IM where meningitis is a possibility. Give 50 mg/kg per dose in other situations. Give one dose every 12 hours in the first week of life, every 8 hours in a baby 1–3 weeks old, and every 6 hours in a baby older than that. Oral dosing can sometimes be used to complete a course of treatment.
- **Benzylpenicillin** Give 60 mg/kg if meningitis, **or** tetanus is a possibility. The same high dose should be given if congenital syphilis is compounded by CNS involvement. Give 30 mg/kg per dose in all other situations. Time the interval between each dose as for ampicillin. Oral dosing (with phenoxymethylpenicillin) can sometimes be used to complete a course of treatment.
- **Cefotaxime** Give 50 mg/kg per dose IV or IM. Time the interval between each dose as for ampicillin except in meningitis where doses are given 6 hourly.
- **Ceftriaxone** Give 25-50 mg/kg once a day IV or IM. A single dose will suffice when treating gonococcal conjunctivitis.
- **Chloramphenicol** This remains a useful antibiotic, although there is a serious risk of death from liver failure if the dose suggested here is exceeded. Give a 25 mg/kg loading dose IM followed by 12.5 mg/kg once every 12 hours to babies less than 1 week old. Give this dose every 8 hours in babies 1–4 weeks old unless there is evidence of liver damage or renal failure. Babies older than this can be given (12.5mg/kg) once every (6) hours

from the outset. Oral dosing can be used to complete any course of treatment. (can double dose in those over 1 month with severe infection)

- **Cloxacillin (or flucloxacillin)** Give 100 mg/kg per dose IM or IV if meningitis or osteitis is a possibility. Give 50 mg/kg per dose in other situations. Time the interval between each dose as for ampicillin. Oral treatment can often be given to complete a course of treatment. (25mg/kg standard, 50mg/kg severe, 100mg/kg in osteomyelitis and meningitis)
- **Erythromycin** Give 12.5 mg/kg per dose by mouth once every 6 hours. There is no satisfactory IM Preparation.
- **Eye drops (and ointments)** Prophylactic 1% silver nitrate drops have been used to minimise the risk of gonococcal infection (IM ceftriaxone being used for overt infection). The use of 2.5% polyvidone-iodine solution may be equally effective. 1% tetracycline ointment should be used (with oral erythromycin) to treat chlamydia conjunctivitis - a condition that is not prevented by silver nitrate use. *Pseudomonas* infection requires treatment with systemic and topical gentamicin (0.3% eye drops).
- **Gentamicin** Give 5 mg/kg IM or IV once every 24 hours. If baby weighs less than 2Kg give 4mg/Kg per dose. Leave 36 or 48 hours between each dose if there is renal failure.
- **(<32 weeks-4-5 mg/kg 36 hourly, >32 weeks 4-5mg/kg 24hrly. Blood levels if available.**
- **Hepatitis B vaccine** Give 0.5 ml IM into the thigh within 12 hours of birth. Remind the mother that booster injections will be required at ages 6 weeks and 14 weeks after birth. Babies born to mothers developing hepatitis during pregnancy, or with hepatitis surface (s) antigen (HbsAg), should also, if possible, be given 200 units of hepatitis B immunoglobulin IM into the other thigh within 24 hours of birth. Breast feeding can safely continue.
- **Isoniazid** Give 5 mg/kg by mouth once a day. Review progress at 6 weeks, noting weight gain and taking an x-ray. If there are features suggestive of active infection start active triple therapy for TB. If there are not continue giving isoniazid for another 4 months, and then give BCG two weeks after this treatment is stopped.
- **Metronidazole** Give a 15 mg/kg loading dose and 7.5 mg/kg per dose once every 12 hours in babies less than 4 weeks old and every 8 hours in children older than that. Treatment can be given IV or my mouth, but solubility makes IM use unsatisfactory. If use IV start maintenance 24 hours after loading, if oral then give first dose 12 hours after loading.

- **Miconazole** This controls infection with Candida ('thrush') better than topical nystatin. Use the oral gel at least four times a day and the skin cream twice a day for at least 7 days. Topical treatment with 0.5% aqueous gentian violet for not more than 4 days may be equally effective. Oral nystatin drops (1 ml four times a day) can be used to reduce heavy intestinal tract carriage.
- **Nevirapine** Give the mother a 200 mg oral dose in labour. Then give the baby one 2 mg/kg dose by mouth 2 days later to minimise feto-maternal transmission of HIV infection. It is not easy to get clear evidence to show that this is worth doing where the mother had already started taking zidovudine at least 4 weeks before delivery. Advice on breast feeding has to be individualised when the mother has HIV.
- **Procaine penicillin** Give asymptomatic babies born to mothers with evidence of untreated syphilis a single 100 mg/kg IM injection. ***Never*** give this drug IV. Babies thought to be infected at birth are often given 100 mg/kg once a day for 10 days, but repeated IM injections can cause a sterile abscess with subsequent muscle fibrosis and atrophy, and treatment with IM or IV benzylpenicillin for 10 days (as specified above) is just as effective. Babies born to mothers fully treated for syphilis (1.8 grams (2.4 megaunits) of benzathine benzylpenicillin at least 4 weeks before birth need no further treatment after birth.
- **Zidovudine** Babies born to mothers taking zidovudine during pregnancy should be given 2 mg/kg once every six hours for 6 weeks after delivery. In babies born more than 6 weeks early this dose should only be given once every 12 hours for the first 2–4 weeks. Advice on breast feeding has to be individualised when the mother has HIV.

SECTION 11 Quiz 4

1) Which of the following are features of sepsis in the first month of life?

a) poor feeding
b) skin capillary refill time less than 2 seconds
c) indrawing of lower chest wall when breathing
d) respiratory rate 60/minute or more
e) hypoglycaemia

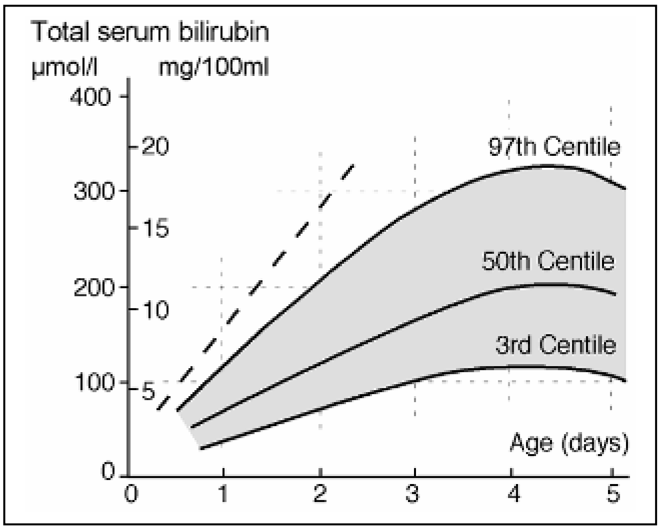
2) Management of suspected sepsis in the first month of life includes which of the following procedures?

a) lumbar puncture
b) urine culture
c) antibiotics only if definite bacteriological evidence of infection

ANSWERS: 1) a,c,d,e 2) a, b

SEVERE JAUNDICE

All babies become progressively more jaundiced for a few days after birth. This is because in utero many of the products liberated when red cells reach the end of their natural life span cross the placenta to reach the maternal liver before birth. These have to be handled by the baby after birth, and it takes the neonatal liver a little time to adjust to this new task. The serum bilirubin level usually peaks at between 100 and 300 µmol/l 3–5 days after birth (Figure), but this peak may be higher than usual if red cells were breaking down faster than usual at the time of birth.



There is in this situation an increasing risk that bilirubin will breach the blood/brain barrier causing critical damage to many cells in the brain's basal nuclei if, in the presence of haemolysis, the unconjugated serum bilirubin level is allowed to rise much above 350 µmol/l. Indeed, in a small preterm baby who is also ill, the safe limit may be nearer to 250 µmol/l).

There is nothing that can usefully be done once that happens. Many of these babies will die after becoming ill and stiff with their heads arched backwards in kernicterus. The survivors will almost all become severely deaf, and the majority will also develop athetoid cerebral palsy.

Regular early and frequent enteral feeding, by increasing bilirubin elimination through the gut, can make such a problem less likely.

Haemolysis

Term babies should seldom need treatment with phototherapy unless there is an unusually high rate of red cell breakdown. However, phototherapy should be started just as soon as jaundice becomes apparent if there is evidence of haemolytic disease. The trend in the bilirubin level should then be checked twice a day (the level can not be judged from skin colour once phototherapy has been started). The following facts or findings suggest that there could be haemolytic disease –

Most importantly: clinically noticeable jaundice within 24 hours of birth (or any level above the dashed line in figure), especially if the mother is blood group O and the baby is group A or group B, or the mother is rhesus negative and the baby is rhesus positive.

These factors below suggest a risk for haemolysis.

- Red cell antibodies in the mother's blood.
- A positive Coombs or direct anti-globulin test in blood from the umbilical cord.
- A family history of G6PD deficiency or congenital spherocytosis.
- A history that previous children were seriously jaundiced in the first week of life.
- Otherwise unexplained neonatal anaemia at birth (a haemoglobin level <130 g/l or a haematocrit < 40%).

Causes of abnormally raised bilirubin

- Haemolytic disease
- Neonatal sepsis
- Breast milk jaundice
- Hypothyroidism
- Congenital infection
    - Toxoplasmosis
    - Cytomegalovirus
    - Rubella
    - Hepatitis

Causes of Physiological Jaundice in the Neonatal Period

- Increased breakdown of red blood cells in the first few days of life
- Reduced life span of red cells (70 days compared with 120 in the adult)
- Less efficient metabolism of bilirubin by the immature liver

Assessing the degree of jaundice

Some means of estimating the level of jaundice makes it much easier to determine which babies really do and do not need such treatment. Kernicterus, in the absence of overt haemolysis, is excessively uncommon in the **term** baby until the serum bilirubin level exceeds 425 µmol/l.

Jaundice in the newborn baby can be overlooked in babies with dark skin but is easily judged once the skin is blanched free of blood by finger pressure. The face is the first to show signs of jaundice. The trunk only becomes yellow as jaundice deepens. If the skin over the lower leg looks yellow then the serum bilirubin level is probably approaching 250 µmol/l. If the hands and feet look yellow it is certainly above 200 µmol/l.

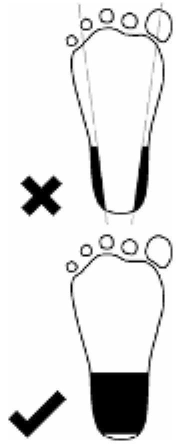
Several electronic devices have been developed for judging skin colour, but none have yet been shown to work significantly better than the simple 'icterometer' devised by Gosset in 1960 (*Lancet*, 1960;**i**:87). Jaundice is judged by pressing the clear plastic of this simple device against the tip of the nose (or against the gums in a dark skinned baby) and then matching the colour of the skin against the icterometer's colour scale. Levels in excess of 350 µmol/l are unlikely to be missed if a blood sample is taken once the icterometer reads 3.5 or more. This inadequately known device, which only costs $20, is still made by Thomas Ingram, PO Box 305, Birmingham, B19 1BB in the UK, and by Cascade Health Care Products of Salem, Oregon in the USA.

Nevertheless high levels can only be monitored by taking a blood sample. Many biochemical techniques for doing this are quite complex and time consuming, and some require quite a large sample of blood. Ward based devices for judging the bilirubin content of a spun microhaematocrit tube optically are accurate until the level exceeds 350 µmol/l, and adequate for most clinical purposes. The machine is only reliable, however, if calibrated daily and regularly serviced. The accurate measurement of values in excess of 350 µmol/l is only possible in a biochemistry laboratory.

Direct or conjugated bilirubin presents no threat to the brain, but conjugated bilirubin only accounts for a small fraction of the total serum bilirubin level in the first week of life (and a fraction that is not easily measured with any precision using most biochemical techniques). Decisions about treatment should be based, therefore, on the total serum bilirubin level, remembering that even laboratory estimates have limited precision – duplicate measurements, even from the same laboratory, can vary by up to 10% (95% confidence limits).

Collecting blood

Only a small amount of blood is needed to check the bilirubin. Although described as a heel prick, sticking a needle into the heel runs a high risk of entering the underlying bone, and can lead to osteomyelitis, so should be avoided.
It is safe to take blood from any part of the back third of the foot.



Try and use a 2.4 mm blood lance, but never use the same lance on more than one baby because of the risk of transmitting hepatitis or HIV infection. It is not necessary or appropriate to try and sterilise the skin first as long as it is clean, and the use of anesthetic cream does nothing to reduce the response of the baby to the pain inflicted. A spring-loaded lance does seem to render the procedure less painful. The baby will also show fewer signs of distress if held, or given something to suck, during the procedure. Grip the heel firmly enough to make it go red, but not white, stab the heel just once, and then squeeze gently and intermittently to stimulate blood flow. The use of a standard lance should optimise blood collection because it helps to ensure that the skin is punctured to a standard depth. A shallower prick is unlikely to reduce the pain inflicted because it will almost certainly prolong the procedure. A double puncture may help if a lot of blood is needed. Slight finger pressure on the site for about a minute is usually enough to stop any further bleeding after the procedure is over.

Phototherapy

In babies who are very yellow, the best preventive measure is to start phototherapy. Use light from a bank of at least six 24-inch 20 watt fluorescent strip lights suspended not more than 30 cm above the unclothed baby. (Lights placed 60 cm from the baby are only about half as effective.) Placing a white sheet under and round the baby will increase the effectiveness of any treatment. Many consider the placing of a thin sheet of perspex or polythene between the lights and the baby a wise safety precaution. Such steps should immediately halt any further rise in the level of jaundice and reduce the level substantially within 36 hours unless there is very serious haemolysis. If it does not, there is something wrong with the way treatment is being given.

It is important to monitor body temperature and to protect the baby from draught. It is also standard practice to mask the eyes to prevent the retinal damage that might occur were the child to lie looking directly at the light with their eyes open for any length of time.

Feeding, especially breast feeding, should continue without interruption and more frequent breast feeding is helpful by helping to elinimate meconium from the bowel. Extra fluid (eg breast milk substitute, water, sugar water etc) should not be given – it actually makes jaundice worse. Letting the baby come out for feeding will not reduce the effectiveness of treatment once the bilirubin level has started to fall.

Exchange transfusion

Exchange transfusion is generally only undertaken if the rate of red cell breakdown is likely to exceed the ability of phototherapy to control levels of bilirubin. However this is very likely to occur in babies with a positive Coombs test who are already anaemic (because of fetal haemolysis) at birth, and a cord blood haemoglobin of less than 130 g/l serves to identify most of these babies. Here a 500 mg/kg infusion of human immunoglobulin, given IV over two hours, marginally reduces the number requiring an exchange, although it also increases the number needing a 'top up' transfusion for late neonatal anaemia.

Function of exchange transfusion

- Removal of maternal antibodies
- Removal of antibody coated red blood cells before they haemolyse
- Corrects anaemia
- Lowers total bilirubin, if sufficient time for equilibration between intravascular and extravascular levels

Exchange Transfusion

1. Calculate the baby's circulating volume = 85 ml/kg. Twice this amount of blood will be required. Do not exceed this (usually <1 bag of blood = 450ml) Do not use blood > 4 days old
2. Check that the blood is compatible with the mother's serum and the same ABO group as the baby. If the exchange is for severe anaemia, use packed red cells if possible
3. Ensure the baby is closely monitored throughout the procedure
4. This is a sterile procedure, so gloves and gowns must be used and universal precautions applied
5. Secure umbilical vein access
6. Ideally, use a blood warmer (especially for low birth weight infants) otherwise warm by placing under mother's dress next to skin
7. Set up a closed circuit with either a 4-way tap, or two 3-way taps. The four links are
    a. The baby
    b. The syringe for removing and replacing blood
    c. The blood to be transfused
    d. The route for discarding the baby's blood
8. Make sure that the total blood in and out is recorded. Plan to spend 1.5 to 2 hours on the procedure
9. Withdraw 6 mls of blood from the baby and discard it
10. Withdraw 6 mls of blood from the blood bag or bottle and transfuse into the baby

Steps 9 and 10 should in total take about 3 minutes to avoid abrupt changes in BP

11. Repeat steps 9 and 10 until the correct volume of blood has been exchanged.
12. Symptomatic hypocalcaemia may occur as the citrate in donor blood binds calcium. This responds best to halting the procedure for 15 minutes. Giving calcium gluconate is of little benefit and may be hazardous, so is best avoided.

Exchange transfusion should only be undertaken once all the attendant risks have been considered. Even in experienced hands 1% of babies may suffer a sudden circulatory arrest during or shortly after the procedure. This should respond to prompt intervention using the approach adopted when dealing with circulatory standstill at birth, but the baby needs to be monitored closely, and staff need to be ready for such a possibility if this is not to prove fatal. Air embolism can kill within minutes, and faulty technique can cause sudden hypo- or hypervolaemia, or introduce later sepsis. The use of donor blood more than five days old can cause serious hyperkalaemia and an arrhythmia. Blood straight from the fridge at 4ºC can impose a major cold stress.

Cytomegalovirus (CMV) infection may occur if the blood does not come from a CMV-negative donor. It is also critical to avoid causing hepatitis B or HIV infection. There is, in addition, a definite, but poorly understood, risk that the procedure will trigger serious necrotising enterocolitis. Avoid, if possible, the use of heparinised blood.

Late jaundice

Ten per cent of breast fed babies are still slightly jaundiced a month after birth, but the institution of further tests and investigations seldom reveals anything worthy of treatment if the baby is otherwise well. However it is important to identify biliary atresia promptly because operative intervention is much more likely to be successful if undertaken within eight weeks of birth. Even mild jaundice merits review if the stool becomes grey or putty coloured rather than yellow or green.

All babies with continuing jaundice should be given a prophylactic 1 mg IM injection of vitamin K if it is not clear that they received such an injection at birth to minimise the risk of potentially fatal late vitamin K deficiency bleeding. **Vitamin K** Vitamin K deficiency bleeding ('haemorrhagic disease of the newborn') is rare except in babies getting relatively little breast or artificial milk after birth. Give babies not well enough to be fed, or showing any sign of a bleeding tendency, a single 1 mg 'depot' injection IM. While IV administration is safe it only provides very short term protection from vitamin K deficiency.

Late anaemia

Causes of anaemia at birth

- Haemorrhage
- Twin-to-twin transfusion
- Feto-maternal transfusion
- Placental abruption
- Haemolysis due to
  - Rhesus incompatibility
  - ABO incompatibility

Haemolysis, even if it is not severe enough to require intervention in the first week of life, may continue for some weeks after birth. An attempt should therefore be made to check all babies with a positive Coombs test for late anaemia when they are about six weeks old. Babies with a capillary haemoglobin of less than 80 g/l or a haematocrit of less than 25% should then be given a 20 mg/kg 'top up' transfusion of cross matched, or group O Rh-negative, blood over two hours. Red cell concentrate or Packed cells is preferable.

SECTION 11 Quiz 5

1) Concerning jaundice in the first few days of life in the full term infant which of the following statements are true?

a) it may be normal
b) it can cause severe brain injury if the unconjugated bilirubin rises above 350 mmol/L
c) during phototherapy the eyes should be masked
d) gastric feeding should be continued throughout phototherapy even when the bilirubin level is falling
e) pre-term infants are more likely to need treatment than term infants

ANSWERS: **1) a, b, c, d, e**

FITS, SPASMS AND COMA

Causes of neonatal fits

- Hypoxia
- Hypoglycaemia
- Meningitis
- Drug related seizures
- Sepsis
- Tetanus
- Hypocalcaemia
- Hyper or hypo natraemia
- Metabolic abnormalities
- Developmental disorders
- Benign neonatal seizures

Focus on the limited number of conditions where immediate treatment can have a major impact on long term outcome. There are many situations where seizures are simply the outward sign of damage that can not now be undone even though it may be possible to stop continuing seizure activity from making matters worse.

If the baby is alert and well between episodes of seizure activity, seems normal on examination, and is feeding normally, it may be perfectly appropriate to do nothing.

In **benign neonatal sleep myoclonus,** jerky movements that spare the face only occur when the child is going to (or waking from) sleep. No treatment is required and the problem disappears before the child is a year old.

Benign neonatal seizures, which are sometimes familial, can also be managed without drug treatment, and resolve within a few days or weeks.

Focal seizures can also be the sign of what was otherwise a silent haemorrhagic infarction of part of the brain. While investigation would explain what was going on, it would not alter management.

Well but jittery baby	**Baby with clonic seizures**
No abnormal eye movements	Abnormal eye movements
No apnoea	Apnoea
No colour changes	Pallor or cyanosis
No heart rate changes	Tachycardia
Easily triggered by handling and stopped by gentle passive flexion of the affected limb	Independent of handling
Rhythmical movements	Jerky with fast and slow components that are not equal

Management of the fitting neonate

- Airway and Breathing
- Circulatory access
- Give glucose IV or NG (2ml/Kg of 10% glucose)
- Give antibiotics IV or IM
- Stop fit with anticonvulsant:
  - Phenobarbitone 20mg/Kg over 5 minutes IV or IM
  - Paraldehyde 0.2ml/Kg IM or 0.4ml/Kg rectally

Airway and Breathing

Give high flow **oxygen**

Circulation

Achieve **vascular access** if possible

Pathway of Care Prolonged Fitting [A] in neonates

A **Airway opening if needed (airway adjunct if needed) but no other object in mouth**
Recovery position if vomited
B **High flow oxygen**
Bag mask ventilation if not breathing
Do not leave alone Call for help

Existing vascular access?

Yes

2ml/Kg of 10% glucose IV ideally after blood glucose
Only if glucose does not stop fitting within 5 minutes
ADD IV Phenobarbital 20mg/Kg over 15 minutes

PLUS if available
Rectal paraldehyde 0.4ml/Kg

No

Rectal diazepam 500 microgram/kg
OR
Rectal paraldehyde 0.4ml/Kg
OR
Buccal midazolam 300microgram/Kg
Gain venous access 2 attempts OR intraosseous
IV/IO 2ml/Kg 10% glucose after blood glucose

Still convulsing **10 minutes**

Only if glucose has not stopped fitting
ADD IV Phenobarbital 20mg/Kg over 15 minutes

15 minutes

At end of phenobarbital dose

Still convulsing

Phenytoin 20mg/kg bolus over 20 minutes

Only 0.9% saline can be used to infuse phenytoin. Flush IV line with 0.9% saline before and after infusing. Do not infuse at a faster rate due to risk of irregular heart beat, hypotension and respiratory depression;- complete administration within 1 hour of preparation.

Repeat blood glucose and if hypoglycaemia treat with IV/IO 2ml/Kg 10% glucose

NOTES

A. Indications: Still fitting when seen (ETAT) OR If already in hospital where onset of fit is seen and generalised convulsion lasting > 10-15 minutes or repeated convulsions without return of consciousness between fits.
B. Hypoglycaemia is blood glucose <2.5 mmol/l (45mg/dl) if well nourished and < 3.0mmol/l (55mg/dl) if severe malnutrition
C. **If blood glucose cannot be measured treat as hypoglycaemia.**
D. If hypoglycaemia has been present give feed (milk or sugar water) orally or NG when conscious. To make an oral or NG sugar solution dissolve 4 level teaspoons of sugar (20 gram) in 200ml of clean water.
E. If IV/IO glucose does stop fitting, repeat blood glucose 30 minutes later.

If there is any concern that the child is not otherwise entirely well it is essential to rule out th**e three main treatable causes of fitting (hypoglycaemia, meningitis and tetanus)** since any delay in diagnosis could be serious.

1. **Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) Always think of this** Erect an IV line, using sterile precautions and take a sample of blood for blood culture and for biochemical tests (if available). Then give 2 ml/kg of 10% dextrose over 2–3 minutes. If the child almost immediately becomes more alert and active 'on the end of your needle' you have made the diagnosis, even before the laboratory report comes back saying the blood glucose was well below 2.5 mmol/l (45mg/dl). You have also initiated the only treatment necessary.

- If this is what happens it is then important to keep the blood sugar level stable by starting a sustained infusion of 5 ml/kg of 10% dextrose per hour for the next 2-4 days while gradually building up oral feeds.
- Fits due to hypoglycaemia typically start in a previously well child on the second day of life. Although laboratory estimates of blood glucose are ideal for diagnosing and managing this condition reagent strips can be helpful.

2. Meningitis *Always try to recognize this.* Meningitis may occur at any time in the neonatal period and is frequently fatal. Survival depends on rapid treatment and early diagnosis. Since, however, confirmatory diagnosis may take several hours it is appropriate to start treatment just as soon as the diagnosis is suspected. Ampicillin and gentamicin (see the neonatal formulary) is the most frequently used combination where the organism remains uncertain. Benzylpenicillin may be preferable for known group B streptococcal infection. Cefotaxime is the drug of choice for most Gram negative organisms (with ceftazidime for *Pseudomonas* infection). Neither cefotaxime nor ceftazidime should be used on its own if *Listeria* infection is a possibility. It is important to attempt lumbar puncture once the baby has been stabilised, and ideally within 2 hours of initiating antibiotic treatment, because this serves to confirm the diagnosis. Failure to recognise that a baby has meningitis as well as septicaemia can result in inappropriate low dose treatment for too short a time**.** Lumbar puncture is also more likely than blood culture to identify the organism responsible, and to identify it quickly.

3. Tetanus *Do not forget this***.** Neonatal tetanus has to be a possibility if a previously well and still conscious baby starts to develop increasingly frequent muscle spasms 3–14 days after birth, especially if there is any doubt about the way the umbilical cord was managed at birth and there is no proof that the mother was ever immunised with tetanus toxoid. Involuntary muscle contractions are typically triggered by quite light touch or sound, and the hands and jaw are often held firmly clenched.

- **Airway** and **Breathing** are frequently compromised. Sometimes a tracheostomy will be required as intubation may trigger very dangerous spasms of the airway.
- Give high dose **benzylpenicillin** 60 mg/kg one dose every 12 hours in the first week of life, every 8 hours in a baby 1–3 weeks old, and every 6 hours in a baby older than that. Oral dosing (with phenoxymethylpenicillin) can sometimes be used to complete a course of treatment.
- Give a 150 unit/kg dose of IM **human tetanus immunoglobulin** (if available), and 0.5 ml of IM tetanus toxoid vaccine into a different limb.
- A 300 - 400mcg/kg dose, can repeat after 10 minutes if required)of **diazepam** IV or, failing that, down a feeding tube, may help to control the spasms. This dose can be doubled if necessary, and further 1 mg/kg doses given every 6 hours as necessary. Repeat treatment can be offered as often as once every six hours as long as the baby is monitored for signs of respiratory depression. Slow and incomplete absorption limits the usefulness of IM administration.
- **Paraldehyde** may occasionally be helpful. Give 0.2 ml/kg *deep* IM. This dose can be repeated once if seizures persist. Give within 10 minutes when using a plastic syringe (because paraldehyde interacts with many plastics). Some clinicians prefer to give a single 0.4 ml/kg dose mixed with an equal volume of mineral oil into the rectum.
- Treat any obvious umbilical infection with an additional broad-spectrum antibiotic.
- Minimise handling and give frequent small tube feeds.
- Oxygen may help if the spasms are causing cyanosis, but in severe cases survival may be dependent on the availability of respiratory support sometimes with tracheostomy to protect the airway.
- Immunising the mother (two 0.5 ml doses a month apart) will prevent a similar tragedy in any future pregnancy.

Treatment of neonatal tetanus

- **Airway and Breathing**
- Benzylpenicillin 60 mg/kg
- Human tetanus immunoglobulin 150units/kg IM
- Tetanus toxoid vaccine 0.5ml IM into **different** limb
- Consider 1mg/kg diazepam IV, NG or PR to control spasms
- Minimise handling
- Frequent small tube feeds
- Oxygen as needed

SECTION 11 Quiz 6

1) To prevent neonatal tetanus which of the following statements are correct?

a) the stump should be cut short
b) the stump should be kept covered for the first 5 days after birth
c) prophylactic antiseptic lotion to the cord is helpful
d) all mothers should be immunised against tetanus before delivery

ANSWERS: **1) a,d**

Rule out any other biochemical cause

Remember the biochemical disturbance may not be the main underlying problem. In many babies with evidence of hypoglycaemia or hypocalcaemia, the biochemical disturbance is only one symptom of another more serious illness. Of these by far the most important treatable condition is meningitis. Unless the baby is otherwise entirely well it is important not to miss this possibility.

- Other important diagnostic possibilities include hypocalcaemia, hyponatraemia and hypernatraemia. Other clinical features will help in the recognition of hypo- and hypernatraemia, and a serum sodium level clinches the diagnosis. Any existing problem will be made worse if hypernatraemia is corrected too rapidly.
- Fits due to hypocalcaemia (a serum calcium of < 1.7 mmol/l), with or without hypomagnesaemia, are generally benign and occur unexpectedly in an otherwise well but hyper-reflexic child more than 2-3 days old. As with hypoglycaemia

symptoms may settle 'on the end of needle' if the baby is given 2 ml/kg of 10% calcium gluconate as a *slow* IV infusion, but such seizures usually respond perfectly adequately to oral supplementation. They are not a serious cause for concern, but it is appropriate to investigate the mother for an unrecognised endocrine abnormality if facilities allow. DO NOT ALLOW IV CALCIUM TO GO OUTSIDE THE VEIN AS IT WILL CAUSE SEVERE TISSUE DAMAGE.

Kernicterus Babies with brain damage due to jaundice are stiff and stuporose, but seldom have fits. Symptoms usually appear quite abruptly 3-6 days after birth, but by the time they appear it is too late to initiate treatment.

Inborn errors of metabolism Other more complex biochemical disturbances are usually associated with metabolic acidosis and progressively deepening coma in a child who was initially well for 1–2 days after birth. They are generally too complex to treat without substantial biochemical support, but it may be appropriate to take specimens for later diagnostic evaluation because many of these conditions are familial and genetically determined. Pyridoxine deficiency is one of the few rare treatable conditions.

Other problems arising during delivery Once bacterial meningitis has been excluded intrapartum asphyxia or birth trauma will turn out to be the underlying problem in most other babies presenting with fits in the first 2–3 days of life. Most of these babies already look stressed and unwell within a few hours of birth. The onset may be a little more sudden and abrupt in the preterm baby who suffers a sudden intraventricular haemorrhage. These babies usually become progressively more stuporose and unresponsive over time, and there is relatively little that can be done to improve the long term outlook. An attempt should be made to minimise hypoxia, and anticonvulsant treatment is sometimes initiated in the hope that it will reduce the number of apnoeic episodes. Many are too ill to accept even tube feeds and, where this is the case, it may be appropriate to minimise the risk of hypoglyceamia by giving IV glucose. Unfortunately an infusion of more than 3 ml/kg of 10% dextrose per hour may result in water retention if there is renal failure. Where there is any possible suggestion of a generalised bleeding tendency give 1 mg of IM vitamin K (unless this was given at birth) especially if the baby has had relatively little milk since birth. **Vitamin K** Vitamin K deficiency bleeding ('haemorrhagic disease of the newborn') is rare except in babies getting relatively little breast or artificial milk after birth. (see above)

The outlook is fairly bleak for babies who have not recovered and started to feed normally within a week of birth.

Drug related seizures Accidental infiltration of the fetal scalp during the injection of lidocaine into the maternal perineum can cause fits simulating intrapartum asphyxia but, with supportive treatment, there is every prospect of complete recovery. Some babies born to drug-dependent mothers show symptoms of drug withdrawal 1–2 days after delivery and a small minority have seizures. More gradual withdrawal from the drug to which they have been exposed is the only treatment usually necessary.

Developmental disorders It is said that up to 10% of otherwise unexplained neonatal seizures are associated with the existence of some underlying cerebral problem (often cortical dysgenesis). Some of these children will benefit from continuing anticonvulsant treatment.

Anticonvulsant treatment

Treatment with phenobarbital will often control neonatal seizures although it is doubtful whether it often has any major influence on the long term outcome. In one recent study it was effective in 45 % of patients studied.

Adding phenytoin increased the success rate to 60% (but treatment with phenytoin is not always straightforward). In cases where such anticonvulsant treatment is effective it can usually be stopped after 7–10 days.

Paraldehyde can be an extremely effective short term measure. While large IM injections can cause a painful sterile abscess, this is not a problem when the volume does not exceed 1 ml. Also consider the rectal route which can be equally effective.

Phenobarbital Give a 20 mg/kg loading dose followed by 4 mg/kg once every 24 hours. Treatment can be given IV, IM or by mouth. Seizure control may be achieved more quickly if the first dose is given IV, but this loading dose must be given slowly, over at least 5 minutes, to minimise the risk of shock, hypotension or laryngospasm. Some texts recommend the use of a higher dose if the standard dose fails, but this can cause respiratory depression.

Phenytoin Initial seizure control with this drug requires the presence of a saline filled IV line (because the drug crystalises out in dextrose solutions). The same problem also renders the IM route unavailable. Give a 20 mg/kg loading dose IV slowly over 10-20 minutes (to avoid cardiac arrhythmia) and then 2 mg/kg IV or by mouth once every 8 hours. Babies more than 2-3 weeks old may need a considerably larger maintenance dose.

Paraldehyde Give 0.2 ml/kg by *deep* IM injection. This dose can be repeated once if seizures persist. Give within 10 minutes when using a plastic syringe (because paraldehyde interacts with many plastics). Some clinicians prefer to give a single 0.4 ml/kg dose mixed with an equal volume of mineral oil into the rectum.

SECTION 11 Quiz 7

1) Causes of fits in babies which need treatment include which of the following conditions?

(a) hypoglycaemia reversed by giving 2.5 to 5 ml/kg of 10% glucose
(b) hypocalcaemia which always needs treatment with intravenous calcium
(c) meningitis

ANSWERS: 1) a,b,c

VOMITING AND FEEDING PROBLEMS

- **Ingested liquor / blood -** Babies who have swallowed a lot of liquor, or blood, before birth may retch and appear distressed after birth, particularly if the liquor contained meconium. Such problems almost always settle within a few hours without any intervention
- **Oesophageal atresia** – should always be considered in the baby with excess frothy saliva. Surgery is much more likely to be successful if this can be performed before aspiration pneumonia develops. Pass a large bore catheter as far down the oesophagus as possible. If an x-ray shows that this has stopped at the level of the heart and has not entered the stomach the diagnosis is made. Such a baby needs referral for surgery and steps taken to suck the blind upper oesophageal pouch clear of all accumulating secretions at least once an hour before and during transfer. Site an IV line and ensure the baby does not become hypoglycaemic.
- **Uncoordinated feeding -** Babies born before 36 weeks gestation often have difficulty sucking and swallowing in a coordinated way. Most will initially need some tube feeds. They are not likely to start gaining weight until they are taking at least 120 ml/kg of milk a day, and they need to be fed regularly at least once every 4 hours day and night. Breast milk can be supplemented with formula milk at this time if donor milk is not available, but every effort needs to be made to sustain the mother's lactation. In this circumstance it may help to let the preterm baby to suckle regularly at the breast.
- **Regurgitation** - Hurried feeding may cause regurgitation and, if the cough reflex is poorly developed, this can cause the baby to inhale milk into the lung. This will cause a chemical pneumonitis – which could progress to bacterial pneumonia, and make the baby increasingly oxygen dependent. Newborn babies benefit, therefore, from frequent small feeds every 2-3 hours. Patience is required, and feeds should only be increased gradually over the first 3-5 days of life. Dehydration (and the risk of hypoglycaemia) need to be prevented during this period by giving supplemental 10% dextrose IV so that total fluid intake (taking the IV and the oral intake together) does not fall below 120 ml/kg per day.
- **Respiratory distress –** A small proportion of babies show signs of respiratory distress during the first 2-3 days of life because lung surfactant production is limited.

Such babies should not be offered anything by mouth until these problems settle. Peristaltic activity is also reduced or absent in babies who are shocked, ill or infected, so these too should not be offered anything by mouth. The passage of stool, a renewed interest in sucking, and return of bowel sounds suggests that the paralytic ileus has resolved, and oral feeding can be re-introduced.

- **Feeding tubes** - Orogastric feeding is the best option for babies who have not yet developed a coordinated suck and swallow reflex. Nasogastric tubes are popular and easier to secure in place, but can almost completely block one nostril, significantly increasing the work of breathing. The modern tendency to leave a fine bore NGT in place is not encouraged as it partially obstructs the nostril, makes estimate of the gastric residue difficult and may encourage reflux. Preterm babies nearly always accept the quick passage of a large orogastric feeding tube without showing any sign of distress. In this situation, therefore, it is often better to pass a wide-bore oral tube each time, test for any 'gastric residual', syringe the feed slowly in over about five minutes, and then withdraw the tube again in one steady movement. The tube can then be washed out, left in weak sodium hypochlorite, and reused for the same baby indefinitely. Small frail babies should be handled as little and gently as possible and can be left lying undisturbed in their cots during a tube feed as long as the head end of the cot is elevated 25 cm.
- **Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl)**

If drowsy, unconscious or convulsing, check blood glucose If glucose <1.1 mmol/l (<20 mg/100 ml), give glucose IV. If glucose 1.1–2.2 mmol/l (20–40 mg/100 ml), feed immediately and increase feeding frequency. If you cannot check blood glucose quickly, assume hypoglycaemia and give glucose IV. If you cannot insert an IV drip, give expressed breast milk or glucose through a nasogastric tube. Consider an IO or UVC line if unconscious and may have hypoglycaemia.

- **Change in feeding habit** - A **sudden reluctance** to feed is one of the commonest early signs of bacterial infection. Babies who are becoming drowsy or unconscious also show no interest in feeding.

- o **Vomiting –** Persisting **minor reflux** is seldom a problem even if it makes the baby go temporarily apnoeic. Indeed it is much better that the baby should go briefly apnoeic, than that it should inhale what has just refluxed up the oesophagus. This is particularly true if what has come up contains gastric acid (easily tested using blue litmus paper 2-3 times a day). Such reflux in a small baby often responds to smaller more frequent feeds.
- o **Serious vomiting**, often associated with abdominal distension, in the first few days of life suggests the existence of a problem requiring referral for surgical review. This is particularly true if the vomit is green or bile stained as this is suggestive of duodenal atresia and requires urgent surgical intervention. If serious vomiting develops in a baby who has passed changing stool, the diagnoses of **volvulus, pyloric stenosis or intussusception** must be a considered, so surgical evaluation is essential.

- **Necrotising enterocolitis** – Preterm or light for dates babies are at increased risk of developing this condition, as are those with underlying cardiac abnormalities. The immature gut is not sufficiently developed to receive enteral feeds or cope with bacterial colonisation.

  Suspect the condition in a baby who had started accepting oral feeds, and then develops an ileus or becomes lethargic and starts passing a bloody stool. The problem is caused by the sudden focal invasion of bacteria into an area of ischaemic gut, and an abdominal x-ray will often show gas accumulating within the gut wall. Treat as for suspected sepsis and, because the gut wall has often been invaded by anaerobic Gram negative organisms, give metronidazole as well. Feeds should be discontinued for at least 5 days. Measure haemoglobin daily and transfuse if it falls below 8g/dl (haematocrit below 24%).

  Immediate mortality is quite high, but many cases resolve without surgical intervention (although a stricture may occasionally develop later in the affected area of gut), and it is usually possible to reintroduce feeds after ~5 days. A baby who is sucking and showing interest in food is usually ready for feeding. Intestinal perforation is generally the main indication for surgical intervention, but the prognosis really depends on whether there is generalised peritonitis, and on whether some part of the gut has become totally dead and gangrenous.

SECTION 11 Quiz 8

1) Concerning feeding in the newborn which of the following statements are correct?

a) preterm babies (< 36 weeks gestation) are likely to need some tube feeds
b) if tube feeds are needed, the orgogastric route will significantly increase the work of breathing
c) sudden reluctance to feed may be an early sign of sepsis

2) Which of the following statements are true concerning necrotising enterocolitis?

a) It should be suspected if there is sudden intestinal ileus
b) It can be confirmed by abdominal x-ray if gas is seen within the gut wall
c) It has a high mortality
d) It should always be treated surgically

ANSWERS: **1) a, c 2) a,b,c**

SECTION 12: Management of Paediatric Emergencies (IMEESC 3.2)

Recognition of the seriously ill child

The outcome following cardiac arrest is poor for children. Early recognition and treatment of children presenting with problems affecting respiratory, cardiovascular and CNS function will reduce mortality and morbidity.

This section will focus on recognition and management of the child developing a potentially life threatening condition. It will link with the next section on management of some important conditions. The child with trauma will be covered in a separate section.

The primary assessment ensures that problems with the greatest threat to well being are treated first. The priority is assessment and management of

A – airway
B – breathing
C – circulation
D – disability – which covers conditions affecting the CNS

To be able to evaluate the child, you must be aware of the normal respiratory and heart rates of children at different ages

Age (years)	Heart Rate (bpm)	Systolic BP (mmHg)	Resp rate (/ min)
≤ 1	**110 - 160**	**70 – 90**	**30 - 40**
1 - 2	**100 - 150**	**80 – 95**	**25 - 35**
2 - 5	**95 - 145**	**80 – 100**	**25 - 30**
5 - 12	**80 - 120**	**90 – 110**	**20 - 25**
≥ 12	**60 - 100**	**100 – 120**	**15 - 20**

WHO definitions for tachycardia are: > 160 bpm aged under 1 year and >120 bpm aged 1 to 5 years.

WHO definitions for raised respiratory rates in the child are:

< 2 months fast breathing is > or = 60/minute

2months to 11 months fast breathing is > or = 50/minute

1 to 5 years fast breathing is > or = 40/minute.

Primary Assessment of the Airway (IMEESC 14.3)

If the child is crying or able to talk, then they have a patent airway. The degree of patency can be assessed by
Look

- obvious obstruction to upper airway
- chest and abdominal movements
- drooling of saliva
- posture adopted – e.g. is the neck extended to maximise the airway opening.

Listen

- Noises
  - coughing or choking sounds
  - Stridor which suggests an upper airway obstruction
  - Air entry

Feel – air movement

If any concerns regarding patency of the airway, use the opening airway techniques and re-assess. Proceed along the lines of basic life support and airway maintenance.

Primary Assessment of Breathing

It is important to check

- Effort of breathing – how hard is the child having to work to breathe; and is the child becoming exhausted
- Efficacy of breathing – is the effort being put in resulting in good air entry and oxygenation
- Effects of inadequate breathing – looking for signs that in spite of the effort being put in, the child is not being adequately oxygenated

Effort of breathing

Be aware of the exhausted child who may show signs of little respiratory effort, but be seriously unwell. Apparent reduction in effort should be accompanied by improvement in the child's condition. If it is not, the child is getting worse, and getting tired. Children with CNS depression and those with neuromuscular problems may not have increased effort of breathing – this does not mean they are recovering.

Respiratory rate

- Too fast suggests either lung / airway disease, or a metabolic acidosis
- Too slow suggests fatigue or raised intra-cranial pressure

Recession

- More common in younger children, and suggests a serious problem if noted in a child over the age of 6-7 years
- Look for intercostal, subcostal and sternal recession
- The degree of recession is a useful indicator of the severity of the problem

Inspiratory / expiratory noises

- Stridor is usually inspiratory and suggests upper airway narrowing
- Severe obstruction might cause expiratory stridor
- Wheeze is usually expiratory and associated with lower airway disease
- In neither stridor nor wheeze is the volume of noise an indicator of the severity of the condition

Grunting

- This means the child is trying to breathe out against a partially closed larynx, to prevent collapse of small airways at the end of expiration
- It is usually heard in infants with stiff lungs and is a sign of severe respiratory distress

Use of accessory muscles

- Head bobbing in infants is an attempt to use the sternomastoid muscles to increase air entry. It is generally ineffective although might be useful in older children when the head bobbing does not occur
- flaring of the nostrils increases the calibre of the nasal airway in infants
- neck extension helps keep the airway straight as to allow ease of air entry
- splinting of the pectoral girdle assists when there is increased stiffness of the lungs

Efficacy of breathing

look chest movements

listen bilateral air entry

a silent chest is a very serious sign

pulse oximetry

useful in almost all cases

unreliable in severe anaemia, shock or carboxyhaemoglobinaemia

Effects of inadequate respiration on other organ systems

Heart rate

- hypoxia leads to tachycardia, as the heart works to increase cardiac output and the amount of oxygen being carried to the organs
- fever, pain and anxiety also cause tachycardia, so this is a non-specific sign. Measuring trends in heart rate is useful
- severe hypoxia leads to an ischaemic heart and brain stem resulting in slowing of the heart rate – this is a very serious sign and can rapidly progress to cardio-respiratory arrest if the hypoxaemia is not effectively treated.

Skin colour

- Hypoxia causes vasoconstriction as the body diverts blood from non-essential areas of the body. This causes pallor.
- Cyanosis is a late sign of hypoxia, and may not be detectable in an anaemic child. Unless chronic and associated with congenital heart disease, it represents a serious life threatening problem that needs urgent treatment.

Central nervous system

- Hypoxia and/or hypercapnia cause agitation and drowsiness
- The change in mental status is difficult to detect in infants
- Failure to interact or recognise parents is a serious sign
- Check AVPU

If there are problems with breathing, provide a high flow of oxygen. It may be necessary to help with ventilation.

Primary Assessment of Circulation

It is important to check

- Cardiovascular status
- Effects of circulatory inadequacy on other organs

Cardiovascular status

Heart rate

- Initially increases in shock as the body tries to maintain cardiac output with a falling stroke volume
- Be sure to be familiar with normal heart rates (above)

Pulse volume

- The quality of the pulse may be helpful; the absence of peripheral pulses and weak central pulses is a sign of serious cardiovascular problems

Capillary refill

- This is measured by pressing over the sternum, or non-dependant periphery, for 5 seconds and then releasing. Normal capillary refill is ≤ 3 seconds
- It is less reliable when the child is cold
- Although not a sensitive or specific sign of shock, it is a useful measure which, taken with other signs, may help in evaluating the response to resuscitation

Blood pressure

- **Systolic BP = 80 + (age in years x 2)**
- Always use the correct sized cuff – the length should be 2/3 the length of the upper arm, and the bladder should go round at least 40% of the arm – but not overlap.
- BP may be maintained despite a loss of up to 50% of the circulating blood volume so is a **late sign which if not treated urgently may progress to cardio-respiratory arrest.**
- Monitoring trends in BP and changes in pulse pressure are useful aides

Effects of circulatory inadequacy on other organ systems

Respiratory system

Tachypnoea and hyperventilation occur in response to metabolic acidosis when the child tries to increase the rate of oxygenation of the blood being circulated.

Skin

Pale, mottled skin indicates under perfusion

Central nervous system

Altered mental status indicate an under-perfused brain

Urine output

< 2ml/kg/hr in infants and <1ml/kg/hr in the older child indicates under perfusion of the kidneys.

If there are signs of circulatory failure, consider giving a fluid bolus of 20ml/kg of 0.9% saline

Primary assessment of disability

Once a respiratory or cardiac cause of altered level of consciousness has been ruled out, it is important to consider the CNS causes. In order to function properly the brain needs

- adequate perfusion with adequately oxygenated blood and this may be compromised by respiratory or cardiovascular inadequacy (as above) or by raised intracranial pressure, causing reduced cerebral perfusion pressure
  - intracranial pressure may be raised by
    - increased brain volume e.g. infection, oedema, trauma or tumour
    - increased CSF e.g. outflow obstruction
    - increased volume of blood e.g. trauma, hypercapnia

- glucose- hypoglycaemia **(less than 2.5 mmol/litre (45mg/dl)** is an important cause of impaired consciousness in children.

CNS function may be compromised by convulsions, drugs, and CNS infections
CNS compromise presents with neurological deficit, and effects the respiratory and cardiovascular systems

Neurological assessment

Conscious level

- A rapid assessment of conscious level can be made by using the AVPU scoring system

A	**ALERT**
V	**responds to VOICE**
P	**responds to PAIN**
U	**UNRESPONSIVE**

- Pain should be elicited by sternal pressure or by pulling the frontal hair. A child who **only** responds to pain has a Glasgow Coma score of ≤ 8

Posture

- Many children who are seriously unwell have a degree of hypotonia – particularly infants
- Decerebrate or decorticate postures are ominous signs and may need to be elicited by use of a painful stimulus

Pupils

- Note pupil size, equality and reactivity
- The most important signs are inequality, dilation and unreactivity to light which indicate serious brain disorder
- Many drugs have an impact on the pupils and their effects are symmetrical

Respiratory effects of CNS failure

- Raised intracranial pressure or drugs may cause
  - Hyperventilation
  - Irregular respiratory patterns (Cheynes Stokes) – suggestive of a mid or hind brain problem
  - Slow, sighing respiration
  - Apnoea

Cardiovascular effects

- Hypertension and bradycardia (Cushing's response) are indicative of a life-threatening rise in intracranial pressure and represent the brains efforts to increase cerebral perfusion pressure
- The same signs appear with pressure on the medulla oblongata caused by herniation of the brain through the foramen magnum. This is associated with altered pupillary signs and is **a late sign which if not treated will lead to cardio-respiratory arrest.**

If there is a problem with the CNS, make sure the airway, breathing and circulation problems have been corrected. Always check blood glucose and correct if it is low.

Summary : The Rapid Clinical Assessment of an infant or child

AIRWAY

Look, listen and feel

BREATHING

Effort of breathing
Respiratory rate and pattern
Added noises – stridor / wheeze
Listen to the chest – bilateral air entry
Saturation monitoring
Skin colour

CIRCULATION

Heart rate
Pulse volume
Capillary refill
Skin temperature
BP

DISABILITY

Mental status –
- **A – ALERT**
- **V –** responds to **VOICE**
- **P –** responds to **PAIN**
- **U – UNRESPONSIVE**

Posture
Pupils

On completion of this primary survey, and stabilisation of A, B and C, the next step is to identify the most likely underlying cause of the problem (if you have not already done so) and initiate definitive treatment

The next sections look at some common conditions affecting airway, breathing, circulation and central nervous system

Section 12 Quiz 1

With regard to the interpretation of clinical signs, which of the following statements are true?

a) a heart rate of 90 bpm in a 7 year old would be considered normal
b) a breathing rate of 60 per minute in a 6 month old would be considered normal
c) a breathing rate of 45 per minute in a 3 year old would be considered normal
d) a heart rate of 100 per minute in a 2 year old would be considered normal
e) a breathing rate of 16 per minute in a 14 year old would be considered normal

Section 12 Quiz 2

During the primary assessment of airway and/or breathing which of the following statements are correct?

a) a slow respiratory rate is always reassuring
b) intercostal recession is a particularly serious sign if seen in a 7 year old child
c) the severity of stridor is directly related to the volume of the noise produced
d) pulse oximetry is of little use because of its limitations
e) cyanosis may not be detected in an anaemic child
f) a high flow of oxygen should be provided as soon as a problem with breathing is recognised

Section 12 Quiz 3

During the primary assessment of circulation, which of the following statements are correct?

a) capillary refill can be measured by pressing on the sternum for 2 seconds and then releasing
b) the quality of the peripheral pulse may be a helpful sign
c) blood pressure may be maintained at normal levels when 40% of blood volume has been lost
d) a fast breathing rate may be noticed when the main problem is with circulation
e) a more reliable assessment of circulation can be obtained when all the parameters are considered together rather than in isolation
f) a fluid bolus of 20 ml/kg of 0.9% saline should be given if there are signs of shock

Section 12 Quiz 4

During the primary assessment of disability, which of the following statements are correct?

a) the Glasgow coma score is the fastest way of assessing conscious level
b) it is important to check blood glucose level
c) if the pupils are unequal and unreactive, drugs are likely to be the cause

ANSWERS

1. a,d,e 2. b,e,f 3. b,c,d,e,f 4. b

The Infant or Child with Serious Breathing Difficulties

Once the initial assessment has been completed, attention must be focused on managing the most likely cause of the breathing difficulty.

When dealing with a child with respiratory problems, always perform the primary assessment and manage problems as they arise.

A – always support and protect the airway

B --provide high flow oxygen; assist ventilation if needed

C – give IV fluids if signs of circulatory failure

Whatever the cause of the breathing difficulty, it is important to act when there are signs that the child is getting worse. Some important signs to look for are below

- Increasing recession
- Increasing respiratory rate
- Decreasing respiratory rate in a child who is not improving
- Apnoeic episodes
- Increasing pulse rate or bradycardia
- Fatigue or exhaustion
- Altered mental state
- Cyanosis

There are many causes of breathing difficulties – not all of them are due to a respiratory condition – see table below

Not all of these conditions are discussed in this section of the manual. More detail is in the Basic Life Support section. Only those subjects in **bold type** are discussed here.

Table – Range of problems that cause breathing difficulties

Breathing difficulties	Causes
Upper airway obstruction	❑ Diphtheria ❑ **Anaphylaxis** ❑ **Croup** ❑ Foreign body (see BLS section) ❑ **Epiglottitis** ❑ Retro-phargyngeal abscess ❑ Anatomical causes
Lower airway obstruction	❑ Tracheitis ❑ **Asthma** ❑ **Bronchiolitis**
Disorders affecting lungs	❑ **Pneumonia** ❑ Pulmonary oedema
Disorders around the lungs	❑ Pneumothorax ❑ Empyema ❑ Rib fractures
Disorders of the respiratory muscles	❑ Neuromuscular
Disorders below the diaphragm	❑ Peritonitis ❑ Abdominal distension
Increased respiratory drive	❑ Diabetic ketoacidosis ❑ Shock ❑ Poisoning (eg salicylates) ❑ Anxiety attack ❑ Hyperventilation
Increased respiratory drive	❑ Diabetic ketoacidosis ❑ Shock ❑ Poisoning (eg salicylates) ❑ Anxiety attack ❑ Hyperventilation
Decreased respiratory drive	❑ Coma ❑ Convulsions ❑ Raised intracranial pressure ❑ Poisoning

Upper airway obstruction

This is potentially life threatening and may be caused by swelling, secretions or foreign material. The smaller the child the more at risk they are because of the small cross sectional area of the airways.

Pathway of Care: Acute Upper Airway Obstruction in Children

Apply choking protocol if aspiration of foreign body suspected (see Section 7)
Other acute or potential obstruction
Do not upset child by examination or procedures
Crying can precipitate respiratory arrest

Is the child alert?

Yes

- Allow the child to adopt position of most comfort
- Parent to hold/support child
- High flow oxygen
- *Alert anaesthetist and ENT surgeon*
- Consider nebulised adrenaline 5ml 1 in 1000
- If **croup** give dexamethasone 150micrograms/kg orally or nebulised budesonide 2mg

No

- *Call for anaesthetist and ENT surgeon*
- Open airway
  - head tilt, chin lift
  - jaw thrust
  - oropharyngeal airway
- High flow oxygen
- Try **nebulised adrenaline** 5ml 1 in 1000
- If **anaphylaxis –** adrenaline 10 micrograms/kg IM
- Assist ventilation with bag, valve, mask if possible
- Laryngoscopy to remove **foreign body** if present
- Consider intubation
- Consider urgent surgical airway:
  - Cricothyroidotomy
  - Tracheostomy

ACTION AFTER AIRWAY SAFE

IV antibiotics effective against epiglottitis, bacterial tracheitis or diphtheria
If diphtheria - antitoxin 60,000 units IV after test dose 0.1ml intradermal - observe for cardiac arrhythmias
Dexamethasone 150 micrograms/kg IV/orally daily for 3 days if severe croup
Dexamethasone 600 micrograms/kg IV/orally daily for 3 days if diphtheria

Specific topics

Croup

Croup is usually caused by a virus. As with any condition which affects the airway, the patient and family will be frightened. Do not do anything to make this worse. Do not put anything in the child's mouth, or cause pain by repeated attempts at cannulation.

Clinical Features

- Child age 6months – 5 years
- 1 – 3 days coryza
- mild fever < 38.5
- barking cough or hoarseness, worse at night
- inspiratory stridor
- variable respiratory distress
- usually resolve without need for admission

Treatment

- Oxygen if SaO2 < 95%
- In severe cases nebulised adrenaline 5ml 1:1000
- Dexamethasone 0.6 mg/kg PO or IM or equivalent dose of other steroid**

Or

- Budesonide 2mg nebulised
- If concerned re bacterial tracheitis treat with antibiotics (e.g. cefuroxime)
- Intubation may be needed in severe cases

** 1mg prednisilone = 5mg hydrocortisone = 0.15mg dexamethasone

Epiglotittis This is almost always caused by *Haemophilius Influenzae type B* and is very rare in children who have been immunized. Some of the features are similar to croup, but the child is more unwell; the onset is more rapid and cough is not a feature

Comparison of Croup and Epiglotittis		
Feature	**Croup**	**Epiglotittis**
Onset	Over a few days	Over a few hours
Preceding coryza	Yes	No
Cough	Severe, barking	Absent or slight
Able to drink	Yes	No
Drooling saliva	No	Yes
Appearance	Unwell	Toxic, very unwell
Fever	< 38.5	> 38.5
Stridor	Harsh, rasping	Soft
Voice	Hoarse	Muffled, soft voice
Need for intubation	≈ 1%	> 80%

Treatment of Epiglotittis

Calm, reassurance. Do not distress the child

Elective intubation is the best treatment but may be very difficult – consider the need for surgical airway

IV antibiotics only when airway is safe– ceftriaxone or cefotaxime 30mg/kg

Measles
Measles is a highly contagious viral disease with serious complications (such as blindness in children with pre-existing vitamin A deficiency) and high mortality. It is rare in infants under 3 months of age.

Diagnosis
Fever plus a generalized maculopapular rash and one of the following—cough, runny nose, or red eyes. In children with HIV infection, these signs may not be present and the diagnosis of measles may be difficult.

Severe complicated measles
The above plus:
- inability to drink or breastfeed
- vomits everything
- convulsions

On examination, look for signs of late complications after the rash has disappeared, such as:
- lethargy or unconsciousness
- corneal clouding
- deep or extensive mouth ulcers.
- pneumonia
- dehydration from diarrhea
- stridor due to measles croup
- severe malnutrition.

Treatment of severe measles
Children with severe complicated measles require treatment in hospital

Vitamin A therapy. Give oral vitamin A **to all** children with measles unless the child has already had adequate vitamin A treatment for this illness as an outpatient. Give oral vitamin A 50 000 IU (for a child aged <6 months), 100 000 IU (6–11 months) or 200 000 IU (12 months up to 5 years). If the child shows any eye signs of vitamin A deficiency or is severely malnourished, a third dose must be given 2–4 weeks after the second dose.

If the temperature is ≥39 °C (≥102.2 °F) and this is causing the child distress, give paracetamol.

Nutritional support

Life threatening complications
- Pneumonia
- Diarrhea: treat dehydration, bloody diarrhea or persistent diarrhea
- Measles croup: WHO say do not give steroids: EMCH as with other causes of croup give one dose of steroids
- Eye problems. Conjunctivitis and corneal and retinal damage may occur due to infection, vitamin A deficiency, or harmful local remedies. In addition to giving vitamin A (as above), treat any infection that is present. If there is a clear watery discharge, no treatment is needed. If there is pus discharge, clean the eyes using cotton wool boiled in water, or a clean cloth dipped in clean water. Apply tetracycline eye ointment,

3 times a day for 7 days. Never use steroid ointment. Use a protective eye pad to prevent other infections. If there is no improvement, refer to an eye specialist.

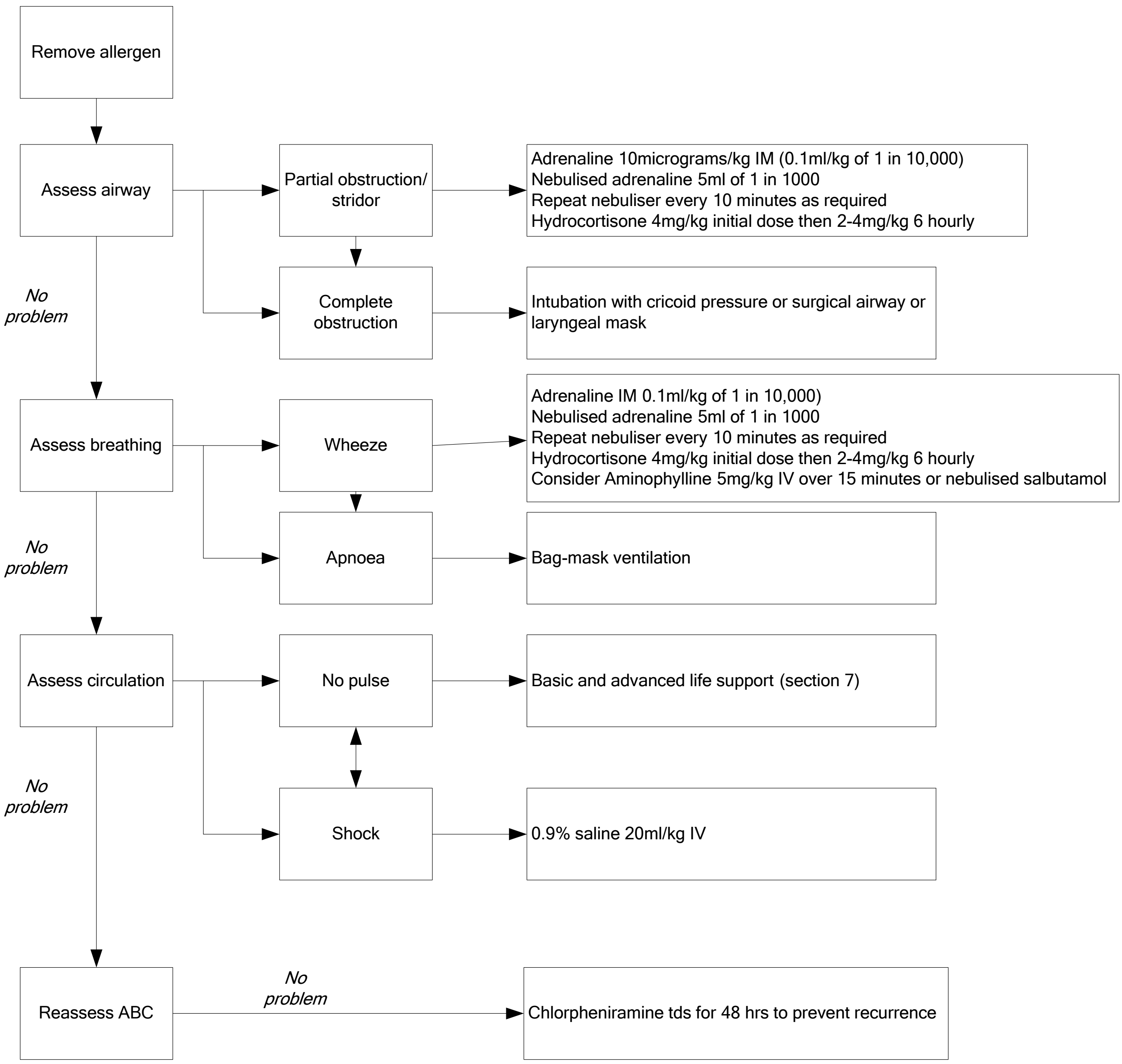
- Mouth ulcers. If the child is able to drink and eat, clean the mouth with clean, salted water (a pinch of salt in a cup of water) at least 4 times a day.
  - Apply 0.25% gentian violet to the sores in the mouth after cleaning.
  - If the mouth ulcers are severe and/or smelly, give IM/IV benzylpenicillin (50,000 units/kg every 6 hours (50mg/kg) and oral metronidazole (7.5 mg/kg 3 times a day) for 5 days.
  - If the mouth sores result in decreased intake of food or fluids, the child may require feeding via a nasogastric tube.
- Neurological complications. Convulsions, excessive sleepiness, drowsiness or coma may be a symptom of encephalitis or severe dehydration.

Anaphylaxis

This is a severe allergic reaction, which may cause respiratory or circulatory problems – or both. The main treatments are IM adrenaline 10micrograms/kg (only given IV / IO if severe shock or cardiac arrest) steroids and IV fluids

Diagnosis
Allergic reaction with respiratory difficulty and / or shock

Pathway of care for Anaphylaxis in a child



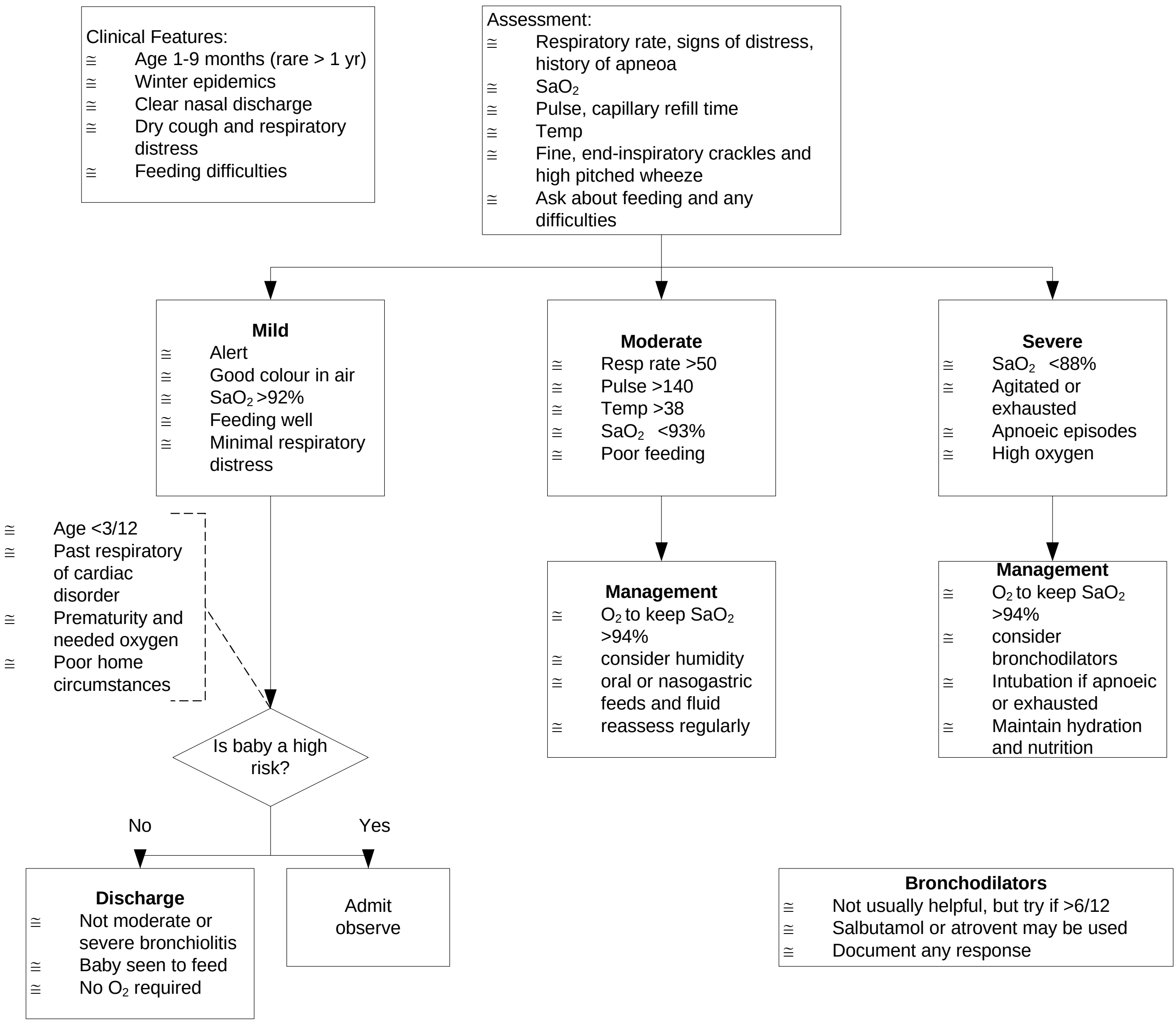
Lower Respiratory Tract infections

Wheeze – The commonest diagnosis is either

- **Bronchiolitis –** in children under 1 year old
- **Asthma** – in older children

Bronchiolitis

Pathway of care for Bronchiolitis



WHO recommends antibiotics for severe cases of bronchiolitis

Severe Asthma

The classic features of acute asthma are cough, wheeze and breathlessness. Any increase in these symptoms, difficulty walking, talking or sleeping, suggests the asthma is getting worse. Worsening asthma is often caused by a viral infection in young children, and by exercise in older children.

Assessment of severity

When trying to decide how severe an attack is, it is helpful to know how often the child has attacks; how severe they are (e.g. has the child ever been intubated); and what treatment is usually given. The clinical examination helps to decide if the child has moderate or severe/life threatening asthma

Features of severe or life-threatening asthma

- Too breathless to feed or talk
- Marked recession / use of accessory muscles
- Respiratory rate > 50/min
- Pulse rate > 140 / min
- Poor chest movement / silent chest
- SaO_2 < 85% or cyanosis
- Depressed level of consciousness / agitation / exhaustion

Pathway of Care for Severe Asthma

High flow oxygen by mask held close to nose and mouth
Salbutamol by spacer (see drug list)

↓

Back to oxygen for 4 minutes

↓

Is the child improving?

YES →

Repeat Salbutamol by spacer as (1-2 hourly EMCH: 4 hourly WHO)
Oral prednisilone

↓

Repeat x 5 cycles as long as improving

NO →

Nebulised Salbutamol driven by O2
Or
Continuous back to back spacers (EMCH)

↓ **If NOT improving**

Continuous (EMCH) (hourly WHO) nebulised salbutamol
IV hydrocortisone 4mg/kg or oral prednisilone if not vomiting

↓ **If NOT improving**

Subcutaneous or IM Adrenaline

OR

IV aminophylline
IV salbutamol

Omit loading dose of aminophylline if any given in preceding 24 hours
Stop infusion if vomits, HR .180, convulses or headache

Drugs in asthma

Salbutamol
- Spacer 10 x 100 mcg puffs initially then 10 breaths from spacer in 2 minutes (WHO 3 -5 breaths)
- Nebulisers
  - 2.5mg if <5 years old
  - 5mg for ≥ 5 years old
- IV loading 1 month to 2 years 5mcg/kg, 2-18 years 15mcg/kg .
- IV infusion 36-300mcg/kg/hr according to need

Aminophylline
- Loading 5-6mg/kg over 20-60 mins (max dose = 300mg)
- Infusion 1mg/kg/hr

Adrenaline
- 10microgram/kg IM or SC

Steroids
- Hydrocortisone 4 to 8 mg/kg IV (max. 300mg)
- Prednisolone 1mg/kg PO

Severe Asthma - Indications for intubation and ventilation (if available):

- Increasing exhaustion
- Progressive deterioration in
  - clinical condition
  - oxygenation decreasing and/or oxygen requirement increasing
  - pCO2 increasing (if measurable from arterial/capillary gas)
- Sudden deterioration – and always think about a pneumothorax

Acute lower respiratory tract infection

Always consider that the child might be suffering from TB or HIV infection.
A high fever in a child with breathing difficulties is likely to be due to epiglotittis, bacterial tracheitis or pneumonia. If the airway is clear, the most likely diagnosis is pneumonia. Although high fever and respiratory signs are the usual way for pneumonia to present, it should always be considered in the list of causes of abdominal pain and neck stiffness

Clinical examination (and CXR) cannot reliably tell the difference between a viral and a bacterial pneumonia, so all cases are treated with antibiotics

Features of Pneumonia

- Fever, cough, breathlessness and lethargy following an upper respiratory infection
- Pleuritic chest pain, abdominal pain and neck stiffness indicate pleural involvement
- Signs of consolidation
  - Dull percussion
  - Reduced breath sounds
  - Bronchial breathing

  May be absent in an infant
- CXR may show pleural effusion or empyema as well as consolidation

Treatment

- Oxygen to maintain $SaO_2 > 94\%$
- IV antibiotics
  - Cefotaxime plus either
    - Flucloxacillin

      OR
    - Erythromycin
  - WHO benzyl penicillin and amoxicillin (see below)
- Maintain hydration and replace losses due to high fever
- Do not overload
- CXR is helpful, but not essential

The following section is modified from the WHO Pocket Book of Hospital Care for Children.

CLASSIFICATION OF THE SEVERITY OF PNEUMONIA (WHO)

Sign or symptom	Classification	Treatment
• Central cyanosis	Very severe	Admit to hospital

• Severe respiratory distress e.g. head nodding, • Not able to drink	pneumonia	Give recommended antibiotic Give oxygen Manage the airway Treat high fever if present
Chest in-drawing	Severe pneumonia	Admit to hospital Give recommended antibiotic Manage the airway Treat high fever if present
Fast breathing ≥60 breaths/minute in a child aged <2 months ≥50 breaths/minute in a child aged 2 – 11 months ≥40 breaths/minute in a child aged 1 – 5 years Definite crackles on auscultation	Pneumonia	Home care Give appropriate antibiotic for 5 days Soothe the throat and relieve cough with a safe remedy Advise the mother when to return immediately Follow up in 2 days
No signs of pneumonia or severe or very severe pneumonia	No pneumonia Cough or cold	Home care Soothe the throat and relieve cough with safe remedy Advise the mother to return Follow up in 5 days if not improving If coughing for more than 30 days follow chronic cough instructions

Very severe pneumonia: Diagnosis

Cough or difficult breathing plus at least one of the following:

- central cyanosis
- inability to breastfeed or drink, or vomiting everything
- convulsions, lethargy or unconsciousness
- severe respiratory distress.

In addition, some or all of the other signs of pneumonia or severe pneumonia may be present, such as:

— fast breathing: age <2 months: ≥60/minute
age 2–11 months: ≥50/minute
age 1–5 years: ≥40/minute

— nasal flaring
— grunting (in young infants)
— lower chest wall indrawing
— chest auscultation signs of pneumonia:
  — decreased breath sounds
  — bronchial breath sounds
  — crackles

— abnormal vocal resonance (decreased over a pleural effusion, increased over lobar consolidation)

— pleural rub

If possible, obtain a chest X-ray and SaO2.

Emergency Treatment

Admit the child to hospital

Antibiotic therapy

- Give ampicillin (50 mg/kg IM every 6 hours) and gentamicin (7.5 mg/kg IM once a day) for 5 days; then, if child responds well, complete treatment at home or in hospital with oral amoxicillin (15 mg/kg three times a day (max 500mg, 1g in severe)) plus IM gentamicin once daily for a further 5 days.
- Alternatively, give chloramphenicol (25 mg/kg IM or IV every 8 hours) until the child has improved. Then continue orally 4 times a day for a total course of 10 days. Or use ceftriaxone (80 mg/kg IM or IV once daily).
- If the child does not improve within 48 hours, switch to gentamicin (7.5 mg/kg IM once a day) and cloxacillin (50 mg/kg IM or IV every 6 hours), as described below for staphylococcal pneumonia. When the child improves, continue cloxacillin (or dicloxacillin) orally 4 times a day for a total course of 3 weeks.

Oxygen therapy

Give oxygen to all children with very severe pneumonia

Oxygen if SaO2 < 90% (WHO) or < 94% ESSEMCH until the signs of hypoxia (such as severe lower chest wall in-drawing or breathing rate of ≥70/minute) are no longer present.

Nurses should check every 3 hours that the catheter or prongs are not blocked with mucus and are in the correct place and that all connections are secure.

Supportive care

- If the child has fever (≥39 °C or ≥102.2 °F) which appears to be causing distress, give paracetamol.
- If wheeze is present, give a rapid-acting bronchodilator
- Remove by gentle suction any thick secretions in the throat, which the child cannot clear.
- Ensure daily maintenance fluids appropriate for age but avoid over-hydration.
  - — Encourage breastfeeding and oral fluids.
  - — If the child cannot drink, insert a nasogastric tube and give maintenance fluids in frequent small amounts. If the child is taking fluids adequately by mouth, do not use a nasogastric tube as it increases the risk of aspiration pneumonia. If oxygen is given at the same time as nasogastric fluids, pass both tubes through the same nostril.
- Encourage eating as soon as food can be taken.

Complications

If not improved after two days, or if condition has worsened, if possible, obtain a chest X-ray.

Staphylococcal pneumonia. This is suggested if there is rapid clinical deterioration despite treatment, by a pneumatocoele or pneumothorax with effusion on chest X-ray, numerous Gram-positive cocci in a smear of sputum, or heavy growth of S. aureus in cultured sputum or empyema fluid. The presence of septic skin pustules supports the diagnosis.

- Treat with cloxacillin (50 mg/kg IM or IV every 6 hours) and gentamicin (7.5 mg/kg IM or IV once a day). When the child improves, continue cloxacillin orally 4 times a day for a total course of 3 weeks. Note that cloxacillin can be substituted by another anti-staphylococcal antibiotic such as oxacillin, flucloxacillin, or dicloxacillin.

Pleural effusion and empyema

Diagnosis
On examination, the chest is dull to percussion and breath sounds are reduced or absent over the affected area.
A pleural rub may be heard at an early stage before the effusion is fully developed.
A chest X-ray shows fluid on one or both sides of the chest.
(An ultrasound examination may be helpful in identifying the size of the effusion and helping to guide drainage ESS-EMCH)
When empyema is present, fever persists despite antibiotic therapy and the pleural fluid is cloudy or frankly purulent.

Treatment

Drainage
Pleural effusions should be drained, unless they are small. If effusions are present on both sides of the chest, drain both. It may be necessary to repeat drainage 2–3 times if fluid returns.

Subsequent management depends on the character of the fluid obtained. Where possible, pleural fluid should be analysed for protein and glucose content, cell count and differential count, and examined after Gram and Ziehl- Neelsen staining, and bacterial and Mycobacterium tuberculosis culture.

Failure to improve
If fever and other signs of illness continue, despite adequate chest drainage and antimicrobial therapy, assess for possible tuberculosis. A trial of antituberculosis therapy may be required

Heart failure

Heart failure causes fast breathing and respiratory distress.

Underlying causes include congenital heart disease (usually in the first months of life), acute rheumatic fever, myocarditis, suppurative pericarditis with constriction, infective endocarditis, acute glomerulonephritis, severe anaemia, very severe pneumonia and severe malnutrition.

Heart failure can be precipitated or worsened by fluid overload, especially when giving salt-containing IV fluids.

Diagnosis

The most common signs of heart failure, on examination, are:

- Tachycardia (heart rate >160/minute in a child under 12 months old; >120/minute in a child aged 12 months to 5 years).
- Gallop rhythm
- Basal crackles on auscultation.
- Enlarged, tender liver.

In infants—fast breathing (or sweating), especially when feeding

In older children oedema of the feet, hands or face, or distended neck veins (raised JVP).

Severe palmar pallor may be present if severe anaemia is the cause of the heart failure.
If the diagnosis is in doubt, a chest X-ray can be taken and will show an enlarged heart.
Measure blood pressure if possible. If raised consider acute glomerulonephritis: microscope urine

Treatment

The main measures for treatment of heart failure in none-severely malnourished children are:
Diuretics. Give frusemide a dose of 1 mg/kg should cause increased urine flow within 2 hours. For faster action, give the drug IV. If the initial dose is not effective, give 2 mg/kg and repeat in 12 hours, if necessary. Thereafter, a single daily dose of 1–2 mg/kg orally is usually sufficient. Maximum is around 40mg per dose, but can give more.
Digoxin.
Supplemental potassium. Supplemental potassium is not required when frusemide is given alone for treatment lasting only a few days. When digoxin and frusemide are given, or if frusemide is given for more than 5 days, give oral potassium (3–5 mmol/kg/day).
Oxygen. Give oxygen if the child has a respiratory rate of ≥70/min, shows signs of respiratory distress, or has central cyanosis or an oxygen saturation of < 94% (EMCH).

Supportive care

- Avoid the use of IV fluids, where possible.
- Support the child in a semi-seated position with head and shoulders elevated and lower limbs dependent.
- Relieve any fever with paracetamol to reduce the cardiac workload.

Section 12 Quiz 5

Which of the following statements are true when considering acute upper airway obstruction in children?

a) upsetting the child can make obstruction much worse
b) expert advice from ENT surgeon and/or anaesthetist should be sought only after diagnosis has been made and specific treatment started
c) nebulised adrenaline may improve symptoms
d) oral or nebulised steroids are indicated for treatment of epiglottis
e) if anaphylaxis is the cause, breathing and circulation problems should be anticipated

Section 12 Quiz 6

When assessing breathing problems in children in their 1st year of life, which of the following statements are true?

a) bronchiolitis is the commonest cause of wheeze
b) management of bronchiolitis includes oxygen to keep $SaO_2 > 94\%$
c) bronchodilators are usually helpful in babies less then 3 months old
d) if the baby has difficulty feeding, naso or orogastric tube nutrition may be needed

ANSWERS
5. a,c,e 6. a, b, d

Section 12 Quiz 7

Features of severe asthma include which of the following?
a) agitation and/or decreased conscious level
b) decreased chest movement and decreased breath sounds
c) cyanosis
d) respiratory rate greater than 50/minute

Section 12 Quiz 8

Which of the following statements about the management of severe asthma are true?
a) salbutamol by spacer or nebuliser
b) oral prednisolone 0.5 mg/kg
c) 5 mg nebulised salbutamol for children aged 1 – 4 years old
d) consideration of pneumothorax if there is a sudden deterioration during treatment

ANSWERS

7. a,b,c,d 8. a, d

Management of the Infant or Child in Shock

Shock is defined as inadequate perfusion of vital organs with adequately oxygenated blood.
Management of shock is focused in two areas

- Resuscitation and support for the circulation, after making sure the airway and breathing are stable and supported
- Treatment of the underlying cause

There are many causes of shock

- Loss of fluid e.g. gastroenteritis; trauma
- Redistribution of fluid e.g. septicaemia; anaphylaxis
- Failure of circulation e.g. cardiac disease; tension pneumothorax

It is often possible to identify the cause of shock with a good history and a careful examination.

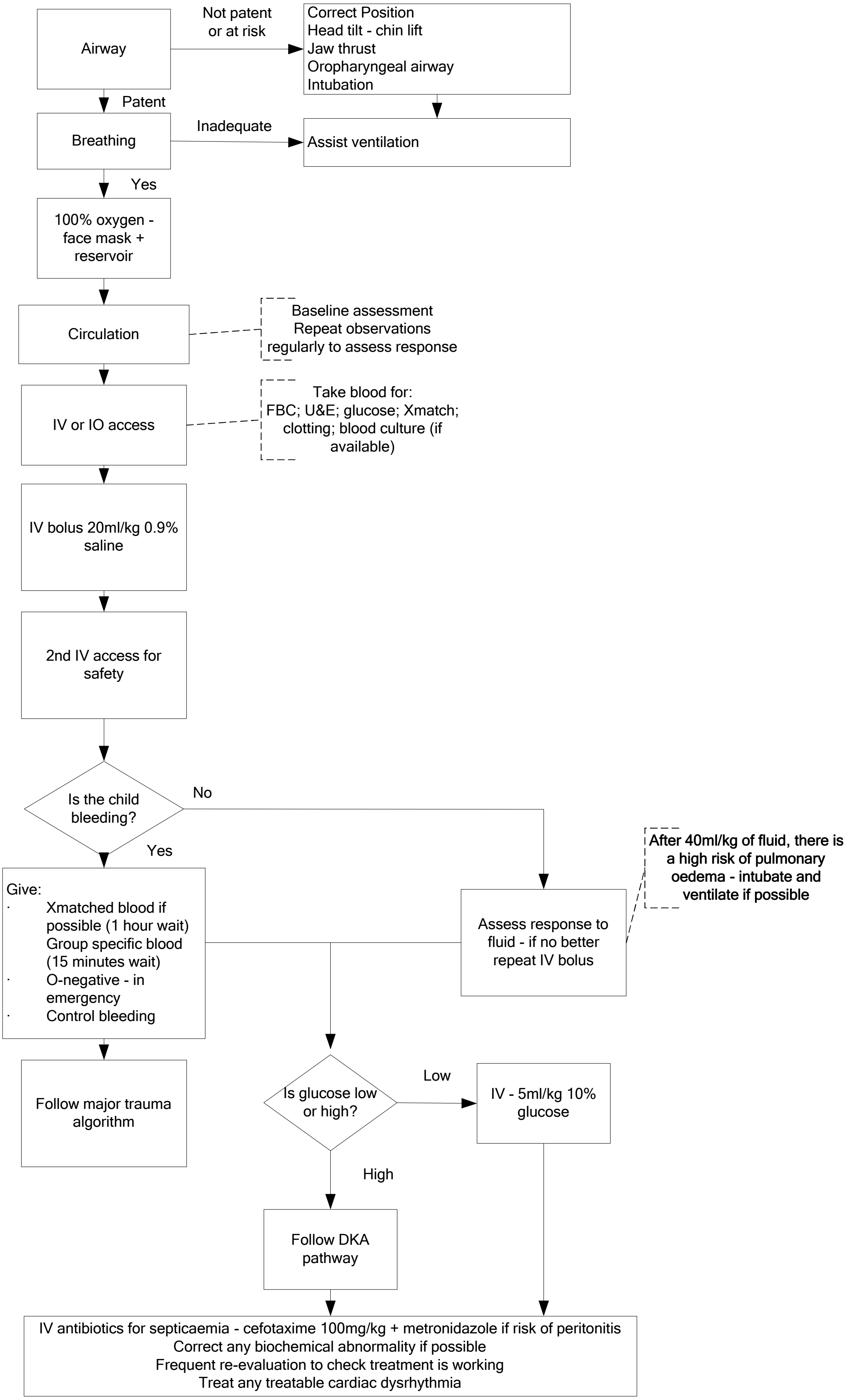
Diagnostic pointers to the cause of shock (those in **bold** will be discussed in detail	
Diarrhoea and / or vomiting	**Gastroenteritis;** volvulus; intussusception
Fever; non-blanching (purpuric) rash	**Septicaemia, Dengue Haemorrhagic Fever**
Urticaria; wheeze; oedema; exposure to allergen	Anaphylaxis
Trauma	Blood loss; tension pneumothorax; internal bleeding
Burns	Fluid loss; blood loss
Baby < 4 weeks old; cyanosis, with no response to oxygen	Congenital heart disease
Very fast pulse; heart failure	**Arrhythmia;** cardiomyopathy
Dehydration, polyuria, polydipsia, high glucose	**Diabetic keto-acidosis**
History of sickle cell disease or diarrhoeal illness and low haemoglobin	Haemolysis with severe anaemia
Pallor, tachycardia, malnutrition	Severe anaemia

The diagnosis and management of shock is complicated by malnutrition, and this will be discussed in a separate section.

Initial Management of Shock

Even though it may be clear on initial inspection that the child is in shock, the first priority will still be the airway, followed by breathing and then management of the circulation.
Intravenous access with short, wide venous cannula, or placement of an intraosseous line (see procedures) is important. It is best to try and get more than one line in case rapid fluid resuscitation is needed. Always take blood for investigations (if available)
FBC; glucose; renal and liver function; blood culture and cross matching

Pathway of Care for the Child in Hypovolaemic/Septic Shock



Specific topics causing shock

The most important thing to do is to stabilise the circulation and maintain perfusion of vital organs. Once this is underway, the cause of the problem needs to be treated.

Dehydration

- Dehydration is loss of water, sodium and other essential electrolytes
- Children are at greater risk because of their higher percentage of total body water
- The most common causes are gastroenteritis and diabetic ketoacidosis
- It is important to also consider surgical causes of dehydration, such as intussusception and volvulus
- Most cases can be managed by simple clinical assessment and treatment
- Most can be treated with oral rehydration solution (ORS) by mouth or NG tube
- In children with severe malnutrition, use a solution with a lower sodium content such as ReSoMal. Care for patients with malnutrition is discussed later.

Dehydration is classified by the percentage of body water lost and is usually only an estimate.

Classification of Dehydration (IMEESC 13.4)

Dehydration is classified according to clinical criteria. This may not apply in severe malnutrition where CARE IS NEEDED

No dehydration <3% wt loss = NO SIGNS!

Some dehydration 3-9% wt loss

Increased thirst, drinks eagerly: dry mucous membranes: loss of skin turgor, tenting when pinched : sunken eyes: sunken fontanel in infants: restless or irritable behavior

Severe dehydration ≥10% wt loss

- More pronounced effects of signs seen in moderate dehydration
- Lack of urine output
- Lack of tears when crying
- Not able to drink or drinks poorly
- Hypovolaemic shock, including:
  - rapid and feeble pulse (radial pulse may be undetectable)
  - low or undetectable BP
  - cool and poorly perfused extremities
  - over sternum decreased capillary refill (> 3s)
  - peripheral cyanosis
- Rapid, deep breathing (from acidosis)
- Altered consciousness or coma
- Lethargy

Emergency treatment of severe dehydration: Principles of treatment

- Recognise and treat shock
  - Give a fluid bolus 20ml/kg 0.9% N/saline IV
  - A second bolus may be needed if the child does not respond well (see the "shock" pathway)
  - It is unusual to need more than this in cases of dehydration due to gastroenteritis – think of other causes. If sepsis is suspected, treat with IV antibiotics
- Decide on the most likely cause of dehydration
- Decide what level of dehydration you are treating (see above)

Calculate the fluid deficit, maintenance needs and on-going losses (see below) When shock has resolved and the patients level of consciousness returns to normal, the remaining estimated deficit MUST BE TAKEN by mouth or by gastric tube especially if severe malnutrition and/or anaemia (danger of large IV fluid volume IV)

- In severe cases, intubation, ventilation, CVP monitoring and inotrope support might be indicated, if these are available
- Check the serum sodium, and if >155mmol/l, reduce it slowly over 48 hrs. Too rapid a reduction in sodium leads to cerebral oedema
- Further tests might include abdominal X-ray or ultrasound, if there is concern regarding a distended abdomen.
- A surgical opinion is needed if bile stained vomiting or abdominal guarding

Calculating Fluid Requirements

WHO Plans A-C for gastroenteritis in children (see Pathway of care) include estimates of total fluid requirements and assume that most children will be drinking by 4 hours into treatment and thus able to "self-regulate". For patients where this is not the case, Fluid Management can be conducted using the following guidelines.

Estimating Fluid requirements

The amount of fluid that the child needs over a 24 hour period needs to be calculated. It is the sum of:

Estimated fluid deficit + maintenance requirements + on-going losses

Deficit

If an accurate recent pre-illness weight is available, subtract current weight to estimate lost fluid (1 kg = 1 litre of fluid)

eg a child who weighed 9.2 kg is seen with diarrhea and weight 8.3kg: estimated fluid loss is [9.2 - 8.3]kg = 0.9kg = 900ml deficit, that is 10% dehydrated

If no recent weight or considered to be unreliable:

decide degree of dehydration

weigh child (or estimate from age as follows: wt(kg) = 2x[age(yrs)+4])

use formula: **% dehydration x weight (kg) x 10 = deficit (in mls)**

eg a child whose weight is estimated as 10 kg is 10% dehydrated: estimated fluid loss is 10 x 10 x 10 = 1000 mls (40 ml/hour if replaced over 24 hours)

Maintenance

Estimated maintenance fluid requirements based on body weight for a child are:

Body weight	Fluid needed per day	Fluid needed per hour
First 10kg body weight	100 ml/kg	4 ml/kg
Second 10kg	50 ml/kg	2 ml/kg
Subsequent kg	20 ml/kg	1 ml/kg

Ongoing losses

for each diarrhea stool	<2 yrs old, give 50-100 ml > 2 yrs old give 100-200 ml
for each vomit	2ml / kg ORS: give small frequent volumes (eg 5ml every minute in a child) via spoon or syringe or cup
For naso-gastric tube aspirates	Replace volume for volume with either ORS or Normal saline with 5 or 10% glucose and 5mmol/litre of potassium chloride OR Hartmanns with 5 or 10% glucose.

Over-hydration

- oedematous (puffy) eyelids may be a sign of over hydration, cardiac failure (as in severe malnutrition) chronic malnutrition or protein losing enteropathy
- cardiac failure (especially in severe malnutrition) chronic malnutrition or protein losing enteropathy
- crepitations at lung bases
- A CXR may be helpful in showing pulmonary plethora or oedema
- stop giving ORS solution, but give breast milk or plain water, and food
- do not give a diuretic unless pulmonary oedema, then give frusemide 1 mg/kg/IV

Pathway for management of gastroenteritis in children

Estimate % loss

None <3%

- Manage at home
- Continue breast feed (frequently or longer at each feed) or diet suitable for their age, even if vomiting
- Frequent sips from cup: if vomits, wait 10 mins then give slowly
- Give extra fluid (as much as will take to prevent dehydration) ORS, food based fluids (soup, rice water, yoghurt) or clean water after each stool (50-100ml up to 2 yrs and 100-200ml after 2 yrs)
- Give extra fluid until diarrhea stops
- Make sure the mother knows to return if the child **becomes sicker, is unable to drink or has blood in the stools**
- Follow up check in 5 days

WHO PLAN A

Moderate 3-9%

- Start ORS straight away (at triage even in queue etc.) MUST be in first 4 HOURS
- Give ORS 75ml/Kg over 4 hours or:

Wt	**Age**	**ORS in first 4 hrs**
<6Kg	<4mth	200-400ml
6 to <10Kg	4-12 months	400-700ml
10 to <12Kg	12m to 2 years	700-900ml
12-19 Kg	32– 5 yrs	900-1400ml

- Continue breast feeding if applicable
- Reassess after 4 hours and reclassify dehydration
- If wants more ORS give more: sips from cup or teaspoon every 1-2 minutes
- Use age only if weight not available

WHO PLAN B

Severe ≥ 10%

Signs of severe malnutrition?

- Yes → See later
- No:
  - If shocked, follow 'Shock Pathway'
  - Give ORS and start IV fluids
  - Either WHO PLAN C OR

  Estimate deficit, maintenance needs and on-going losses

Deficit in mls

% dehydration x wt (kg) x 10

In 10% dehydration = 100ml/kg

Maintenance

Body wt	Fluid/24hrs	Fluid/hr
1st 10 kg	100ml/kg	4 ml/kg
2nd 10kg	50ml/kg	2 ml/kg
Subsequent kg	20ml/kg	1ml/kg

On-going losses

After each loose stool give extra fluid

- ≤ 2yrs old give 50-100 ml
- > 2 yrs old give 100-200ml

Fluid replacement

- Start IV at once and give 100ml/kg Ringer's lactate or 0.9% saline as follows

Infants < 1 year	30ml/kg in 1 hour	Then 70ml/kg in 5 hrs
Children ≥ 1 year	30ml/kg in 30 mins	Then 70ml/kg in 2.5 hrs

- Repeat once if pulse still very weak
- If available check initial U&E and repeat at 4 hours
- Give ORS as soon as child can drink (about 5ml/kg/hr)
- Reassess and re-classify at 3 hrs for child and 6 hours for infant
- If no IV/IO access, give fluid through NGT at 20ml/kg/hr for 6 hours
- Do not discharge patient until oral re-hydration is established

Consider and treat severe hypokalaemia with acidosis

In poorly resourced countries severe hypokalaemia with acidosis is common in severe gastroenteritis (BMJ 2002:324;369-270). Potassium replacement here needs to be at a higher rate than recommended; namely up to 2mmol/Kg per hour and up to a maximum daily requirement of 15mmol/Kg/24 hours. Earlier we suggested the following regime for treating severe hypokalaemia: Initially an IV infusion of 0.5mmol/Kg over 30 minutes followed by an IV infusion of potassium not exceeding 0.5mmol/Kg per hour.

Reassess

ABC

state of intravascular repletion

plasma electrolytes if possible

urine output and urine electrolytes

give fluid according to plan, don't forget ongoing losses

reassess regularly (including biochemistry if possible)

don't forget glucose

Gastroenteritis in Childhood (IMEESC 3.2)

Gastroenteritis is an acute infection of the small bowel leading to diarrhoea, and often vomiting, and is common in children below the age of three years. In 80% of cases it is viral and settles over 3-5 days. Bacterial cases may be associated with prolonged or severe symptoms and a higher fever. Dehydration risk is greatest in infants < 1year old; stool frequency > 8/day; vomiting for > 2 days

Making the diagnosis

Diarrhoea, abdominal discomfort +/- vomiting; headache and fever often present
Alternative diagnoses – especially if vomiting is more prominent than diarrhoea

- Surgical abdomen
    - Intussusception / Appendicitis / Volvulus / Incarcerated hernia
- Medical causes – DKA; pneumonia

Infants and young children are more likely than older children or adults to present with shock due to sudden fluid loss in gastro-enteritis or with **concealed fluid loss secondary to a surgical abdomen such as a volvulus.** This is due both to the infants low physiological reserve and his/her increased susceptibility to these conditions. **Cholera** is also a common cause.

In infants gastroenteritis may occasionally present as a circulatory collapse with little or no significant preceding history of vomiting or diarrhea. The infecting organism can be any of the usual diarrhea pathogens, of which the most common is rotavirus. The mechanism leading to this presentation is that there is a sudden massive loss of fluid from the bowel wall into the gut lumen, causing depletion of the intravascular volume and the appearance of shock in the infant. This occurs before the stool is passed so that the diagnosis may be unsuspected. Usually during resuscitation of these infants, copious watery diarrhea is evacuated.

Management

The two essential elements in management of all children with diarrhea are re-hydration and continued feeding. Do not give any drugs to control diarrhea or vomiting, as they can have serious side effects, and do not improve hydration or nutritional status. Antibiotics are only used for acute bloody diarrhea or suspected cholera.

Oral Fluids

Recommendations for oral replacement therapy in gastroenteritis are:

- use either low-sodium ORS (containing 40-60 mmol/L of sodium), or
- if unavailable, use ORS containing 75-90 mmol/L of sodium and 75mmol/l of glucose with an additional source of low-sodium fluid (eg breast milk, formula, or clean water)
- encourage the mother to continue breastfeeding her child
- giving high osmolar fluids may contribute to hypernatraemia, whilst giving water alone, or low salt drinks may cause hyponatraemia
- oral glucose within ORS enhances electrolyte and water uptake in the gut
- high sugar drinks (hyper-osmolar) such as coca cola or fruit juices can worsen diarrhea by their osmotic effects.

Intravenous Fluids

- even in patients who are drinking poorly, try to give enteral fluids by mouth or by gastric tube until the IV drip is running
- use Ringer's Lactate or Hartmann's Solution which has Na 131mmol/l; K 5mmol/l; HCO3 29mmol/l; Ca 2mmol/l
- Hartmann's solution has no glucose to prevent hypoglycaemia: this can be corrected by adding 100ml of 50% glucose to 500ml of Hartmann's giving approximately a 10% glucose solution (adding 50ml gives a 5% solution)
- Ringer's Lactate Solution already prepared with 5% dextrose has the added advantage of providing glucose to help prevent hypoglycaemia.
- If Ringer's Lactate or Hartmann's is unavailable, use 0.9% saline. It does not contain a base to correct acidosis and does not replace potassium losses, therefore add 5mmol/litre of Potassium Chloride. Also it does not contain glucose and therefore add 100ml of 50% glucose to 500ml of 0.9% saline to give approximately a 10% glucose solution.
- **do NOT use plain 5% glucose solutions, or 0.18% saline + 4% glucose. They do not contain adequate electrolytes, do not correct the acidosis or hypovolaemia and can produce dangerous hyponatraemia**
- all patients should start to receive some ORS solution (about 5 ml/kg/hour) when they can drink without difficulty, which is usually within 3 - 4 hours (for infants) or 1 - 2 hours (for older children). 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.

Management of diarrhea using WHO guidelines

See pathway of care above for plans A and B (no or some dehydration)

Diarrhea with severe dehydration

If no signs of Severe malnutrition: **Plan C treatment:**

While setting up IVI (or Intraosseous if needed), give ORS
Start IV immediately; 100mls/kg of Ringer's lactate or Normal Saline divided as follows:

Age	First give 30ml/Kg in:	then give 70mls/kg in
Infants < 12 months	1 hour *	5 hours
Children 1 to 5 years	30 minutes *	2.5 hours

* Repeat once if pulse is still very weak; reassess every 15-30 minutes until strong radial pulse present:

- then reassess every 1-2 hours – if hydration not improving give IV more rapidly. If available take U&E initially and at 4 hours but don't let this delay your treatment.
- Also give ORS (about 5mls/kg/hour) as soon as the child can drink
- Reassess and Reclassify
- at 3 hours for child, 6 hours for infant and choose appropriate plan for continued management
- If IV or IO access not possible, and child not able to drink, give ORS by NGT at 20mls/kg/hour for 6 hours, reassessing every 1-2 hours (IV or IO access must be obtained if hydration status not improving)
- If possible, observe the child for at least 6 hours after rehydration to be sure adequate hydration can be maintained orally.

If signs of Severe Malnutrition:
- Remember that dehydration is generally over diagnosed in malnourished children, but that low circulating volume can co-exist with oedema
- Do NOT use IV route for rehydration **except in cases of shock**.
- Standard ORS is not suitable (Sodium to high, Potassium too low); use ReSoMal (can be prepared by adding one 1 litre WHO-ORS packet to 2 litres of water, adding 50g Sucrose and 40 mls of Electrolyte/mineral solution)
- Give ReSoMal PO or NG more slowly than well-nourished child rate:
  - 5mls/kg every 30 minutes for first 2 hours
  - then 5-10 mls/kg/hour for the next 4-10 hours
- Then proceed to starter-F-75 solution (see Malnutrition section)
- Monitor every 30 minutes for first 2 hours – be alert to signs of over-hydration (increasing respiratory and pulse rates): stop and reassess after one hour if found

Zinc treatment

Zinc is an important micronutrient for a child's overall health and development. Zinc is lost in greater quantity during diarrhea. Replacing the lost zinc is important to help the child recover and to keep the child healthy in the coming months. It has been shown that zinc supplements given during an episode of diarrhea reduce the duration and severity of the episode, and lower the incidence of diarrhea in the following 2–3 months. For these reasons, all patients with diarrhea should be given zinc supplements as soon as possible after the diarrhea has started.

Up to 6 months give 1/2 tablet (10 mg) per day
6 months and more give 1 tablet (20 mg) per day for 10–14 days

Diabetic Ketoacidosis (IMEESC 13.8)

DKA is the commonest endocrine emergency and should be suspected in any patient presenting with dehydration, abdominal pain, ketotic breath, altered level of consciousness. The mainstay of treatment is to correct dehydration; reduced blood glucose levels and treat any intercurrent infection. The most serious acute complication of DKA is cerebral oedema (mortality rate 80%) which is thought to be due to over vigorous resuscitation

Pathway of care for DKA

Airway

Not patent or at risk →

Correct Position
Head tilt - chin lift
Jaw thrust
Oropharyngeal airway
Intubation

Patent ↓

Breathing

Inadequate → Assist ventilation

Yes ↓

100% oxygen - face mask + reservoir

Circulation
Obtain IV or IO access

Check (where possible)
- Blood glucose
- U&E
- Blood gas
- Blood culture
- Urine microscopy

If shocked:
Give bolus 10-20ml/kg 0.9% saline

Estimate fluid needs
Fluids = maintenance + deficit
(see page 197 above)

Give over 24 hours

- Blood glucose >12mmol/l - 0.9% saline IV
- Blood glucose <12mmol/l - 0.45% saline IV + 5% glucose IV
- Watch Na+ carefully - avoid rapid falls (cerebral oedema risk)
- Replace any large gastric aspirates as 0.45% saline + 10mmol/l KCl

Potassium
Add 20mmol KCl to every 500ml unit of IV fluid
OR
Add 2mmol/kg to oral fluids every 12 hours

Short acting Insulin
0.6 units/kg SC 6 hourly
OR
0.1 units/kg/hour IV infusion (ONLY if SAFE)

Continuing Care
- Measure blood glucose hourly
- U&E 4 hourly
- Reassess ABC and degree of dehydration regularly
- Treat infection - cefotaxime 100mg/kg
- Insert NG tube (ileus usual)
- Accurate fluid balance (consider urinary catheter)
- Neurological assessments hourly - look for evidence of cerebral oedema
- ECG for hypokalaemia

If cerebral oedema
Mannitol 250-500mg/kg of 20% IV
2/3 maintenance IV fluids
Keep plasma Na >135mmol/litre
Avoid fever >38 degrees centigrade
Head midline and 30 degrees elevated

Septicaemia

In septic shock, the cardiac output may be normal or raised, but fail to deliver as much oxygen as the body needs. This is partly due to the changes in small blood vessels which become dilated and leaky, so blood is not distributed normally. In addition, in septic shock, cells do not take up oxygen as effectively.

Features of septic shock
- Fever
- Hyperventilation
- Tachycardia
- Prolonged capillary refill
- Altered mental state

Late signs
- Hypotension
- Irregular or slow pulse or breathing pattern

Meningococcal septicaemia
- Purpuric non-blanching rash
- 7% no rash; 15% blanch
- not always associated with meningitis

Toxic shock syndrome
- high fever, headache, confusion
- red conjunctivae and oral mucosa
- scarletiniform rash+ desquamation
- subcutaneous oedema
- vomiting and watery diarrhoea

Non-typhoidal salmonella
Common in malarial areas

It can be difficult to tell the difference between severe dehydration and septic shock in the malnourished child. Always treat for septic shock.

Resuscitation in septic shock
- Oxygen – consider assisting ventilation if respiratory effort is great, or oxygenation poor
- Fluids – start with 20ml/kg and repeat
- After 40ml/kg, the child will need ventilatory support
- Check glucose and correct hypoglycaemia with 5ml/kg 10% glucose
- Give ceftriaxone 100mg/kg/IV as soon as possible (add ampicillin in neonates) (WHO Benzyl penicillin + chloramphenicol)
- Check and treat any clotting abnormality with vit K, FFP, platelets if available
- Inotropes e.g. dobutamine 5 – 20 mcg/kg/min, or adrenaline 0.05 – 2 mcg/kg/min may be needed and expert advice should be sought
- Correct any fall in potassium or calcium-if possible monitor acid base.

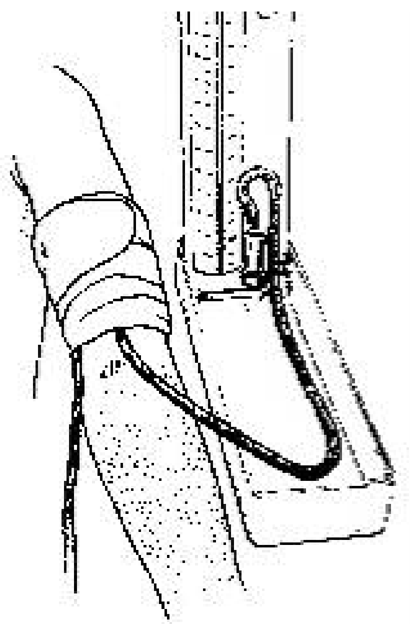
Dengue Haemorrhagic Fever

Dengue fever affects older children and young adults. It is characterised by a biphasic fever with headache, muscle and joint pains, rashes and a low white cell count. It is usually benign but can be incapacitating with severe muscle and joint pain – known as 'break-bone fever'. Occasionally it is associated with severe haemorrhage – Dengue haemorrhagic fever. This is an emergency and can progress to untreatable shock

Management is focused on correcting shock caused by increased vascular permeability, and on treating the bleeding disorder. Fluid losses are monitored by evaluating the cardiovascular status and checking for rising haematocrit and for evidence of pleural effusions and ascites. Clotting disorders are monitored by serial measurement of platelets and APTT if available (or by measuring the whole blood clotting time.

Grading of Severity of Dengue Haemorrhagic Fever		
Grade	**Features**	**Management**
1	Fever; general malaise; positive tourniquet test	Antipyretics; analgesics; oral fluids – avoid NSAIDs
2	Spontaneous bleeding in skin ± other haemorrhage	As above plus IV fluids if needed
3	Evidence of shock; weak pulse, low BP; rising haematocrit	IV fluid resuscitation with 0.9% saline
4	Profound shock with undetectable BP or peripheral pulse	Careful fluid resuscitation with colloid if available. May need blood transfusion and correction of clotting disorder

Treat Dengue fever with shock along the lines of the common care pathway for shock, but be careful not to fluid overload. If fluid overload does occur, treat with frusemide 1mg/kg IV and repeat as necessary.



Tourniquet test in Dengue Haemorrhagic Fever

Apply BP cuff inflated to level of mean arterial pressure (systolic + diastolic, divided by 2). Leave inflated for 5 minutes; a positive test is if there are ≥10 petechiae in 1 sq inch after the cuff is removed

Cardiogenic shock

Causes

- **Abnormal pulse rate or rhythm**
- Congenital cardiac abnormality *(see neonatal section)*
- Cardiomyopathy

Abnormal pulse rate or rhythm - Presentation

- History of palpitations
- Poor feeding
- Heart failure or shock
- Episodes of loss of consciousness

When a child presents in shock or imminent cardiac failure due to an abnormal pulse, the treatment priorities are to secure the airway and breathing, and provide oxygen. Treatment of the rhythm will depend on a few simple criteria

Most serious diseases or injury states are associated with a sinus tachycardia, which might be as fast as 220 in infants and 180 in children. Sinus tachycardia can be caused by fever, dehydration or blood loss and usually responds to basic resuscitation such as oxygen and fluids.
An abnormally slow rate, bradycardia, is defined as ≤ 60 or a rapidly falling heart rate in a child who is deteriorating. Bradycardia is most commonly a finding that will rapidly lead to cardio-respiratory arrest and is associated with respiratory failure and/or shock. Vigorous resuscitation is required.

Assessment

- Is the child stable or in shock?
- Is the rate too fast or too slow?
- Is the pulse regular or irregular?
- If there is an ECG, are the QRS complexes wide or narrow?
- Is there a non-cardiac cause of the problem?

Emergency treatment

- Airway Secure the airway with simple opening manoeuvres and adjuncts as necessary
- Breathing High flow oxygen. Assisted ventilation will be needed if the child is shocked
- Circulation
    - Heart rate < 60
        - start chest compressions and vigorous resuscitation
        - ensure adequate oxygenation
        - give a bolus of fluid 20ml/kg IV or IO
        - try atropine 20mcg/kg and adrenaline 10mcg/kg
        - if organophosphate poisoning, give atropine 50-100mcg/kg IV or IM

    - If heart rate 150 - 180 (up to 220 in infant) no ECG and no history of cardiac disease or exposure to drugs causing VT, presume the child has SVT.

    - If ECG shows SVT (or no ECG available)
        - Apply vagal manoeuvres (ice pack on face; valsalva; firm carotid massage
        - If shocked and access to defibrillator give 0.5, 1 and 2 joules
        - If not shocked or no defibrillator, give IV adenosine 50mcg/kg; followed by 100mcg/kg and 250mcg/kg as necessary
        - If no adenosine or defibrillator, try digoxin

    - If ECG shows VT and the child is shocked
        - Cardiovert with 0.5, 1 then 2joules/kg as needed
        - If no defibrillator, give amiodarone 5mg/kg over 30 mins
        - If no other options available
            - treat hyperkalaemia with calcium gluconate and glucose plus insulin
            - give magnesium sulfate (25-50mg/kg) over a few minutes

    - If poisoning with Tricyclic antidepressants
        - treat with sodium bicarbonate 1mmol/kg followed by phenytoin 15mg/kg over 15 minutes if no improvement

After Resuscitation and Emergency Treatment

After emergency treatment of shock a search should be made for organ damage so that appropriate treatment may be given and further morbidity avoided. The problems are similar but of a lesser degree than those expected following resuscitation from cardiac arrest. The most important consideration is renal function.

Section 12 Quiz 9

When considering the cause of shock, which of the following symptoms and/or signs may indicate the likely cause?

a) if the heart rate is very high and heart failure is present, an arrhythmia may be the cause
b) if there is fever with a non-blanching rash, the child should be treated for septicaemia
c) if there is diarrhea, gastroenteritis is likely
d) diabetic ketoacidosis should be suspected if the child is dehydrated with a history of polyuria

Section 12 Quiz 10

Which of the following are signs of severe dehydration?

a) loss of weight of 10% or more when compared with pre-illness weight
b) no urine output
c) decreased capillary refill (> 3 seconds)
d) decreased conscious level
e) sunken eyes

Section 12 Quiz 11

When considering gastroenteritis in children which of the following statements are true?

(a) in infants, circulatory collapse is always preceded by significant vomiting and diarrhea
(b) if there is moderate dehydration, ORS can be given prior to full history and examination
(c) if there is severe dehydration, deficit, can be calculated by % dehydration x wt (kg) x 5 in ml and replaced over 24 hours in addition to maintenance requirements and ongoing losses.
(d) patients should be reassessed regularly after initiating treatment and treatment modified if necessary
(e) reassessment should include biochemistry if available

Section 12 Quiz 12

During treatment of diabetic ketoacidosis which of the following statements are true?

a) 0.9% saline should be given IV until blood glucose is <12 mmol/L
b) rapid fall in plasma Na+ levels may lead to cerebral oedema
c) insertion of NG tube is recommended
d) total body potassium is increased so potassium supplements are not needed
e) if short-acting insulin is given subcutaneously, 0.6 units/kg is an appropriate initial dose

Section 12 Quiz 13

Which of the following statements regarding septic shock are true?

a) there is always a low cardiac output
b) a prolonged capillary refill time may occur
c) hypotension is an early sign
d) confusion may occur
e) there are similar features to those of severe dehydration in the malnourished child

Section 12 Quiz 14

Which of the following statements regarding Dengue haemorrhagic fever are true?

a) the accompanying shock is treated in a similar way to the shock of meningococcal sepsis
b) it most often affects children in the first year of life
c) it can lead to ascites
d) it may cause coagulation disorders

ANSWERS

9. a,b,c,d **10.** a,b,c,d,e **11.** a,b,d,e **12.** a,b,c,e **13.** b,d,e **14.** a,c,e

The infant or child with acute renal failure

Introduction

Minimum urine output: >1ml/Kg/hour in children
>2ml/Kg/hour in infants

Types

- **Pre-renal**:
  - insult to renal tubule cells from poor perfusion, usually due to shock. This is most commonly associated with gastroenteritis, but must also be thought about in trauma, burns, sepsis and heart failure.
- **Renal:**
  - usually due to the same problem causing pre-renal failure, but is more serious. Other causes include poisoning by drugs eg gentamycin, end stage glomerular diseases and haemolytic-uraemic syndrome. Prognosis depends on whether only tubule cells are damaged or if glomeruli are involved. If damage is confined to the proximal tubule (the most vulnerable part of the kidney), this causes acute tubular necrosis (ATN). This will recover fullyin 2 to 4 weeks if health can be retained during period of renal failure. More severe insults damage to some or all glomeruli as well, which are in renal cortex. Glomerular damage is irreversible, and acute cortical necrosis usually results in chronic or end-stage renal failure. No reliable imaging can differentiate ATN from cortical necrosis.
- **Post renal:**
  - Acute complete obstruction is rare. Causes include a stone obstructing urethra, and in patient with single kidney include a ureteric stone, or a pelviureteric junction narrowing.

Diagnosis and initial management of ARF

	Pre-renal Failure	**Renal Failure**
Urine Na+ mmol/l	<10	>10
Urine osmolality ÷ plasma osmolality	>1.5	<1.5
FENa	<1%	>2% **
Microscopy of Urine	no casts	granular/red cell casts
(**Fractional excretion of sodium is the diagnostic test for discriminating between pre-renal and renal failure)		

Pre-renal acute renal failure

- **Clinical diagnosis** reflects **features of shock**
  - usually low BP. However, BP may be unexpectedly high because of powerful renin drive in response to hypovolaemia.
  - abdominal pain (induced by splanchnic ischaemia as blood flow diverted from gut to more vital organs).

- **Laboratory diagnosis** by measuring fractional excretion of sodium **(FENa).** Measure the sodium and creatinine in a simultaneously obtained sample of urine (by catheter if necessary) and blood.

FENa (%) = **U/P sodium** x **P/U creatinine** x **100**

- If FENa <1% , renal tubule cells are still alive, and able to respond to shock by reabsorbing sodium which confirms a diagnosis of pre-renal failure. No other tests, including measurements of osmolality, of urinary Na concentration alone, nor urine microscopy can reliably differentiate pre-renal from established renal failure. Ultrasound looks normal or echo-bright.
- **Treatment is by urgent rehydration**. Give 20 ml/kg as rapidly as possible initially, and repeat if necessary. Thereafter give normal (0.9%) saline to fully correct the fluid deficit within 2 to 4 hours. The deficit can be estimated by multiplying the child's weight by the estimated percentage **dehydration**.
- Once rehydration has started give frusemide 2 mg/kg orally or IV.
- If blood pressure remains markedly depressed after rehydration, it may be due to cardiogenic shock; consider inotropes (if available).

Established acute renal failure

- Laboratory diagnosis FENa is typically > 2% because damaged tubules unable to reabsorb sodium avidly.
- Fluid repletion and frusemide will not result in recovery of renal function.
- If FENa not available, give trial of frusemide (2mg/Kg IV) and consider a fluid challenge if evidence of dehydration
- If not dehydrated (or after correction of dehydration) carefully maintain fluid and electrolyte balance and nutrition while waiting/hoping for recovery.
- Dialysis may be needed (if available).
- If recovery not started by 4 weeks, it is unlikely.

Post-renal ARF

- All cause severe acute colicky abdominal pain: unilateral with ureteric obstruction, or lower abdominal with bladder neck obstruction.
- Ultrasound, if available, will reveal stones and dilatation proximal to obstruction.
- Remove or bypass the obstruction. For a bladder neck stone obstruction, catheterise. Pain relief with an opiate and a muscle relaxant may allow time for an obstructing stone in the ureter to pass, or for the intermittent blockage from a pelviureteric junction narrowing to clear. If not, stone removed cystoscopically or by ureterolithotomy, or the upper renal tract drained by insertion of a percutaneous nephrostomy under ultrasound guidance. This may require transfer to another centre

Ongoing management of persistent ARF

Good general care:

Meticulous fluid balance:

- Accurately measure all intake and losses. For babies, stool and urine losses estimated by weighing clean and dirty nappies.
- Insensible water losses: (see appendix for table of estimate of body surface area)
    - 300ml/m2/24 hours or
    - 12ml/Kg/24 hours if > 1 year
    - 15ml/Kg/24 hours if an infant
    - 24ml/Kg/24 hours if a preterm infant
- Increased in hot climate by around 50%.
- Best guide is to weigh twice daily.

Adequate nutrition is important but difficult to provide. Aim to

- provide normal calorie intake from carbohydrates and fats
- limit protein intake to about 1 g/kg/day to minimise uraemia.
- Young infants who normally take milk, and children too ill to eat solid food, or with gastrointestinal involvement, will need NG feeding or IV nutrition
- nutrition may have to be delivered in a large fluid volume.
- If there is polyuric renal failure or high non-renal water losses such as from diarrhoea or drain fluids this can be achieved.
- if oligoanuric, it is not possible to give sufficient nutrition without fluid overload leading to hypertension and pulmonary oedema.
- Concentrated fat-based oral feeds can be made up from double cream.
- sophisticated IV fluids with high glucose content and individually adjusted sodium (and bicarbonate) concentrations, tailored to balance losses are usually only available in well resourced settings.

Usually necessary to limit salt intake to prevent sodium retention with hypernatraemia, leading to insatiable thirst, and fluid overload.

Provide some bicarbonate to prevent acidosis, typically at a starting dose of 1 mmol/kg/day sodium bicarbonate (note, 1 ml of an 8.4% sodium bicarbonate solution contains 1 mmol, and 1 g of powder contains 12 mmol)

Dietary potassium must be restricted to avoid hyperkalaemia. Hyperkalaemia causes arrhythmias, especially in ARF where other metabolic changes may exacerbate the risk (for example, hypocalcaemia). Aim to keep plasma potassium < 6.5 mmol/L in an older child and < 7.0 mmol/L in neonates who tolerate hyperkalaemia better.

Dietary phosphate restricted to prevent hyperphosphataemia. Giving calcium carbonate with the food (eg, 0.5 to 2 grams with each meal) will bind the intestinal phosphate and reduce hyperphosphataemia as well as improving the tendency to hypocalcaemia.

Blood pressure monitoring and anti-hypertensives may be needed

Many drug dosages will need adjustment as they are renally excreted

Peritoneal dialysis

This is indicated if

- oligoanuria persists
- hyperkalaemia occurs (the commonest indication)
- severe metabolic acidosis. Treatment with sodium bicarbonate is limited because this may lead to massive sodium overload, and hence to dangerous levels of hypernatraemia, and to greater fluid retention.
- hypoglycaemia occurs and needs IV glucose solutions
- other fluids are required such as platelets.
- urea rises > 40 mmol/L causing clinical uraemia

Pathway of care Acute Renal Failure in a child

Minimum urine output >1ml/Kg/hour in children
>2ml/Kg/hour in infants

↓

Measure Fe Na%(= u/p sodium x p/u creatinine x 100)

<1% pre-renal

- Shock usual
  Urgent rehydration
  20ml/Kg 0.9% saline IV
- Repeat x 1 if necessary
- Correct fluid deficit with 0.9% saline over 2-4 hours
- Frusemide 2mg/Kg IV
- If BP still low - inotropes

>2% renal

- Try Frusemide 2mg/Kg IV
  Correct dehydration
- Measure all intake and losses
- Calculate insensible loss: 300ml/m^2/24 hours
  or 12ml/Kg/24 hours >1 year
  15ml/Kg/24 hours infant
  24ml/Kg/24 hours if preterm infant
  ↑ by 50% if hot climate
- Add all losses to insensible loss and give total fluid containing as many calories as possible
- Weigh twice daily
  Observe for oedema and heart failure
- Limit protein intake 1g/Kg/day
  Give calories as carbohydrate and fat
- Restrict salt intake
- Avoid potassium in diet
- Restrict phosphate intake and add calcium carbonate orally 0.5-2g with each meal
- Monitor BP regularly
- Adjust drug doses
  Do not use nephrotoxic drugs
- Watch for hypoglycaemia
- Sodium bicarbonate 1mmol/Kg/day to prevent acidosis

Consider need for dialysis
- Oligo or anuria
- Hyperkalaemia
- Severe acidosis
- Urea >40
- Hypoglycaemia
- Need for other IV fluids

Section 12 Quiz 15

Which of the following statements are true when considering acute renal failure?

a) minimum urine output for a child is >2ml/kg/hour
b) ultrasound scan, if available, may help diagnose a post renal cause
c) fractional excretion of sodium is the only reliable way of differentiating pre-renal from established renal failure
d) shock may cause pre-renal, renal or post renal failure
e) if recovery from pre-renal or renal failure has not started within 4 weeks, it is unlikely

Section 12 Quiz 16

Which of the following treatments may be helpful in the management of persistent ARF?

a) strict fluid balance management, including insensible losses
b) a protein-limited diet
c) limited sodium and potassium intake
d) phosphate supplement
e) an adjustment to the doses of drugs excreted by the kidneys

ANSWERS

15. b,c,e **16.** a, b,c, e

The Infant or Child in Coma (IMEESC 14.6)

Coma may be the presentation of many illnesses. It is unusual for children to have a structural problem so the cause of coma is most likely to be a diffuse metabolic or infective process, or to be associated with trauma.

In order to function normally, the brain needs an adequate supply of oxygenated blood and glucose. The supply of oxygen might be compromised by problems affecting airway, breathing and circulation. If these are all stable and secure, the problem relates to the brain itself.
For blood to circulate around the brain, the pressure inside the skull – the intracranial pressure (ICP) must be low enough to allow blood to flow.

Causes of coma
- Hypoglycaemia
- **Malaria**
- **Meningitis** (including TB)
- Head injury –see trauma section
- HIV
- **Drugs / poisons**
- **Post convulsion**

Cerebral perfusion pressure (CPP) = mean arterial pressure (MAP) – ICP

Normally for a child < 3 this would be about 60mmHg, and for an older child 70mmHg. By the age of 12, the child has an adult CCP of about 80mmHg.

Primary assessment

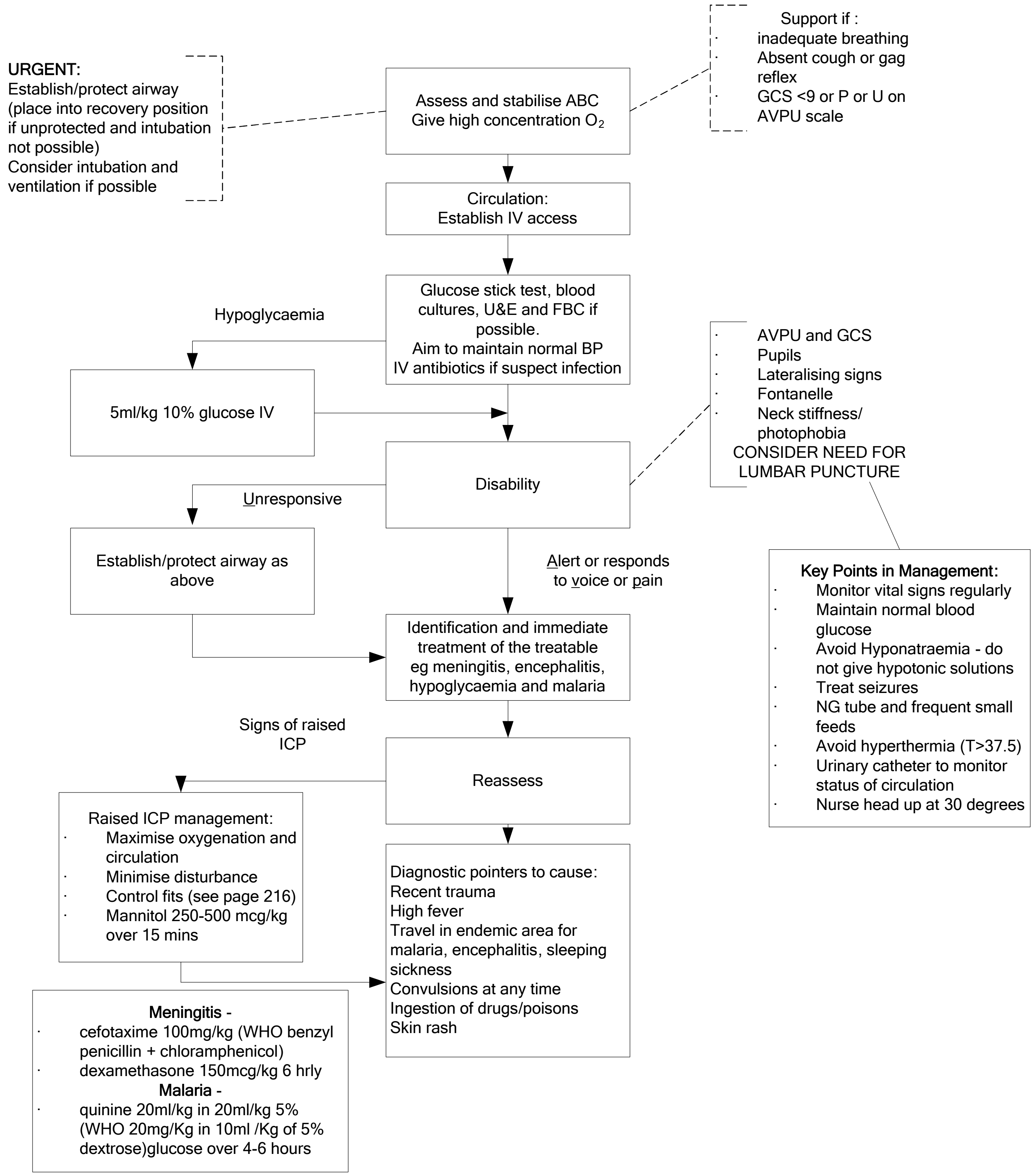
The first steps in managing a child with an altered level of consciousness are to assess and, if necessary, support Airway, Breathing and Circulation.

- **Airway** – this is at risk if the child scores 'P' or 'U' on the AVPU scale
- **Breathing** – this may be the cause of coma, by inadequate oxygenation or increasing CO_2; or be compromised by coma with centrally driven hypoventilation.
- **Circulation** – hypotension leads to under-perfusion of the brain. In late stages of raised intracranial pressure, the child becomes hypertensive in an attempt to preserve CPP.
  The body responds by reducing heart rate.
  Hypertension and bradycardia are very serious signs.
- **Disability**
  - Assess using AVPU score
  - Check blood glucose
  - Check pupils for size, equality and reaction to light
  - Palpate fontanel for signs of raised ICP

  A more formal assessment may be made using the Glasgow Coma Scale (GCS)

Pupillary changes	
Pupil size & reactivity	Causes
Small, reactive	Metabolic disorder Medullary lesion
Pin-point	Metabolic disorder Narcotics /orgnophosphates
Fixed, dilated	Hypothermia Hypoxic / ischaemic brain During and post seizure Anticholinergics / barbiturates
One fixed. dilated pupil	Ipsilateral lesion Tentorial; herniation III cranial nerve lesion Epileptic seizure

Pathway of Care for Child in Coma (IMEESC Best Practice Protocol and 13.1 and 13.6)



Specific conditions

1. Meningitis or encephalitis (after the neonatal period)

The three common organisms causing meningitis are
- *Neisseria meningitides* which has a high mortality and morbidity;
- *Haemophilus influenzae* which is much less common in areas with immunisation programmes
- *Streptococcus pneumoniae* which is more commonly seen in disadvantaged countries and in immunocompromised patients
- *Gram negative organisms such as Ecoli* in neonates

Classic signs might be absent in a small child. A bulging fontanel is a clear sign of intracranial infection, but may be masked by associated dehydration. Meningitis is almost always associated with raised ICP, so the symptoms and signs are related to this.

There is a risk of coning if an LP is performed in a child with raised ICP

Diagnosis in a child ≤ 3 yrs old
- Reduced level of consciousness
- Irritability
- Poor feeding or vomiting
- Fever with no apparent cause
- Convulsions with or without fever
- Apnoeic or cyanotic episodes
- Purpuric rash
- Recent head injury

Diagnosis in a child ≥ 4 years old
- Headache or neck pain
- Vomiting
- Neck stiffness
- Opisthotonous
- Photophobia
- Rash
- Altered level of consciousness
- Recent head injury

Early diagnosis is essential for effective treatment.
.
On examination, look for:
- a stiff neck
- repeated convulsions
- lethargy
- irritability
- bulging fontanel
- a petechial rash or purpura
- evidence of head trauma suggesting possibility of a recent skull fracture.

Also, look for any of the following signs of raised intracranial pressure:
- unequal pupils
- rigid posture or posturing
- focal paralysis in any of the limbs or trunk
- irregular breathing

Laboratory investigations
If possible, confirm the diagnosis with a lumbar puncture and examination of the CSF. If the CSF is cloudy, assume meningitis and start treatment while waiting for laboratory

confirmation. Microscopy should indicate the presence of meningitis in the majority of cases with the white cell (polymorph) count above 100/mm3. Confirmatory information can be gained from the CSF glucose (low: <1.5 mmol/litre), CSF protein (high: >0.4 g/litre), and Gram staining and culture of the CSF, where possible.

If there are signs of increased intracranial pressure, the potential value of the information gained from a lumbar puncture should be carefully weighed against the risk of the procedure. If in doubt, it might be better to start treatment for suspected meningitis, and delay performing a lumbar puncture. In general LP is safer in infants where sutures are still open.

Specific causes of meningitis

During a confirmed epidemic of meningococcal meningitis it is not necessary to perform a lumbar puncture on children who have petechial or purpuric signs, which are characteristic of meningococcal infection. During such epidemics, give oily chloramphenicol (100 mg/kg IM as a single dose up to a maximum of 3 grams) for the treatment of meningococcal meningitis. The oily suspension is thick and may be difficult to push through the needle. If this problem is encountered, the dose can be divided into two parts and an injection given into each buttock of the child. This simplified treatment schedule is particularly useful in situations where there are limited resources to deal with the epidemic.

Consider tuberculous meningitis if:

— fever persists for 14 days

— fever persists for more than 7 days and there is a family member with tuberculosis

— a chest X-ray suggests tuberculosis

— the patient remains unconscious

— CSF continues to have moderately high white blood cell counts (typically, <500 white cells per ml, mostly lymphocytes), elevated protein levels (0.8–4 g/l) and low glucose levels (<1.5 mmol/litre).

In children known or suspected to be HIV-positive, tuberculous or cryptococcal meningitis should also be considered. For diagnosis of cryptococcus, do a CSF stain with India ink.

Treatment

If the CSF is obviously cloudy, treat immediately with antibiotics before the results of laboratory CSF examination are available. If the child has signs of meningitis and a lumbar puncture is not possible, treat immediately.

Antibiotic treatment

Give antibiotic treatment as soon as possible. Choose one of the following two regimens:

1. Chloramphenicol: 25 mg/kg IM (or IV) every 6 hours plus ampicillin: 50 mg/kg IM (or IV) every 6 hours

OR

2. Chloramphenicol: 25 mg/kg IM (or IV) every 6 hours plus benzylpenicillin: 60 mg/kg (100 000 units/kg) every 6 hours IM (or IV).

Where there is known significant drug resistance of common pathogens (e.g. Haemophilus influenzae or Pneumococcus) to these antibiotics, follow the national guidelines. In many

circumstances, the most appropriate treatment will be a third-generation cephalosporin such as:
— ceftriaxone: 50 mg/kg IM/IV, over 30–60 minutes every 12 hours; or 100 mg/kg IM/IV, over 30–60 minutes once daily; or 1month-12 years: 50-80mg/kg OD, 12-18 years: 1g, up to 2-4g in severe infections
— cefotaxime: 50 mg/kg IM or IV, every 6 hours.

Review therapy when CSF results are available. If the diagnosis is confirmed, give treatment parenterally for at least 5 days. Once the child has improved, give chloramphenicol orally unless there is concern about oral absorption (e.g. in severely malnourished children or in those with diarrhoea), in which cases the full treatment should be given parenterally. The total duration of treatment is 10 days.

If there is a poor response to treatment:
— Consider the presence of common complications, such as subdural effusions (persistent fever plus focal neurological signs or reduced level of consciousness) or a cerebral abscess. If these are suspected, refer the child to a central hospital with specialized facilities for further management
— Look for other sites of infection which may be the cause of fever, such as cellulitis at injection sites, arthritis, urinary tract infection or osteomyelitis.

-Repeat the lumbar puncture after 3–5 days if the fever is still present and the child's overall condition is not improving, and look for evidence of improvement (e.g. fall in leukocyte count and rise in glucose level).

Consult national tuberculosis programme guidelines if TBM is found or strongly suspected. The optimal treatment regimen, where there is no drug resistance,
comprises:
— isoniazid (10 mg/kg, max 300mg) for 6–9 months; and
— rifampicin (15–20 mg/kg, max 600mg) for 6–9 months; and
— pyrazinamide (35 mg/kg max 2g) for the first 2 months.

Steroid treatment
There is not sufficient evidence to recommend routine use of dexamethasone in all children with bacterial meningitis in poorly resourced countries.

Do not use steroids in:
• newborns
• suspected cerebral malaria
• suspected viral encephalitis
• areas with a high prevalence of penicillin-resistant pneumococcal invasive disease.

Dexamethasone (0.6 mg/kg/day for 2–3 weeks, tailing the dose over a further 2–3 weeks) should be given to all cases of tuberculous meningitis.

Antimalarial treatment

In malarial areas, take a blood smear to check for malaria since cerebral malaria should be considered as a differential diagnosis or co-existing condition. Treat with an antimalarial if malaria is diagnosed. If for any reason a blood smear is not possible, treat presumptively with an antimalarial drug.

Supportive care
Examine all children with convulsions for hyperpyrexia and hypoglycaemia. Treat the hypoglycaemia. Control high fever (≥39 °C or ≥102.2 °F) with paracetamol.

In an unconscious child:
- Maintain a clear airway.
- Nurse the child on the side to avoid aspiration of fluids.
- Turn the patient every 2 hours.
- Do not allow the child to lie in a wet bed.
- Pay attention to pressure points.
- Monitor for signs raised intracranial pressure Give mannitol 250-500mg/kg if deteriorating

Oxygen treatment
Oxygen is not indicated unless the child has convulsions or associated severe pneumonia with hypoxia (SaO2 <90%) (EMCH <94%), or, if you cannot do pulse oximetry, cyanosis, severe lower chest wall in-drawing, respiratory rate of >70/minute.

Fluid and nutritional management
There is no good evidence to support fluid restriction in children with bacterial meningitis. Give them their daily fluid requirement, but not more because of the risk of cerebral oedema. Monitor IV fluids very carefully and examine frequently for signs of fluid overload. Give due attention to acute nutritional support and nutritional rehabilitation. Provide food as soon as it is safe. Breastfeed every 3 hours, if possible, or give milk feeds of 15 ml/kg if the child can swallow. If there is a risk of aspiration, give the sugar solution by nasogastric tube. Continue to monitor the blood glucose level and treat accordingly (as above), if found to be <2.5 mmol/ litre or <45 mg/dl.

Complications

Convulsions
If convulsions occur, give anticonvulsant treatment.

Hypoglycaemia
Give 5 ml/kg of 10% glucose solution IV rapidly Recheck the blood glucose in 30 minutes and if the level is low (<2.5 mmol/litre or <45 mg/dl), repeat the glucose (5 ml/kg)
Prevent further hypoglycaemia by feeding, where possible (see above). If you give IV fluids, prevent hypoglycaemia by adding 10 ml of 50% glucose to 90 ml of Ringer's lactate or normal saline. Do not exceed maintenance fluid requirements for the child’s weight. If the child develops signs of fluid overload, stop the infusion and repeat the 10% glucose bolus (5 ml/kg) at regular intervals.

2. Malaria

Features

- There are no pathognomic signs; fever in an endemic area is malaria until proven otherwise
- Typical features include high swinging fever, chills, rigors, sweating, myalgia, arthralgia, headache, lethargy, cough, nausea, vomiting and diarrhea
- In infants the only findings may be fever and failure to feed properly (malaria is very rare in < 2/12 old because of the protective effect of HbF)
- Severe disease may cause altered level of consciousness, fits, severe anaemia and jaundice
- Cerebral malaria is associated with raised ICP and rapid onset coma

Malaria may be accompanied by non-typhoid salmonellosis or meningitis

Signs of severe malaria
- Altered conscious level
- Convulsions
- Severe anaemia
- Acidosis
- Hypoglycaemia
- Hyperpyrexia
- Pulmonary oedema) uncommon
- Renal failure) in
- Jaundice) children
- DIC)

Poor prognostic features
- Acidosis
- Hypoglycaemia
- Deep coma
- Repeated convulsions
- Age < 3 years
- Leucocytosis
- hyperparasitaemia

Cerebral malaria
- Plasmodium falciparum
- Altered level of consciousness
- Commonest cause coma in age 1-5 in endemic areas
- Convulsions, severe anaemia, hypoglycaemia, hyperpyrexia and acidosis are common
- Signs of raised ICP
- Other causes of coma such as meningitis should be sought

Diagnosis

Investigations (if available)

Investigation	Findings
Thick & thin blood films	Thick confirms diagnosis; thin identifies species
FBC and sickle test	Anaemia; sickle disease / trait
Blood glucose	Hypoglycaemia
U&E	Effect of vomiting / diarrhoea
Group & save	? need transfusion
Urinalysis	UTI, haemaglobinurea (may cause renal failure)
Lumbar puncture – not if signs of raised ICP. However, if suspect RICP assume meningitis is present and give antibiotics IV.	?meningitis
CXR	? pneumonia / pulmonary oedema
Blood gases	Monitor acid / base status

Management

Airway & Breathing

- Assess and provide support as needed. Protect airway if altered level of consciousness. Consider NGT to prevent aspiration
- High flow oxygen
- Check for acidotic breathing

Circulation

- IV or IO access; if not possible, or risk of fluid overload, use NGT
- Treat hypoglycaemia (less than 2.5 mmol/litre (45mg/dl) with 5ml/kg 10% glucose (via NGT if no IV access)
  - o Recheck glucose after 30 mins and repeat if needed
- Treat severe anaemia – Hb < 5g/dl; or haematocrit < 15%; or evidence cardiac failure
  - o Packed cells 10ml/kg or whole blood 20ml/kg over 3-4 hours
  - o If severely malnourished there is a risk of overload; if occurs treat with frusemide 1-2mg/kg
- If acidosis (or acidotic breathing in absence of blood gas analysis) give extra fluids
- Monitor urine output and aim for 1ml/kg/hr. Rehydrate to maintain output; consider use of frusemide if unable to achieve 4ml/kg/24hrs
- Shock is unusual in malaria – if present treat with fluid bolus 20ml/kg. Take blood cultures and start broad spectrum antibiotics in addition to anti-malarial treatment

Disability

- Treat convulsions
- Consider lumbar puncture but avoid if V, P or U on AVPU (GCS <13); signs raised ICP or papilloedema (treat for meningitis as well if these signs are present)
- Consider other causes of coma
- Avoid or treat hyperpyrexia (T > 39, or > 38 if cerebral malaria) – use tepid sponging, fanning and oral / rectal Paracetamol 20mg/kg

Malarial treatment

- IV quinine is first line drug – **never give it as a bolus** Use quinine dihydrochloride salt.
  - o 20mg/kg in 20ml/kg 5% dextrose over 4-6 hours (WHO = 20mg/Kg quinine in 10ml/Kg 5% dextrose over 4-6 hours).
  - o Must not be given too quickly because of serious cardiac effects
  - o If there is a risk to IV, give 10mg/kg IM (diluted in 0.9% saline to give concentration of 60mg salt/ml to aid absorption and is less painful) followed by 10mg/kg IM at 4 hours
  - o Subsequent dose given 8 hours following start of loading dose of 10mg/kg over 4 hours, every 12 hours until child able to take oral treatment (WHO 10mg/Kg over 2 hours repeated 8 hourly)
  - o Change to oral medication as soon as possible and give 10mg/kg every 8 hours for 7 days

Alternatives

➤ **IM artemether**. Give 3.2 mg/kg IM on the first day, followed by 1.6 mg/kg IM daily for a minimum of 3 days until the child can take oral treatment. Use a 1 ml tuberculin syringe to give the small injection volume.

➤ **IV artesunate**. Give 2.4 mg/kg IV or IM on admission, followed by 1.2 mg/ kg IV or IM after 12 hours, then daily for a minimum of 3 days until the child can take oral treatment of another effective antimalarial.

Complete treatment in severe malaria following parenteral artesunate or artemether administration by giving a full course of artemisinin-based combination therapy or oral quinine to complete 7 days of treatment. If available and affordable, quinine should be combined with clindamycin.

Supportive care

Examine all children with convulsions for hyperpyrexia and hypoglycaemia. Treat hypoglycaemia (see below). If a temperature of ≥39 °C (≥102.2 °F) is causing the child distress or discomfort, give paracetamol.

If meningitis is a possible diagnosis and cannot be excluded by a lumbar puncture (see above), give parenteral antibiotics immediately

Avoid useless or harmful ancillary drugs like corticosteroids and other anti-inflammatory drugs, urea, invert glucose, low-molecular dextran, heparin, adrenaline, prostacyclin and cyclosporin.

In an unconscious child:

Maintain a clear airway. Nurse the child on the side to avoid aspiration of fluids. Turn the patient every 2 hours. Do not allow the child to lie in a wet bed. Pay attention to pressure points.

Take the following precautions in the delivery of fluids:

- Check for dehydration and treat appropriately.
- During re-hydration, examine frequently for signs of fluid overload. The most reliable sign is an enlarged liver. Additional signs are gallop rhythm, fine crackles at lung bases and/or fullness of neck veins when upright. Eyelid oedema is a useful sign in infants.
- If, after careful re-hydration, the urine output over 24 hours is less than 4 ml/kg body weight, give IV frusemide, initially at 2 mg/kg body weight. If there is no response, double the dose at hourly intervals to a maximum of 8 mg/kg body weight (given over 15 minutes).
- In children with no dehydration, ensure that they receive their daily fluid requirements but take care not to exceed the recommended limits Be particularly careful in monitoring IV fluids.

Complications

Coma (cerebral malaria)

• Assess the level of consciousness according to the AVPU or another locally used coma scale for children
• Give meticulous nursing care and pay careful attention to the airway, eyes, mucosae, skin and fluid requirements.
• Exclude other treatable causes of coma (e.g. hypoglycaemia, bacterial meningitis). Perform a lumbar puncture **if there are no signs of raised intracranial pressure**. If you cannot do a lumbar puncture and cannot exclude meningitis, give antibiotics as for bacterial meningitis.

Convulsions

These are common before and after the onset of coma. When convulsions are present, give anticonvulsant treatment.
Correct any possible contributing cause such as hypoglycaemia or very high fever. If there are repeated convulsions, give phenobarbital.

Shock

Some children may have a cold, clammy skin. Some of them may be in shock (cold extremities, weak pulse, capillary refill longer than 3 seconds). These features are not usually due to malaria alone. Suspect an additional bacteraemia and give both an antimalarial and antibiotic treatment, as for septicaemia.

Severe anaemia

This is indicated by severe palmar pallor, often with a fast pulse rate, difficult breathing, confusion or restlessness. Signs of heart failure such as gallop rhythm, enlarged liver and, rarely, pulmonary oedema (fast breathing, fine basal crackles on auscultation) may be present.
Give a **blood transfusion** as soon as possible to:
— all children with a haematocrit of ≤12% or Hb of ≤4 g/dl
— less severely anaemic children (haematocrit >12–15%; Hb 4–5 g/dl) with any of the following:
 — clinically detectable dehydration
 — shock
 — impaired consciousness
 — deep and laboured breathing
 — heart failure
 — very high parasitaemia (>10% of red cells parasitized).
Give packed cells (10 ml/kg body weight), if available, over 3–4 hours in preference to whole blood. If not available, give fresh whole blood (20 ml/ kg body weight) over 3–4 hours.

A diuretic is not usually indicated because many of these children have a low blood volume (hypovolaemia).

Check the respiratory rate and pulse rate every 15 minutes. If one of them rises, transfuse more slowly. If there is any evidence of fluid overload due to the blood transfusion, give IV frusemide (1–2 mg/kg body weight) up to a maximum total of 20 mg.

After the transfusion, if the Hb remains low, repeat the transfusion.
In severely malnourished children, fluid overload is a common and serious complication. Give whole blood (10 ml/kg body weight rather than 20 ml/kg) once only and do not repeat the transfusion.

Hypoglycaemia

Hypoglycaemia (blood glucose: <2.5 mmol/litre or <45 mg/dl) is particularly common in children under 3 years old, in children with convulsions or hyperparasitaemia, and in comatose patients. ***It is easily overlooked because clinical signs may mimic cerebral malaria.***

Give 5 ml/kg of 10% glucose solution IV rapidly Recheck the blood glucose in 30 minutes, and repeat the glucose (5 ml/kg) if the level is low (<2.5 mmol/litre or <45 mg/dl).
Prevent further hypoglycaemia in an unconscious child by giving 10% glucose infusion (add 10 ml of 50% glucose to 90 ml of a 5% glucose solution, or 10 ml of 50% glucose to 40 ml of sterile water). Do not exceed maintenance fluid requirements for the child's weight. If the child develops signs of fluid overload, stop the infusion; repeat the 10% glucose (5 ml/kg) at regular intervals.

Once the child is conscious, stop IV treatment. Feed the child as soon as it is possible. Breastfeed every 3 hours, if possible, or give milk feeds of 15 ml/kg if the child can swallow. If not able to feed without risk of aspiration, give sugar solution by nasogastric tube. Continue to monitor the blood glucose level, and treat accordingly (as above) if found to be <2.5 mmol/ litre or <45 mg/dl.

Respiratory distress (acidosis)

This presents with deep, laboured breathing while the chest is clear— sometimes accompanied by lower chest wall in-drawing. It is caused by systemic metabolic acidosis (frequently lactic acidosis) and may develop in a fully conscious child, but more often in children with cerebral malaria or severe anaemia.

Correct reversible causes of acidosis, especially dehydration and severe anaemia.
— If Hb is ≥ 5 g/dl, give 20 ml/kg of normal saline or an isotonic glucose//electrolyte solution IV over 30 minutes.
— If Hb is <5 g/dl, give whole blood (10 ml/kg) over 30 minutes, and a further 10 ml/kg over 1–2 hours without diuretics. Check the respiratory rate and pulse rate every 15 minutes. If either of these shows any rise, transfuse more slowly to avoid precipitating pulmonary oedema

Aspiration pneumonia

Treat aspiration pneumonia immediately because it can be fatal. Place the child on his/her side. Give IM or IV chloramphenicol (25 mg/kg every 8 hours) until the child can take this orally, for a total of 7 days. Give oxygen if the SaO_2 is <90% (<94% EMCH), or, if you cannot do pulse oximetry, there is cyanosis, severe lower chest wall in-drawing or a respiratory rate of ≥70/minute.

Monitoring

The child should be checked by nurses at least every 3 hours and by a doctor at least twice a day. The rate of IV infusion should be checked hourly. Children with cold extremities, hypoglycaemia on admission, respiratory distress, and/ or deep coma are at highest risk of death. It is particularly important that these children be kept under very close observation.

Monitor and report immediately any change in the level of consciousness, convulsions, or changes in the child's behaviour.

Monitor the temperature, pulse rate, respiratory rate (and, if possible, blood pressure) every 6 hours, for at least the first 48 hours.

Monitor the blood glucose level every 3 hours until the child is fully conscious.

Check the rate of IV infusion regularly. If available, use a giving chamber with a volume of 100–150 ml. Be very careful about over-infusion of fluids from a 500 ml or 1 litre bottle or bag, especially if the child is not supervised all the time. Partially empty the IV bottle or bag. If the risk of over-infusion cannot be ruled out, re-hydration using a nasogastric tube may be safer.

Keep a careful record of fluid intake (including IV) and output.

Section 12 Quiz 17

Which of the following statements are true in a child with coma?

a) part of the primary assessment includes checking blood glucose
b) the Glasgow coma score is the quickest way of assessing disability
c) compromised airway, breathing or circulation may lead to coma
d) hypertension with bradycardia are serious signs
e) hyponatraemia should be avoided

Section 12 Quiz 18

When considering the causes of coma, which of the following statements are true?

a) malaria is a common cause in a 1 year old child
b) if meningitis is suspected, a lumbar puncture should always be performed before giving IV antibiotics
c) if malaria is suspected, IV quinine can cause cardiac side effects if given too quickly
d) shock is common if malaria is the cause
e) high flow oxygen should be given, whatever the cause.

ANSWERS

17. a,c,d,e **18.** a,c,d,e

Management of the infant or child with convulsion

Remember, cerebral malaria, meningitis, including TB, HIV, metabolic disorders (more likely with consanguineous marriages) are common cause of convulsions

Introduction

Status epilepticus is defined as either a generalised convulsion lasting > 30 minutes, or repeated convulsions without return of consciousness between fits. It occurs in 1- 5% of patients with epilepsy, and up to 5% of children with febrile convulsions.

Pathophysiology

Injury to the brain during status epilepticus occurs as a result of one, or more, of the following

- The underlying disease – malaria, meningitis, trauma
- Systemic complications of the convulsions, especially hypoxia, acidosis and raised intracranial pressure
- Direct injury from repetitive neurone firing

Management

This is focused on terminating the fit, preventing secondary damage from hypoxia or hypoperfusion of the brain and identifying and treating the most likely underlying cause

Diagnostic pointers	
Fever	suggestive of infection, but also occurs with ecstasy, cocaine and salicylate poisoning
Hypothermia	associated with ingestion of barbiturates or alcohol
Rash	Purpuric suggestive of meningococcal disease
Bruising	Consider trauma, including non-accidental injury or bleeding disorder
Retinal bleed/bruises/fractures	Suggest subdural bleed; consider child abuse
Urinalysis	If available, check for evidence of poisoning or drug ingestion

Pathway of Care Prolonged Fitting [A] in post-neonatal infants and children

A **Airway opening if needed (airway adjunct if needed) but no other object in mouth**
Recovery position if vomited
B **High flow oxygen**
Bag mask ventilation if not breathing
Do not leave alone and call for help

Existing vascular access?

Yes:

5ml/Kg of 10% glucose IV ideally after blood glucose
If fitting does not stop within 5 minutes ADD
IV diazepam 250 microgram/Kg over 5 mins
OR
IV lorazepam 100 microgram/Kg over 5 mins

No:

Rectal diazepam 500 microgram/kg
OR
Rectal paraldehyde 0.4ml/Kg
OR
Buccal midazolam 300microgram/Kg
Gain venous access 2 attempts OR intraosseous
IV/IO 5ml/Kg 10% glucose after blood glucose

10 minutes ***Still convulsing*** **10 minutes**

Repeat anticonvulsants IV/IO
IV/IO diazepam 250 micrograms/Kg
OR
IV/IO lorazepam 100 microgram/Kg

Still convulsing **10 minutes**

Phenobarbital 20mg/Kg IV or IO over 15 minutes
PLUS if available
Rectal paraldehyde 0.4ml/Kg
Repeat blood glucose and if low 5ml/Kg IV/IO glucose

Still convulsing

10 minutes after end of phenobarbital dose

Phenytoin 20 mg/kg bolus over 20 minutes
or if already on Phenytoin give further phenobarbital 10mg/kg over 10 minutes

Do not infuse phenytoin at a rate exceeding 50mg per minute due to the risk of irregular heart beat, hypotension and respiratory depression

NOTES

A. Indications: Still fitting when seen (ETAT) OR If already in hospital where onset of fit is seen and generalised convulsion lasting > 10-15 minutes or repeated convulsions without return of consciousness between fits.
B. Hypoglycaemia is blood glucose <2.5 mmol/l (45mg/dl) if well nourished and < 3.0mmol/l (55mg/dl) if severe malnutrition
C. If blood glucose cannot be measured treat as hypoglycaemia.
D. If hypoglycaemia has been present give feed (milk or sugar water) orally or NG when conscious. To make an oral or NG sugar solution dissolve 4 level teaspoons of sugar (20 gram) in 200ml of clean water.
E. Only 0.9% saline can be used to infuse phenytoin. All other IV fluids will cause crystallisation. Flush IV line with 0.9% saline before and after infusing phenytoin. Complete administration within 1 hour of preparation.
F. If IV/IO glucose does stop fitting, repeat blood glucose 30 minutes later and treat if hypoglycaemia

Febrile Convulsions

Definition a seizure in a child aged up to 6 years, caused by fever arising from infection or inflammation outside the central nervous system in a child who is otherwise neurologically normal. Simple febrile convulsions are generalized, tonic-clonic seizures. They usually last < 10 minutes (50% last < 3 minutes). A small proportion (5%) last more than 30 minutes. This is a common condition with an estimated prevalence of 2-4% and there is often a family history. Long term effects are rare.

Management

- Temperature control
  - Paracetamol 20mg/kg and / or ibuprofen 4-10mg/kg
  - Tepid sponging
  - fanning
- Identification of the cause of infection – always check the urine

Any child with a prolonged or focal seizure, or who has not recovered within an hour, should be suspected of having serious pathology.
Although most children rapidly make a good recovery, it is important to have considered other causes of fever and/or convulsions before planning to discharge

Causes of fever ± convulsions

- In an endemic area consider malaria
- Urinary tract infection
- Measles in the unimmunised child
- Meningitis or encephalitis
- Hypoglycaemia
- Metabolic abnormality
- Poisoning

Indications for admission after febrile convulsion

- Age < 18 months unless very clear focus of infection
- Signs of meningitis
- Child is drowsy, irritable or systemically unwell
- Recent or current treatment with antibiotics (partially treated meningitis can be missed)
- Complex convulsion, or delayed recovery
- If there are concerns the child may not be able to get back if deteriorates

If a child is being discharged home, make sure the parents

- understand what has happened
- know what treatment their child is on
- understand the importance of keeping the child's temperature down
- will bring the child back if there is a worsening in their condition

Severe Malnutrition in the Child

In children, there is a high mortality rate associated with malnutrition. This can be reduced a great deal by the delivery of good care.

Clinical evaluation of the severely malnourished child

Nutritional status is assessed according to weight for length/height; height for age; and the presence of oedema. Children who are below –3S.D. or who have oedema of both feet, are severely malnourished (see Table)

Mid upper arm circumference (MUAC) is a good way of identifying wasted children as it is relatively constant between 1 and 5 years of age when a MUAC of less than 12.5cm indicates malnutrition.

Features

- Characterised by oedema or wasting (e.g. of the buttocks), anorexia and infection
- Anaemia is frequently present
- Biochemical abnormalities include : low protein, potassium, urea, magnesium and glucose
- Two overlapping clinical pictures are seen, marasmus and kwashiorkor.

Marasmus
- Affects young children
- Due to lack of calories over many weeks
- Extreme thinness with loss of subcutaneous fat and muscle mass
- Prominent bones and joints
- Sunken eyes
- Often hungry and active
- Weight for length < 70% median

Kwashiorkor
- Acute illness, appears over a few days
- Affects children < 4 yrs old
- Maybe be precipitated by acute illness – measles or diarrhoea
- Involves sodium retention and pitting oedema of peripheries
- Causes dermatosis and desquamation
- Dry, brittle hair
- Child is apathetic and feeds poorly
- Associated with persistent anorexia, diarrhoea and vomiting

Mortality from malnutrition can be reduced by correct early treatment. The common causes of early death are

- Hypoglycaemia
- Hypothermia
- Fluid and electrolyte imbalance – particularly hypokalaemia
- Infections and septic shock
- Failure to correct vitamin and micronutrient deficiencies
- Inappropriate IV fluid treatment, including blood transfusion

Harmful aspects of treatment for severe malnutrition

- Too much energy and protein given during first phase of treatment

- Diuretics given to treat oedema causing hypokalaemia
- Anaemia treated with iron early leading to free radical damage and infections
- Vitamin A and measles vaccine not given
- Albumin or amino acids infused
- High sodium ORS and intravenous fluids administered
- Routine antibiotics not given
- Failure to monitor food intake
- Lack of overnight feeding
- Hypoglycaemia not monitored and treated
- Hypothermia not monitored and treated
- Inadequate staffing and poor organisation of care

Principles of Treatment

Stabalisation phase (up to7 days)	**Transition over 48 hours**	**Catch up growth Phase (usually 14-21 days)**
Treat or prevent dehydration, hypoglycaemia, hypothermia		
Treat infection	Treat worms	
Correct electrolyte imbalance Correct micro-nutrient deficiencies		
Do not give iron	Do not give iron	Correct iron deficiency
DIET Maintenance intake	Moderate intake	High intake
Stimulate child	Stimulate child	Stimulate child
		Provide physical activities Prepare for discharge

- Treat dehydration cautiously
- Prevent hypoglycaemia and hypothermia
- Treat infection, congestive heart failure and severe anaemia
- Correct electrolyte and micronutrient deficiency
- Provide standard maintenance nutrition within first few days of treatment
- Remember potential for sodium overload and cardiac failure
- Remember signs of coincidental sepsis may be hidden

General Treatment

- Keep malnourished separate from patients with infections in a warm room without draughts
- wash minimally, with warm water and dry immediately
- avoid IV cannulae / infusions (unless in shock)
    - o high risk of heart failure from fluid overload

- risk of infection
- give blood transfusion only when anaemia is life-threatening
- remove IV cannulae immediately after treatment

- use a nasogastric tube for feeding if:
    - anorexia with intake of <80% prescribed
    - severe dehydration with inability to drink oral fluids
    - painful or severe mouth lesions (herpes, cancrum oris, severe oral/oesophageal thrush)
    - recurrent, frequent vomiting

Principles of therapy

Hypoglycaemia (< 2.5 mmol/litre (45mg/dl)

Presume present if unable to test
Treat with 50ml of 10% glucose or 50 ml of drinking water with 10 g of sugar via nasogastric tube or 5 ml/kg 10% glucose IV
Prevention by 2 hourly feeds – day and night

Hypothermia

Check with low reading thermometer and keep T > 36.5
Treat with passive re-warming – e.g skin to skin contact with carer
Prevent by keeping child warm, and dry and away from draughts
Avoid prolonged medical examinations and washing

Dehydration

Usually over estimated in malnutrition as reduced skin elasticity and sunken eyes are features of malnutrition
Features suggestive of dehydration as well as malnutrition are
Frequent watery stools
Minimal urine output (no urine output for 12 hours or more)
Thirst
Weak pulse
Treat with oral re-hydration (only give IV if in shock)
Standard ORS has too much sodium and too little potassium – use ReSoMal
Check for fluid overload
Liver enlargement; basal creps; raised JVP: rising pulse ± respiratory rate: oedema
If overloaded, treat with fluid restriction NOT with diuretics

Electrolytes

Malnourished patients have low potassium and magnesium and high total body sodium
Treat with oral replacement
Potassium 3-4 mmol/kg /day
Magnesium 0.5 mmol/kg / day

Infection

Clinical signs may be absent; suspect if hypoglycaemia or hypothermia
Treat all with broad spectrum antibiotics – orally if tolerated. If very unwell give IV (Amoxicillin plus gentamicin). Note that doses based on actual body weight might be too low – increase by 10% in severe malnutrition
Give measles immunisation if not previously immunised
Treat specific infections –always consider malaria, TB, worms and HIV

Acute severe anaemia

Transfuse at Hb < 4g/dl, or signs of heart failure and Hb 4-6 g/dl
Partial exchange transfusion is better than giving whole blood or packed cells
Withdraw 2.5ml/kg anaemic blood and replace with 5ml/kg whole blood or packed cells
If not exchanging, give 10ml/kg packed cells over 3-4 hours, with frusemide 1mg/kg

Congestive heart failure

Serious and common; occurs several days after treatment started; due to cardiomyopathy secondary to malnutrition
Often caused by over hydration, excess sodium, over transfusion, inadequate correction of potassium deficit
Treat with fluid restriction and frusemide 1mg/kg

Micronutrients

Single oral dose vitamin A on admission, plus daily supplements of zinc, potassium, magnesium and copper.
Folic acid 5mg stat and 1mg/day
DO NOT GIVE IRON during first 14 days of treatment
If xeropthalmia or measles give 3 doses of vitamin A

Nutrition management

Start feeding as soon as possible
Give small frequent meals of low osmolality, low sodium, low lactose and low protein
Feed throughout the day and night

By careful attention to detail, and maintaining treatment throughout the day and night, severely malnourished children have a better chance of survival.

Section 12 Quiz 19

Which of the following are features of the malnourished child?

a) More than 3 standard deviations below weight for height
b) Mid upper arm circumference less than 12.5 cm in the age group 1 – 5 years
c) Hyponatremia
d) May be hungry and active
e) May be apathetic and reluctant to eat

Section 12 Quiz 20

Which of the following are common causes of death in severe malnutrition?

a) Hypoglycaemia
b) Sepsis
c) Iatrogenic
d) Hypokalaemia
e) Inappropriate blood transfusion

Section 12 Quiz 21

Which of the following are important aspects of treatment in severe malnutrition?

a) Iron supplements should be given early
b) Standard ORS should be given if the child is dehydrated
c) Particular care is needed to prevent hypothermia
d) NG feeding is only needed if there is recurrent vomiting
e) Feeding should continue regularly throughout the night
f) Diuretics are needed if oedema is present
g) Potassium and magnesium supplements may be needed
h) Antibiotics should be avoided unless there are obvious clinical signs of infection
i) If Hb is less than 4g/dL packed cell transfusion with frusemide is the best way of giving blood
j) Measles immunisation should be given if not previously immunised

ANSWERS:

1. abde 2. abcde 3. cdegij

SECTION 13: Serious Injury in the Infant, Child and Mother (IMEESC Chapter 16)

Introduction

The structured approach to management of mothers and children with trauma follows the same pattern. Trauma is a common cause of death in children. In infancy child abuse is a prominent cause. Mothers are at high risk of trauma during pregnancy, largely as a consequence of domestic violence (see later).

Death following trauma falls into 3 time zones:

1. Immediate - where the injury is overwhelming and incompatible with life.
2. Early - where progressive respiratory failure, circulatory insufficiency, or raised intracranial pressure cause death if no appropriate interventions are applied.
3. Late deaths - due to raised intracranial pressure, infection or multi-organ failure.

Prompt effective intervention **will** decrease mortality (and morbidity) in the latter 2 groups.

The following recommendations are made in **IMEESC**:

Make a full primary and secondary survey of any patient who is injured, especially patients who have:

- History of:
  - A fall >3 metres
  - Road traffic accident: net speed >30 km/hour
  - Thrown from a vehicle or trapped in a vehicle
  - Pedestrian or cyclist hit by a car
  - Unrestrained occupant of a vehicle
  - Death of a person in the same accident or from assault
  - Injury from high or low velocity weapon
- And/or on examination:
  - Airway or respiratory distress
  - Blood pressure <100 mmHg
  - Glasgow Coma Scale <13/15 (see Annex, page PCTM–23)
  - Penetrating injury
  - >1 area injured.

Children are not good at describing pain, or what has happened to them, and they tend to behave in the manner of a much younger child. They are at risk of developing long term psychological problems if not cared for as sympathetically as possible. The smaller the child the greater the likelihood that he or she will suffer from injuries to multiple areas of the body, when compared to an adult.

The key principles of managing major trauma are to

Treat the greatest threat to life first **Do no further harm**	and	**AVOID – hypoxia; hypercapnia, hypovolaemia, hypoglycaemia and hypothermia**

By following a structured approach, problems will be identified and managed in order of priority. The key steps are outlined in the primary survey, which is intended to enable identification and treatment of life threatening injuries. The secondary survey identifies potentially life and limb threatening injuries.

Structured Approach
- Primary survey
- Resuscitation and stabilisation
- Secondary survey
- Emergency treatment
- Definitive care

Primary Survey
- **A**irway and cervical spine control
- **B**reathing
- **C**irculation **and** haemorrhage control
- **D**isability
- **E**xposure – avoiding hypothermia

Primary Survey – Airway plus cervical spine control

The approach is similar to that used for managing any airway, in that you must

LOOK) whilst protecting the cervical spine
LISTEN) with collar, sand bags and tape
FEEL) (see procedures section)

Management
Do only that which is needed to keep the patient safe

- Jaw thrust – **avoid head tilt until cervical spine is cleared**
- Suction / removal of blood, vomit or a foreign body
- Oropharyngeal airway – **avoid nasopharyngeal airway if suspicion of base of skull injury**
- Intubation or surgical airway might be needed
- Identify the 'at risk' airway
    - **Altered level of consciousness, with failure to protect airway**
    - **Vomiting with risk of aspiration**
    - **Facial trauma – including burns**

Neck injuries are common in trauma therefore treat as a cervical injury until disproved.

Beware of significant incidence of Spinal Cord Injury Without Radiological Abnormalities (SCIWORA) in children

Primary Survey - Breathing

After management of the airway and securing of the cervical spine, 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, ala flaring
- **Efficacy** – breath sounds, chest expansion; abdominal excursion; SaO2
- **Adequacy** – heart rate, skin colour, mental status

Unequal breath sounds or poor oxygenation?
- Misplaced or blocked ETT
- Pneumo / haemothorax

In the primary survey it is important to actively look for life threatening injuries, and to examine the back and the front of the chest (whilst fully supporting and protecting the spinal cord)

- **GIVE HIGH FLOW OXYGEN TO ALL**
- **PROVIDE ASSISTED VENTILATION IF NEEDED**

Look for and treat

- Airway obstruction (see above)
- Tension pneumothorax
- Open pneumothorax
- Haemothorax
- Flail chest
- Cardiac tamponade

Breathing problem	Clinical signs	Treatment
Tension pneumothorax	• Decreased air entry on side of pneumothorax • Decreased chest movement on side of pneumothorax • Hyper-resonance to percussion on side of pneumothorax • Tracheal deviation away from side of pneumothorax • **Hypoxic, shocked patient** • **Full neck veins**	**High flow oxygen** **Needle thoracocentesis** Chest drain insertion
Open Pneumothorax	• Penetrating chest wound with signs of pneumothorax • Sucking or blowing chest wound	**High flow oxygen** **Chest drain** **Wound occlusion on 3 sides**
Massive Haemothorax – blood in pleural space	• Decreased chest movement • Decreased air entry • Dullness to percussion • **Shock and hypoxia** • **Collapsed neck veins**	**High flow oxygen** **Venous access and IV volume replacement** **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 greater than 1500–2000 ml or with continued bleeding of more than 200–300 ml per 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	• Rare in children because they have elastic chest wall • **Decreased efficiency of breathing**	**Oxygen and pain relief** May need intubation/ventilation transfer if feasible
Cardiac tamponade – blood in pericardial sac causing a decrease in cardiac output	• Shock associated with penetrating or blunt chest trauma • Faint apex beat and/or muffled heart sounds • **Distended neck veins**	**Oxygen** **IV access/ IV fluids** **Emergency needle pericardiocentesis– may need to be repeated** Consider transfer if feasible

Primary Survey - 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 in planning resuscitation. Remember that a child's circulating blood volume is only 80ml/kg so is easily compromised. Blood volume in pregnancy is 100ml/Kg or between 5 and 7 litres.

	Percentage blood loss		
Sign	**< 25**	**25 – 40**	**>40**
Heart rate	slight ↑	moderate ↑	marked ↑ or bradycardia
Systolic BP	normal	normal	beginning to fall
Pulse volume	normal or ↓	↓↓	↓↓↓
Skin	cool, pale	cool, mottled	cool
Respiratory rate	slight	moderate	sighing respirations
Mental status	slight agitation	lethargic; unco-operative	reacts to pain

Note: blood pressure may be normal until up to 50% of a patient's circulatory volume has been lost. Management is focused around avoiding hypovolaemia and controlling blood loss. The following steps should be taken:

Stop obvious bleeding by direct pressure. Don't forget that the patient may have a wound on the back that is bleeding into the bed. Remember log rolling if indicated.

Concealed bleeding severe enough to cause shock can occur from chest, abdomen, pelvis, femur. Forty percent of the circulating blood volume can be lost via an open femoral fracture. Initial treatment should include pressure, splinting and analgesia.

Vascular access is essential in all seriously injured patients.

A minimum of 2 relatively large bore IV cannulae is essential.

Drip IV line flow rates

Color Code	Gauge	Water Flow Rates (ml/min)
Brown	14	240
Gray	16	172
Yellow	17	130
Green	18	76
Pink	20	54
Blue	22	25
Lime	24	14

Peripheral veins are preferable – the inexperienced should not attempt central venous cannulation.

Do not forget about the intraosseous route in a child if venous access is not possible. A cut down onto the long saphenous vein can also be used.

Circulation and IV fluid resuscitation

Guidelines for fluid therapy following trauma are under frequent review. There is some evidence in *adults* that vigorous fluid administration is harmful in the presence of uncontrolled bleeding, especially following penetrating trauma. This has led to a much more cautious fluid regime, until the risk of uncontrolled bleeding has been ruled out. The concern is that increasing the blood pressure back to normal rapidly may disrupt early clot formation with subsequent exsanguination.

In the absence of further evidence, it is recommended that in children start with 10ml/Kg boluses of 0.9% saline or plasma expander with frequent re-assessment, rather than the full 20 ml/kg recommended in other life-threatening situations in children such as sepsis or severe dehydration.

Fluid resuscitation in the mother starts with 500-1000ml of 0.9% saline or plasma expander.

Similar volumes may be repeated if there is continuing evidence of haemorrhagic shock, after re-evaluating the state of the circulation.

Early surgical involvement is essential.

Management of circulation
- Peripheral or IO access (see procedures)
- Direct pressure on bleeding sites
- External jugular or femoral venous access
- Saphenous or cephalic cut down
- Fluid resuscitation if any evidence of shock
- Monitor response and only continue with fluids if needed
- **Do not give excess fluids – especially to patients with head or chest injuries, or malnutrition**
- Consider need for surgical intervention

If possible take blood for
- Cross matching
- Hb and full blood count
- Glucose
- Electrolytes

Fluid Resuscitation

Crystalloid / colloid 10 ml /Kg in child or 500ml-1litre in mother

↓

monitor response

If no change or worse

Repeat above bolus

↓

monitor response: no change/ worse

↓

Blood 10 ml / kg in child or 500ml in a mother

The most important aspect of fluid resuscitation is the response to a fluid challenge.

Improvement is indicated by
- Decreased heart rate
- Increased skin temp
- Faster capillary refill
- Improved mental state
- Increased systolic BP
- Improved urinary output

If the patient fails to improve, look for chest, abdominal or pelvic blood loss and consider surgical intervention

Warnings	**Cardio-respiratory arrest despite secure airway and adequate oxygenation:** o Tension pneumothorax **needs** emergency thoracocentesis and insertion of intercostal drain(s) o Exsanguination **needs** large fluid boluses and blood transfusion o Pericardial tamponade **needs** pericardiocentesis

Primary Survey - Disability

Head Injury is the major cause of death in trauma

Rapid assessment of the CNS includes
- Applying AVPU score
  - Aim to intubate with a score of ‘P’ or ‘U’ as the airway is unprotected
  - 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

- 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 and look for other lateralizing signs like weakness of a part of body and localised seizures etc

At this stage, the brain is best cared for by close attention to managing A B and C and correction of any hypoglycaemia. If raised ICP, intubate, ventilate, (to maintain oxygenation and aim for PCO_2 of about 4kP) maintain systolic BP, give mannitol 0.5mg/kg, nurse the patient 30° head up and contact a neurosurgeon (if available).

(Mannitol if given in a situation of raised intracranial pressure ***without first excluding intracranial haematoma****, will produce temporary improvement because of shrinkage of brain that it produces, but will, at the same time, allow rapid expansion of the haematoma leading to sudden worsening a little while later.)*

- Low blood glucose is common in child trauma victims and can cause brain injury. Always check the blood glucose and if not possible - treat immediately any baby or small child with 5ml/kg of 10% glucose IV.

Primary survey – exposure – avoid hypothermia

Undress patient fully and examine front and back, looking for evidence of injury. Remember to use a log roll when examining the back. Always keep warm (especially infants and small children) using blankets and other thermal material. If hypothermia is suspected, check rectal temperature with low reading thermometer

The injured patient should have

- Clear airway and 100% oxygen for breathing
- Cervical spine immobilisation
- Adequate respiration, achieved by manual or mechanical ventilation and chest decompression when indicated
- Venous access and an initial fluid challenge, if indicated on circulatory assessment
- Blood sent for typing and cross matching
- Identification of the need for life saving surgery and preparation underway
- Identification of any serious head injury and attention paid to maximising A B and C

Life threatening injuries identified and treated

Injury	Treatment
Airway obstruction	Jaw thrust, oropharyngeal airway, intubation or surgical airway
Tension pneumothorax	Needle thoracocentesis and chest drain
Open pneumothorax	3 sided dressing, then chest drain
Massive haemothorax	IV access, chest drain and blood transfusion
Flail chest	Intubation if needed
Cardiac tamponade	Pericardiocentesis Spinal needle ideal UBL (Upwards, Backwards, Left)

At the same time, or shortly after the primary survey, resuscitation and stabilisation, various adjuncts help with protecting the patient and monitoring progress

Primary Survey – Adjuncts

- Monitoring ECG, SaO2 and BP
- Urinary and gastric catheters
- X-rays of chest, pelvis (± cervical spine)
- Ultrasound of abdomen if available
- Adequate pain control (see below)
- Base line blood tests (especially Hb, cross match, biochemistry and clotting

History

- Events before and after incident
- First aid given at scene
- Past medical history
- Medications and allergies
- Immunisation status
- Last food and drink

Analgesia *(see section on pain control)*

- **There is never any reason to withhold analgesia from a patient in pain**
- **Morphine – 100micrograms/kg IV or 5-10mg in the mother is the drug of choice in major trauma**
- **If conscious level falls, the effect can be reversed with naloxone**

Secondary Survey (IMEESC Chapters 17-18)

On completion of the primary survey and any necessary resuscitation – including emergency surgery – a secondary survey must be completed.
The aim is to identify all injuries in a systematic manner

If, at any time, the patient's condition worsens, return to the Primary Survey

Summary of secondary survey	***(* CT scan might be indicated if available)***
Head * Perform a full neurological examination	Look for lacerations, bleeding, bruising Palpate for fractures or deformity Look for signs of # base of skull – periorbital bruising; blood behind the eardrum; CSF leak or bleeding from the nose or ears Consider need for Skull X-ray
Face	Check orbits; maxilla, mouth and mandible Check the teeth
Neck	Remember that bradycardia and hypotension could be the signs of a spinal injury **Treat any spinal injury with 0.5mg/kg of dexamethasone Careful examination front and back. C. spine X-ray if available, but be aware of Spinal Cord Injury Without Radiological Abnormality (SCIWORA) Check for bony deformity or tenderness and any neurological deficit Feel for surgical emphysema and look for penetrating wounds
Chest*	Reassess as in primary survey. Look for penetrating injuries and think about cardiac tamponade. Make sure the posterior chest is properly examined for flail segments Review CXR looking for evidence of aortic damage, lung contusion and pneumothorax. Do ECG if available
Abdomen	A good history is invaluable Look for signs of bruising and penetrating trauma Palpate and percuss gently. Listen for bowel sounds Check renal angles and examine urine for blood Ultrasound is useful if available
Pelvis	Gentle palpation. If identify a fracture, immobilise the pelvis to contain bleeding. Check perineum and urethral meatus for signs of bleeding Palpate the bladder Review X-ray

Thoraco-lumbar spine	Log roll for examination Palpate for tenderness and deformity Perform careful assessment of motor and sensory function in limbs
Limbs / extremities	This must include examination of the musculoskeletal system, peripheral nerves and distal circulation Assess for fractures and soft tissue injuries; immobilisation is a good method of pain relief Always consider the risk of compartment syndrome – especially in the lower leg and with injuries to the forearm. Bleeding is best controlled with direct pressure, rather than with a tourniquet. Involve orthopaedic surgeons early.
Whenever you identify an injury, ensure it is clearly documented. If the treatment for it is beyond your expertise, always call for assistance as soon as possible.	

Section 13 Quiz 1.
In the management of the seriously injured which of the following statements are true?

a) Cervical spine control should be maintained while assessing the airway
b) Jaw thrust should be avoided if there is a possibility of a cervical spine injury
c) Facial burns may be an indication that early intubation is desirable
d) If a massive haemothorax is suspected in the primary survey, it should be drained prior to gaining IV access
e) High flow O_2 is only needed if low oxygen saturations are shown by pulse oximetry

Section 13 Quiz 2. When assessing circulation in the seriously injured which of the following statements are true?

a) A raised HR alone is a good sign of blood loss
b) Blood pressure may be normal despite loss of more than a 1/3 of blood volume
c) The intraosseous route as an alternative to IV access should be considered early in the resuscitation of children.
d) Capillary refill time is more reliable if assessed on the hand than over the sternum?

Section 13 Quiz 3. During the primary survey which of the following statements are true?

a) Part of assessment of the CNS includes checking blood glucose early
b) Close attention to airway, breathing and circulation is the best management for any brain injury
c) The treatment for a flail chest airway involves intubation
d) Suspected bleeding from an intra-abdominal injury always requires surgery

Section 13 Quiz 4. When evaluating major trauma which of the following statements are true?

a) An AP CXR and pelvic x-ray are indicated early in management
b) If no fractures are seen on a child's CXR severe underlying damage is unlikely to be present
c) The lateral cervical spine x-ray will identify 95% of fractures
d) The skull x-ray is more useful than repeated neurological examination for detecting intracranial injury
e) Morphine when indicated, should be given intravenously

ANSWERS:

1. ac 2. abc 3. abc 4. ae

Section 13 Quiz 5.

In which of the following circumstances should Spinal injuries be suspected?

a) in multiply injured patients
b) if there are injuries above the clavicle
c) if the injured is a pedestrian hit by a vehicle

Section 13 Quiz 6.

When treating trauma patients which of the following statements are true?

a) The frightened, uncooperative child and hypoxic older patient will not benefit from aggressive effort to immobilize the neck
b) All patients with major trauma should have full spinal stabilisation and be treated as if they have a cervical spine injury until proven otherwise
c) Examining the back by logrolling a mother or older child requires 4 people
d) When cardiac tamponade is treated, aspiration of blood from the pericardium leads to a permanent improvement in cardiac function
e) Anti tetanus prophylaxis should be given

Section 13 Quiz 7.

What are the 6 life threatening chest injuries to diagnose and treat in the primary survey?

ANSWERS:

5. abc 6. abce 7. airway obstruction, tension pneumothorax, open pneumothorax, massive haemothorax, flail chest, cardiac tamponade

Emergency Radiology

The key X-rays in evaluating major trauma in the primary survey / resuscitation phase, are the AP chest X-ray, the pelvic X-ray and lateral cervical spine radiograph. Other useful X-rays include the cervical spine, skull and limbs, as indicated during the secondary survey.

Chest X-ray (CXR)

There are many schemes for examining the CXR in trauma. It is important to remember that, unlike with medical conditions, trauma is not usually confined to anatomically discrete areas. This means that great care must be taken to ensure multiple pathology is not missed. The child's chest wall is very elastic, so the energy from an impact may be transmitted to the heart and lungs, without causing rib fractures. If rib fractures are seen, this indicates a high energy impact.

Note that in a supine film, air/fluid levels will not be detected and a haemothorax may be seen as a generalised 'greyness' of the involved lung

System for examining the CXR in trauma

A	**Adequacy**	**Correct patient. Apices, bases and edges of lung visible on both sides**
A	**Airways**	**Trachea central. Examine lungs for increased or decreased density, and lung markings to edge of pleura;**
B	**Bones**	**Check all ribs for fractures – look for flail segment. Check spine alignment, clavicles and shoulder**
C	**Cardiac outline & mediastinum**	**Look for pneumomediastinum; increased heart size (is wider on AP film); note the thymus in children up to 6-8**
D	**Diaphragm and pleura**	**Look for air above and below diaphragm (not seen if supine film). Note any fluid or air in the pleural space**
E	**Everything else**	**Tubes – check position of ETT, chest drain, NGT, central line. Foreign bodies on chest wall or in chest Peripheral soft tissues for subcutaneous air**

Pelvic X-rays

The pelvis is composed of three bones – the sacrum and two innominate bones, bound together by strong ligaments. The bones can only separate if there are strong forces which tear these ligaments. If this happens, it is very likely that the nerves and blood vessels running close by will also be damaged. This can lead to life threatening blood loss. Fractured bones bleed less, but still pose a threat.

The pubic symphysis is a fibrocartilage joint which lies close to the urethra and bladder. These may be damaged in up to 20% of cases if the pubic symphysis is disrupted.

Do not mistake epiphyseal lines for fractures. The apophyses of the ischial tuberosity, lesser trochanter and iliac crest do not disappear until late puberty. The bones in the acetabular floor do not fuse until puberty.

Remember that there are three ‘rings’ to inspect – the pelvic brim, and both obturator formina. If there is a break at one point, look very carefully for another disruption – it is almost impossible to break a ring in one place only

System for examining Pelvic X—ray in Trauma

A	Adequacy	Correct patient Check L5, sacrum, iliac crest and proximal femurs present
A	Alignment	Symphysis pubis midline, normal width Check 3 rings – pelvic brim and both obturator foramina
B	Bones	Look for damage to the outer edge of the pelvis; the trabecular pattern of the bones Inspect the femoral head and neck, and the lumbar vertebrae for fractures
C	Cartilage and joints	Inspect the sacro-iliac joints and compare the two sides
S	Soft tissues	Look for foreign bodies and the position of obturator internus – normally seen both sides of the pelvis, but obliterated or displaced with haemorrhage

Cervical Spine X-ray in Trauma

The lateral cervical spine X-ray will only identify about 80% of fractures, and is no substitute for a good clinical examination. It may not always be available, and cannot be used as the only reason for removing neck immobilisation.

Up to 60% of spinal cord injuries occur in children without any abnormality being seen on the X-ray
SCIWORA = Spinal Cord Injury WithOut Radiological Abnormality

If in doubt about an x-ray, consider it to be abnormal and continue with immobilisation

System for examining Cervical Spine X-ray in Trauma

A	Adequacy	Correct patient. Check X-ray includes C1 – top of T1, the base of skull, top of shoulders, trachea and spinous processes
A	Alignment	Look for three smooth lines –anterior and posterior to the bodies of the vertebrae; and the posterior border of the vertebral canal. Look carefully for mal-alignment – but be aware that a degree of subluxation may be normal
B	Bones	Check each bone carefully looking for breaks in the cortex, or loss of height. Inspect the base of the odontoid peg
C	Cartilage and joints	Compare the joints of each vertebra with the ones above and below looking for similarity of disc space, facet joints and inter-spinous distance. Note the gap between C1 and C2 which should be < 5mm
S	Soft tissue	Look for swelling in the pre-vertebral space – anything > 1/3 width of C2 at that level, or > width of the vertebral body below C4 suggests presence of a haematoma and ligament damage

Skull X-ray in Trauma

The most useful investigation in a trauma situation, is a CT scan. If this is not available, a good quality skull X-ray and period of careful neurological observations, is a good alternative. The indications for skull X-ray are below

Indications for Skull X-ray (in absence of CT scan)

- P on AVPU score
- Loss of consciousness or period of amnesia
- Suspected base of skull fracture
- Suspected penetrating injury or depressed fracture
- Significant scalp bruising or swelling
- Significant mechanism of injury
- Persistent headache, vomiting or fitting
- All non-mobile infants with head injury
- Suspected non-accidental injury
- Difficult to assess patient – e.g. under influence drugs or alcohol

Important points to remember

- In children, up to 85% of intracranial bleeds occur without a skull fracture

- Positive predictive value for intracranial injury
  - Neurological abnormality 91%
  - Fractured skull 65%
- Negative predictive value for intracranial injury
  - Normal neurological examination 99%
  - No skull fracture 83%

This supports the view that repeated neurological assessments are better than an isolated skull X-ray at picking up intracranial injury

Analgesia (*see Section 4)*

There is no excuse for withholding pain relief from any patient who is in pain. If the patient is aware enough to respond to pain, then they can experience pain and need to be helped. Pain increases fear and distress, makes the patient less able to co-operate and raises intracranial pressure.

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
    - The drug of choice is IV morphine 100 micrograms/kg titrated to response
    - Entonox (50/50 O_2/N_2O) is useful, especially for limb injuries whilst splints are being applied. Do not use if head, chest or abdominal trauma

A head injury is NOT a contra-indication for giving morphine

MAJOR TRAUMA IN PREGNANCY (IMEESC Chapters 16-18 and WHO Pregnancy S-4)

Major trauma is a life threatening emergency with road traffic accidents the most common cause. Domestic violence starts or increases in pregnancy and 40% of women who are murdered are killed by a current or ex-partner. Preventable deaths occur as a result largely of inadequately treated hypoxia and hypovolaemia. Good management within the first few hours after the traumatic incident is vitally important in preventing death and long term disability.

Physiological changes of pregnancy which affect the management of trauma

Increased basal heart rate to 85-90 beats per minute
Fall in blood pressure 5 - 15 mm Hg
Blood volume increased by 40% to 100ml/Kg
Vena-caval compression as uterus increases in size
Upward displacement of diaphragm as uterus increases in size

Action plan

1. Call for the most senior help available
2. Take history and note mechanism of injury. Ask about direct impact, a deceleration injury e.g. a car accident or fall, penetrating injury, stab wound, gunshot etc. Ask about symptoms and signs. Ask about any treatment already given.
3. Consider any pre-injury condition which may affect management.
4. Perform primary survey and resuscitation

Structured approach to the pregnant patient

- Primary survey - find threat to life
- Resuscitation - deal with these threats to the life of the mother
- Assess fetal well-being and viability - deal with threats to life of the fetus
- Secondary survey - full examination
- Definitive care - specific management

Primary Survey

Airway and breathing

- Airway plus cervical spine control
- Supplemental oxygen via a tight fitting facemask and reservoir bag at a flow of 12 - 15 litres per minute
- Protect airway if the patient is unconscious. Early endotracheal intubation using a cuffed tube to protect the airway and control ventilation to ensure normal oxygen and carbon dioxide levels can minimise brain injury.

Circulation

- Circulation may be compromised by a pregnant uterus and aorto-caval compression: prevent by a lateral tilt or manual displacement of the uterus with spine immobilisation.
- Aggressive volume replacement.

Recognise signs of hypovolaemia, which are delayed in pregnancy as the mother has a higher circulating volume (see shock). Hypovolaemia may compromise the fetus before the mother's vital signs become abnormal.

Disability

Early assessment by AVPU:

- Alert
- Responding to Voice
- Responding to Pain
- Unresponsive

Secondary survey

Commence intensive monitoring of:

- Heart rate, capillary refill time, respiratory rate
- Blood pressure
- ECG
- SaO_2 and fetal heart
- Head to toe examination including log roll to examine back, maintaining spine and cervical protection if appropriate.

Abdominal examination
Consider:

- Signs of blunt trauma which may cause placental separation up to 48 hours after trauma, fetal distress or death
- Abdominal haemorrhage from injury to intra-abdominal organs
- Uterine rupture

Assess for:

- fetal distress
- vaginal examination to diagnose cause of bleeding or rupture of the membranes (be very careful if there is a possibility of placenta praevia).

Further management

- Correct hypoxia by high flow oxygen and intubation if available
- Correct maternal hypovolaemia with warmed IV fluids/blood
- Assess fetal wellbeing. Use ultrasound to detect fetal heart rate and to identify any retro-placental or intra-abdominal bleeding.
- Detect any abnormal position of the fetus suggesting rupture of the uterus
- Make an early decision to perform Caesarean section for fetal or maternal reasons

Indications for Caesarean section (if safely available):

Fetal distress with a viable fetus
Placental abruption (separation)
Uterine rupture
An unstable pelvic or lumbo-sacral fracture with the patient in labour
Inadequate exposure during laparotomy for other abdominal trauma
Cardiac arrest

Peri-mortem Caesarean section

Undertake this when the mother is unconscious and cardio-pulmonary resuscitation (CPR) is being undertaken. Left sided tilt and CPR are continued throughout as there are reported cases of late maternal survival following delivery of the baby as this process has major benefits for maternal resuscitation.

Post mortem Caesarean section
There is a poor success rate for fetal survival but it has been reported.

Secondary survey

After completion of the primary survey and performing any measures necessary for immediate resuscitation, a full examination should be performed to identify any potentially lethal or non lethal injuries sustained. If the woman has experienced major trauma, x-rays of the chest, pelvis and cervical spine should be taken. A thorough assessment of fetal well being should be performed. Previously undected lethal chest injuries in the mother may be identified.

In cases of major trauma remember there are four areas for concealed blood loss: chest; abdomen; pelvis and abdomen, long bone fractures.

To avoid supine hypotension in the pregnant patient, the right hip should be elevated with a towel and the uterus displaced manually (left lateral tilt).

Specific types of trauma

Blunt trauma
The three commonest causes are motor vehicle accident, falls and domestic violence.

A pregnant uterus is a resilient organ and uterine rupture is rare. There is a high chance of haemorrhage from the fetus into the mother which can be detected by Kleihauer testing if available. There is a significant danger of placental separation with blunt trauma to the abdominal wall. Detection of intra abdominal haemorrhage may be difficult so early laparotomy is recommended. Remember 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 mother by absorbing energy and displacing bowel upwards and to the side. Penetrating injuries above the uterus tend to cause extensive gastrointestinal and vascular damage. Early exploratory laparotomy should be performed to assess and treat injury. Penetrating wounds carry a high risk of major bowel or organ damage so exploratory laparotomy is therefore virtually mandatory.

Thoracic trauma
Thoracic trauma is common in patients with major trauma and accounts for 25% of all related deaths. Only 10% require surgical intervention, but all patients with respiratory compromise require supplemental oxygen.

Chest trauma in pregnancy provides a combination of injury to major thoracic structures and the disadvantage of a large gravid uterus that can easily impair venous return and compromise respiration. Most injuries can be identified by careful assessment and managed with simple measures including the avoidance of aorta caval compression.

Life threatening injuries to identify and treat

A	Airway obstruction
T	Tension pneumothorax
O	Open pneumothorax
M	Massive haemothorax
F	Flail chest
C	Cardiac tamponade

A surgical airway should be used when trauma or severe burns to the face and neck makes endotracheal intubation impossible. Intubation should have usually been undertaken before this point in a case of burns. Surgical airway may be required.

Chest drain insertion should be considered early if there is respiratory distress, shock, cyanosis, tracheal deviation and asymmetry on chest examination suggestive of a traumatic pneumothorax. IV lines should be inserted and an IV fluid/blood bolus immediately available before chest drain is placed as cardiovascular collapse may occur when large amounts of blood are released from a haemothorax.

Other potentially life-threatening injuries:
Pulmonary contusion
Myocardial contusion
Diaphragmatic rupture
Tracheo-bronchial rupture
Oesophageal disruption
Aortic disruption

Non life-threatening injuries:
Simple pneumothorax
Simple haemothorax
Uncomplicated rib fractures

Spine and spinal cord injuries

Spinal injuries should be suspected in falls from a height, in vehicle collisions particularly pedestrians hit by a vehicle or fall from a horse, in the multiply injured patient and in a patient with injury above the clavicle. The spine should be immobilised until spinal injury has been excluded by examination and x-ray. Immobilisation should be carried out in the neutral position. Immobilisation of the cervical spine is done by manual inline immobilisation or by semi-rigid cervical collar, blocks on a board and straps. The use of a long spine board is recommended. Early neurosurgical or orthopaedic opinion, if available, should be sought.

Major Limb injuries

The main threat to life with pelvic and limb trauma is blood loss. Press on any obvious source of bleeding and splint and immobilise the damaged limb to reduce the bleeding.

Take the history and examine the limbs in detail. Look for obvious deformity and the presence of any swelling. Note the colour and perfusion of the limb, which may suggest vascular injury. Feel for tenderness or crepitus which may reveal the presence of a fracture. Assess each limb for temperature, capillary return time, sensation and peripheral pulses.

Pathway of Care: Trauma in Pregnancy

Ensure anti-tetanus measures
X rays as needed
On discharge to report abdominal pain, decreased fetal movements, vaginal bleeding or fluid leakage

Primary Survey and Emergency Care:

Airway: increased risk aspiration – early gastric tube
Breathing: chest drains if needed place at higher level 3-4 ics
Circulation: left lateral tilt
Abnormalities in pulse rate, BP, capillary refill are late because of hypervolaemia of pregnancy
Significant hypovolaemia compromises fetus – therefore aggressive treatment with 0.9% saline and then blood (if haemorrhage), **avoid hypotension**
Disability: convulsions may be due to eclampsia as well as head injury

Secondary survey: Additionally look for

- placental separation after blunt trauma to abdomen (uterine tenderness, vaginal bleeding, shock)
- premature rupture of membranes
- ruptured uterus (eg seat belt injury) – shock, dead fetus, easy palpation of fetal parts, abdominal fluid

Assess for fetal distress
Assess uterus for contractions, abruptio placenta or rupture
Cervix and vagina examined by speculum for amniotic fluid and source of any vaginal bleeding
Consider bowel injury (compressed by uterus and therefore more vulnerable to blunt trauma or penetrating injuries)

Caesarean Section: If fetal distress <u>or</u> placental abruption with viable fetus <u>or</u> uterine rupture

: Consider perimortem/post mortem CS in mother if chance of fetal viability

Section 13 Quiz 8.
Which of the following physiological changes of pregnancy are correct and affect the management of trauma?

a) Basal heart rate decreased
b) Fall in blood pressure
c) Increased blood volume
d) Vena caval compression with increasing uterine size
e) Upward displacement of diaphragm compromising respiratory function

Section 13 Quiz 9.
The primary survey of the injured pregnant patient must include which of the following?

a) Airway assessment and protection
b) Providing lateral tilt or manual displacement of the uterus after 20 weeks gestation
c) Aggressive volume replacement
d) USS to assess fetal wellbeing

Section 13 Quiz 10.
Which of the following are indications for Caesarean section in the management of major trauma in pregnancy?

a) Cardiac arrest, primarily for fetal survival
b) Uterine rupture
c) Bleeding from a pelvic fracture which cannot be stabilised
d) Other abdominal trauma, if there is inadequate exposure at laparotomy

Section 13 Quiz 11.
In major trauma what are the 4 areas where blood loss can be concealed?

Section 13 Quiz 12.
Concerning trauma occurring in pregnancy which of the following statements are true?

a) Domestic violence often starts or increases during pregnancy
b) Risk of placental abruption is not uncommon with blunt abdominal trauma
c) Intra abdominal haemorrhage is relatively easy to detect clinically
d) Penetrating injuries above the uterus are an indication for early laparotomy
e) Burns to face and neck warrants early consideration of endotracheal intubation

ANSWERS:

8. bcde 9. abc 10. bcd 11. chest, abdomen, pelvis, femur
12. abde

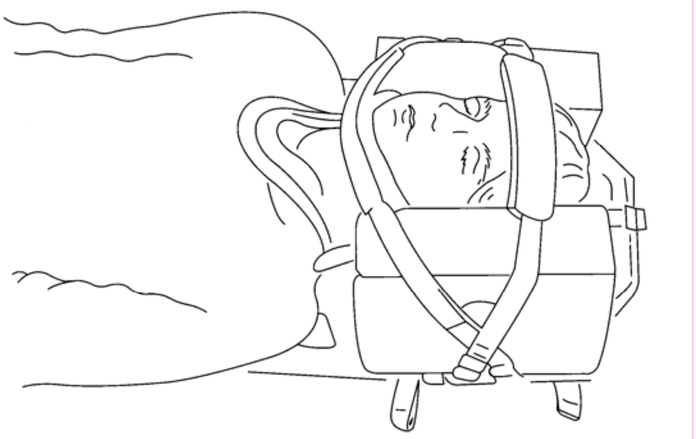
Practical Procedures related to trauma

This section will cover practical procedures related to trauma. Other procedures, including airway management and access to the circulation are covered in chapters on basic and advanced life support.

Cervical spine immobilization (IMEESC 16.4)

All patients with major trauma should have full spinal stabilisation and be treated as if they have a cervical spine injury until proven otherwise. Immobilisation can be achieved

- either by holding the head still and in line (manual in-line immobilisation)
- or by applying
  - a semi-rigid collar, which has been correctly fitted
  - sandbags on either side of the head,
  - and tape across the forehead and the chin piece of the collar to prevent the heads being lifted off the bed.



Head-blocks and straps

Exceptions

Two groups of patients may prove to be difficult

- the frightened, uncooperative child (most common)
- the hypoxic, combative patient

In both these cases over enthusiastic efforts to immobilise the neck may increase the risk of spinal injury as the patient fights 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.

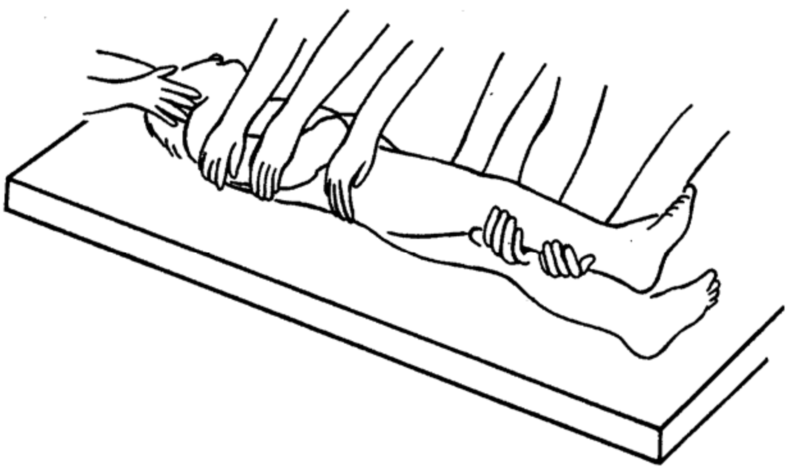
It is best to try and apply just a collar and address the patient's other clinical needs.

Log roll

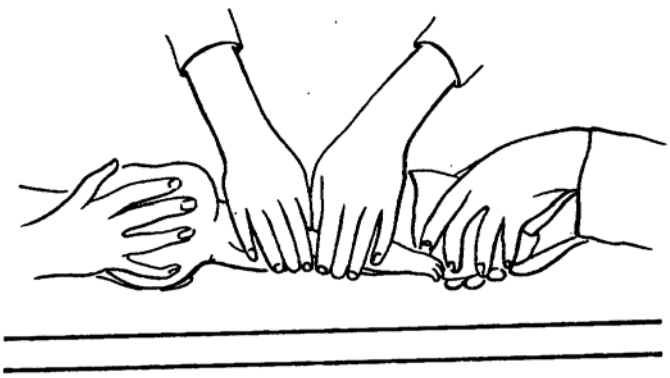
When examining the back of the patient, it is important to minimise the risk associated with unrecognised spinal injury. It is essential to examine the back of the patient at the end of the primary survey (or even during it if there is suspicion of serious injury to the back of the chest or abdomen)

The aim of the log roll is to maintain the orientation of the spine during turning of the patient. It requires four people for a mother or child and three for an infant. In addition one person is required for the examination of injuries.

	Position of staff for log roll	
Staff number	Infant or small child	Larger child or mother
1	Examination of back	Examination of back
2	Stabilisation of head and neck – in charge of the procedure	Stabilisation of head and neck – in charge of the procedure
3	Chest	Chest
4	Pelvis and legs	Pelvis
5		Legs



Logrolling a child



Logrolling an infant

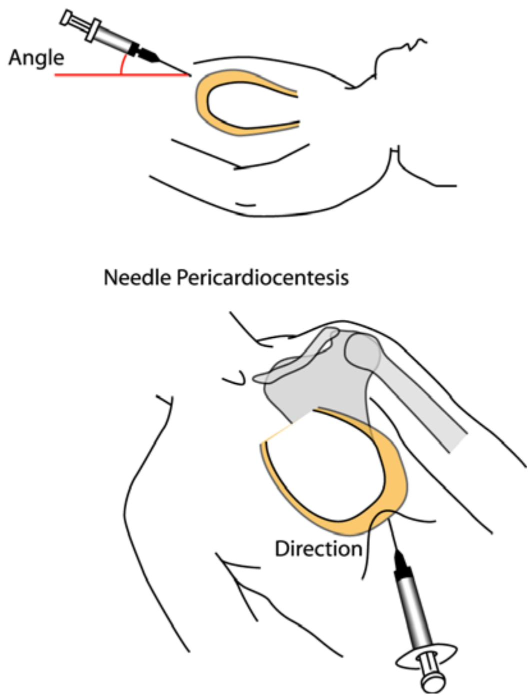
Pericardiocentesis (IMEESC 13.2)

Indication – in the trauma situation this is performed when cardiac tamponade is suspected. This is usually, but not always caused by a penetrating injury between the nipple line, or 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.

Procedure

- Lie child on the back and attach ECG
- Prepare yourself and patient; this is a sterile procedure
- If conscious, infiltrate local anaesthetic at the costal margin just below the xiphisternum
- Attach cannula to syringe and insert cannula just below and left of the xiphisternum
- Angle at 45° and advance towards the tip of the scapula
- Aspirate continuously whilst advancing and watch the ECG
- Blood will flow into the syringe when the pericardial sac is entered
- Watch the ECG for arrhythmias, ectopic beats or injury pattern – all signs that the myocardium has been touched
- If bright red blood flows in large amounts, the heart has been entered, and the cannula should be withdrawn
- If successful, cardiac function should improve immediately
- Withdraw needle and leave cannula in place with a 3-way tap for further use



Pericardiocentesis is a temporary procedure. If repeat aspiration is needed, it is likely that a pericardiotomy will be needed. Always try to discuss the case with a cardiothoracic surgeon.

The child with burns (IMEESC 5.3 and Best Practice Protocol)

The commonest cause of death within the first hour after burns is smoke inhalation. Thus attention to the airway and breathing is of prime importance.

Pathway of Care: burns in a child

Primary Survey:	Airway –	look for inhalation injury – deposits round mouth - carbon in sputum - burns to face
	Breathing –	look for lung injury circumferential burns to chest Carbon monoxide poisoning?
	Circulation –	shock is late in burns
	Disability –	AVPU, pupils, posture
	Exposure	

Emergency treatment:	Airway -	protect
	Breathing -	high flow oxygen
	Circulation -	IV access, bloods for FBC, X match
	Disability -	if PU on AVPU support airway and breathing

Secondary survey:	Exclude other injuries	
	Assess burn -	surface area depth – superficial, partial thickness, full thickness? Special areas involved? – mouth, hands, perineum

Treatment:
Analgesia – oral codeine, entonox, IV morphine
Consider ranitidine for stress ulceration (refer to paediatric formulary for dosage at different ages)
100% O_2 if CO poisoning

IV Fluid therapy - burns >10%
Fluid (crystalloids) additional to maintenance ml/day = % burn x wt (Kg) x 4
Give half of additional fluid in first 8 hours – colloids may be better but are not calculated according to this formula
Keep urine output >1ml/kg/hr

Wound care - cover burns with sterile dressings
leave blisters
prevent contractures

High protein diet + multivitamins
Monitor Hb
Mobilise
Splint joints in position of function

Primary survey

Remember other injuries may exist. Follow a structured approach

Emergency treatment

Follow a structured approach

Secondary survey

Other injuries may occur from a blast, falling objects, or while trying to escape. Follow a structured approach

Assessing the burn:

Surface area

- estimate using burns charts
- or with the patient's palm and adducted fingers (1% body surface area)
- do not use rule of nines <14 years old, but acceptable for mother

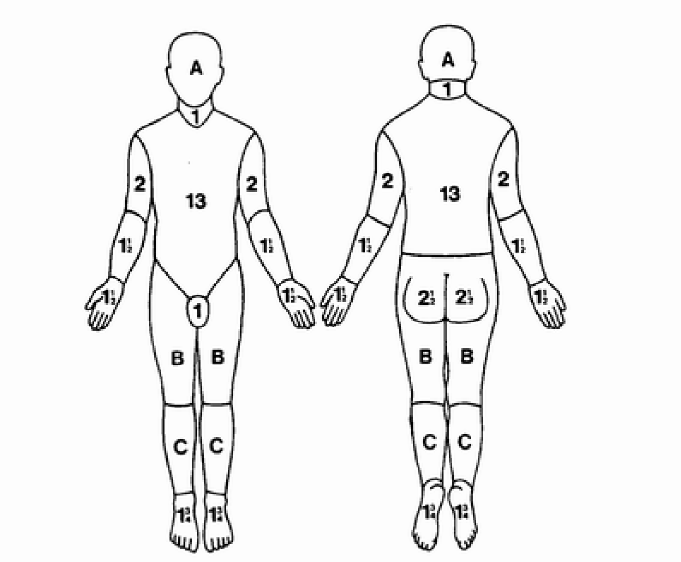
Depth

- superficial - injury only to the epidermis; skin is red with no blister formation
- partial thickness - some damage to the dermis; blistering is usually seen and the skin is pink or mottled
- full thickness - damage to epidermis, dermis and below; the skin looks white or charred, and is painless and leathery to touch.

Special areas

- face and mouth - risk of inhalational injury
- hand - can cause severe functional loss if scarring occurs
- perineal burns - prone to infection and are difficult to manage

Area indicated	Surface area (%) at				
	0	1 year	5 years	10 years	15 years
A	9.5	8.5	6.5	5.5	4.5
B	2.75	3.25	4.0	4.5	4.5
C	2.5	2.5	2.75	3.0	3.25



Specific treatment

Analgesia

- IV morphine 100 micrograms/kg early in burn if severe pain is present: later use WHO ladder
- Ketamine 5 to 10mg/Kg in a child can be given orally, PR or IM for dressing changes. If given IV, use lower dose of 500 micrograms to 1mg/Kg. **Person administering this drug must be capable of managing the airway and breathing.** In children give atropine 20 micrograms/Kg IM before the ketamine.
- Consider ranitidine oral or IV (refer to paediatric formulary for dosage) twice daily to reduce stress ulceration

Inhalation of toxic fumes

- toxic gases include carbon monoxide and hydrogen cyanide
- give 100% oxygen

Fluid therapy

- with burns of >10% give IV fluids **additional to maintenance**.
- calculate as fluid (ml of crystalloid) / day = percentage burn (%) x weight (kg) x 4

give half this in the first 8 hours (calculate from the actual time of burn) after the burn - (0.9% saline or Hartmanns)

Assessment of the size and extent of the burn is difficult. This formula is only a rough guide and it is essential to reassess the fluid state of the patient regularly.

- keep urine output at >1ml/kg/hour
- consider bladder catheterisation if shocked

Wound care

Started early, this will reduce infection and provide analgesia

- Cover burns with sterile towels / cling film (not circumferentially)
- Leave blisters intact
- Avoid unnecessary examination
- Prevent contractures: escharotomies if burn constricts limb blood supply

BURNS IN THE PREGNANT MOTHER (IMEESC 5.3 and Best Practice Protocol)

These may be flame burns, scalds, chemical or electrical burns. Any burn affecting more than 20% total body surface area (TBSA) is a serious risk to the mother and fetus. In a mother with a burn > 70-80% of the TBSA mortality is 50-90%. If the burn affects < 30% TBSA the prognosis is good for both fetus and mother and depends on the management of complications such as hypoxia, hypotension and sepsis. If the pregnancy has reached more than 36 weeks, delivery maybe advisable before complications set in.

Immediate first aid involves extinguishing the flames by wrapping the patient in a blanket or equivalent. Small burns can be cooled with clean cold water but if the burns are extensive, cold water may cause hypothermia.

Fluid loss is greatest in the first 12 hours, causing disturbances in fluid and electrolyte composition.

Primary Survey

Airway and breathing

Airway burns may cause immediate **or delayed** airway compromise so **consider early intubation** as severe swelling of the airway can lead to obstruction. Chemical damage may occur from highly irritant gases, which can lead to progressive respiratory failure. Many plastics and modern materials give off cyanide, which may be absorbed into the blood stream. Many plastics and modern materials give off cyanide, which may be absorbed into the blood stream. Carbon monoxide is the most common poison produced in fires.

Circulation

Assess the amount of body surface area burned

The rule of nines is used to assess the body surface area burned:
Head and neck 9%
Each upper limb 9%
Front of trunk 18% (the pregnant abdomen would represent a larger proportion of the total body surface area)
Back of trunk 18%

Each lower limb 18%

Perineum 1%
The area of the patient's palm represents about 1% of the body surface area

Assess the depth of the burn

In partial thickness burns sensation to pinprick and pain, sweat glands and hair follicles are preserved.
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

IMEESC The following principles can be used as a guide to detect and manage respiratory injury in the burn patient:

- Burns around the mouth
- Facial burns or singed facial or nasal hair
- Hoarseness, rasping cough
- Evidence of glottic oedema
- Circumferential, full-thickness burns of chest or neck.

Assess the circulatory status.

- Secure IV access and replace fluids with warmed 0.9% saline or Hartmanns each containing 5 or 10% glucose (see appendix). A pregnant mother requires 2 to 4mls per kg per % of body surface area burnt to be given over the first 24 hours in addition to baseline maintenance fluids. Half of this volume is given in the first 8 hours, half in the next 16hours
- Monitor urinary output (should be > 30 ml per hour).
- Assess the need to deliver the fetus. Fetal survival is poor in burns affecting > 50% TBSA. In view of the high perinatal mortality in mothers with extensive burns, those who are extensively burned and more than 32 weeks gestation should be delivered soon after admission. Abortion is common in patients with burns > 33% TBSA, especially during the second trimester. Fetal loss during the third trimester can be expected with extensive burns unless delivery occurs within 5days. **If the pregnancy has reached more than 36 weeks, delivery maybe advisable before complications set in.**
- Consider the need for escharotomy, as burnt tissue may constrict the blood supply to the limbs.

IMEESC states the following:

Depth of burn

It is important to estimate the depth of the burn to assess its severity and to plan future wound care. Burns can be divided into three types, as shown below.

Depth of burn	Characteristics	Cause
First degree burn	• Erythema • Pain • Absence of blisters	• Sunburn
Second degree (partial thickness)	• Red or mottled • Flash burns	• Contact with hot liquids
Third degree (full thickness)	• Dark and leathery • Dry	• Fire • Electricity or lightning • Prolonged exposure to hot liquids/objects

Serious burn requiring hospitalization

- Greater than 15% burns in an adult
- Greater than 10% burns in a child
- Any burn in the very young, the elderly or the infirm
- Any full thickness burn
- Burns of special regions: face, hands, feet, perineum
- Circumferential burns
- Inhalation injury
- Associated trauma or significant pre-burn illness: e.g. diabetes

The mother or child with Electrical injuries

Emergency treatment

- disconnect in a safe way from the electric source
- the airway may be compromised by facial burns
- consider cervical spine injury, particularly in the unconscious child
- consider other life-threatening injuries from being thrown from the electrical source

Other treatment

- cutaneous and deep tissue burns lead to fluid loss and oedema
- myoglobinuria may occur from muscle breakdown
- acute renal failure is a threat
- keep a urine flow of at least 2 ml/kg/hour in a child or 1ml/kg/hour (60 ml/hour) in a mother

Near drowning in the mother or child

Emergency treatment

- assess ABC and cervical spine
- assume neck injury in all cases, especially after diving
- ensure adequate oxygenation
- remove all wet clothes
- external re-warming if core temperature > 32 degrees C (radiant heaters, warmed dry blankets)
- core re-warming if core temperature < 32 degree C (warmed IV fluid (39 degree C) or gastric/lavage with warmed 0.9% saline at 42 degree C and heated humidified oxygen at 42 degree C)
- assume the stomach is full of water
    - aim for early nasogastric drainage and intubation (if possible)
- anticipate and treat hypothermia (measure with low reading thermometer in rectum)
- beware of shock after warming from vasodilatation (prevent core temperature exceeding 37 degree C). Treat with IV fluids.
- check for electrolyte abnormalities especially hyponatraemia - this will increase the risk of cerebral oedema
- expect infection

Do not discontinue resuscitation until core temperature is at least 32 degree C or cannot be raised.

Failure to restore an adequate circulation after 30 minutes of resuscitation after re-warming to 32-35 degree C makes further efforts unlikely to be successful.

Section 13 Quiz 13.

When considering burns which of the following statements are true?

a) The rule of nines is used to assess the body surface area burned in pregnancy
b) Inhalation of Carbon monoxide is a serious complication of fires
c) If the burn has affected less than 30% of the body surface area of a pregnant mother, the prognosis is good for mother and fetus
d) Complications include hypotension, hypoxia and sepsis
e) Cooling extensive burns with cold water is always indicated as a first aid measure

Section 13 Quiz 14.

When assessing and treating major burns which of the following statements are true?

a) Full thickness burns are very painful
b) Partial thickness burns have hair follicles preserved
c) If a pregnant mother is more than 30/40 gestation, delivery may be advisable
d) Fluid loss via burnt skin may be extensive and is initially treated with IV crystalloid or colloid in addition to maintenance fluids
e) Subsequent IV fluids should be guided by urine output and measurement of plasma electrolytes.

Section 13 Quiz 15.

When considering burns in children which of the following statements are true?

a) The rule of nines is an effective way to assess surface area of burn
b) The patient's palm and outstretched fingers can be used to estimate every 1% body surface area of burn
c) It is important to exclude other injuries
d) Inhalation of a significant amount of carbon monoxide will cause central cyanosis
e) Blisters should be left intact

Section 13 Quiz 16.

When there has been near drowning, which of the following statements are true?

a) A neck injury should be assumed
b) A low reading rectal thermometer may be needed to measure body temperature
c) Core re-warming is needed if core temperature is $< 32^{o}C$
d) Resuscitation should not be discontinued until the core temperature is at least $32^{o}C$ or cannot be raised
e) Hypovolaemic shock may occur after re-warming

ANSWERS:

13. abcd 14. bcde 15. bce 16. abcde

The mother or child suffering envenomation (IMEESC 5.2)

Diagnosis and Initial Assessment

- assess ABCD: shock is common in viper bites
- endotracheal intubation and assisted ventilation if available and sustainable are indicated for bulbar palsy and paralysis of intercostal muscles and diaphragm (alternatively prolonged bag/mask ventilation – possibly in rotation by family members)
- look for signs of bleeding
- look for early signs of neurotoxicity: ptosis, limb weakness, or difficulties in talking, swallowing or breathing
- check for muscle tenderness and myoglobinuria in sea-snake bites
- take blood for Hb, WCC and platelet count; prothrombin time, APTT and fibrinogen levels (if available); urea and creatinine; creatine phosphokinase (if available)
- if sophisticated clotting studies are unavailable, perform the 20 minute whole blood clotting test (WBCT20):

- place a few ml of freshly sampled blood in a new, clean, dry glass tube or bottle - leave undisturbed for 20 minutes at ambient temperature - tip vessel once - If blood is still liquid (unclotted) and runs out, patient has hypofibrinogenaemia ('incoagulable blood') as a result of venom-induced consumption coagulopathy - perform on admission and repeat 6 hours later

Further Management

- observe in hospital for at least 24 hours - envenoming can develop rapidly after latent period
- give antivenom if there are signs of envenoming; ideally type specific
- fasciotomy is needed if there is clinical evidence of raised intra-compartmental pressure
- correct any coagulopathy as soon as possible using fresh blood if available
- if venom has been spat in the eyes, eg cobras, irrigate rapidly with water; adrenaline 0.5% drops may help reduce pain and inflammation
- avoid IM injections and invasive procedures in patients with incoagulable blood
- give tetanus prophylaxis
- excise any necrotic tissue

The mother or child who has ingested drugs or poisons

Introduction

- in poor countries the most commonly ingested poisons are kerosene and caustic solutions
- self-harm is a major cause in adolescents and in mothers
- most accidental ingestions are non-toxic and deaths are uncommon
- accidental poisoning is most common aged 18-36 months: ask specifically about access to prescribed drugs, household substances etc.
- many die from inhalation of carbon monoxide and other gases in household fires
- traditional remedies can sometimes be highly toxic
- alcohol and solvent abuse are common
- occasionally an adult will deliberately poison a child. It is necessary to have a high index of suspicion in such cases as the history of poisoning will not be given
- some drugs are particularly dangerous in overdose e.g. quinine, diphenoxylate with atropine and tricyclic anti-depressants

Pathway of Care Poisoning in a child

Assess: Safe approach – remove from inhaled poison
care with chemicals such as organophosphates (external decontamination)

Airway - if consciousness depressed GCS <8 or P or U (AVPU) assume compromised
protect airway by recovery position and intubation if available

Breathing - consider high concentration of oxygen (especially CO poisoning even if pink)
give rescue breaths if necessary

Circulation - treat shock and arrhythmias

Disability - check blood glucose/give IV/NG glucose (5ml/Kg 10% glucose)
check pupils – dilated suggests amphetamines, atropine, tricyclic antidepressants, constricted suggests opiates or organophosphates

Posture - hypertonia suggests amphetamines, ecstasy or tricyclic antidepressant poisoining

Convulsions - suggests hypoglycaemia (alcohol), tricyclic antidepressants or some insecticides

Exposure - injection sites
core temperature

↓

Emergency treatment – drink milk or water urgently after caustic substances
- naloxone if opiate suspected (10micrograms/Kg IV repeated every 2-3 minutes to maximum dose of 2mg)
- consider phenytoin if tricyclic antidepressant poisoning (15-20mg/Kg IV infusion over 30 minutes then 2.5 to 7.5mg/Kg 12 hourly
- consider sodium bicarbonate 1 mmol/kg in tricyclic poisoning

↓

Drug elimination –
- activated charcoal 1g/Kg urgent (not useful alcohol or iron)
- repeat after 4 hours
- gastric lavage (for high lethality ingestions) 10 – 20 ml/kg 0.9% saline aliquots NOT after corrosives or petroleum products
- emesis is not now routinely recommended

Airway protection essential if impaired consciousness

Pathway of Care Poisoning in pregnancy

Assess: Safe approach – remove from inhaled poison
care with chemicals such as organophosphates (external decontamination)

Airway - if consciousness depressed GCS <8 or P or U (AVPU) assume compromised
protect airway by recovery position and intubation if available

Breathing - consider high concentration of oxygen (especially CO poisoning even if pink)
give rescue breaths if necessary

Circulation - treat shock and arrhythmias

Disability - check blood glucose/give IV/NG glucose (5ml 50% glucose)
check pupils – dilated suggests amphetamines, atropine, tricyclic antidepressants, constricted suggests opiates or organophosphates

Posture - hypertonia suggests amphetamines, ecstasy or tricyclic antidepressant poisoining

Convulsions - suggests hypoglycaemia (alcohol), tricyclic antidepressants or some insecticides

Exposure - injection sites
core temperature

↓

Emergency treatment – drink milk or water urgently after caustic substances
- naloxone if opiate suspected (0.8-2mg IV repeated every 2-3 minutes to maximum dose of 10mg)
- consider phenytoin if tricyclic antidepressant poisoning (15-20mg/Kg IV infusion over 30 minutes-not exceeding a dose rate of 50mg/minute then 2.5 to 7.5mg/Kg 12 hourly

↓

Drug elimination – activated charcoal 50 grams urgent (not useful alcohol or iron) repeat after 4 hours
OR

- gastric lavage (for high lethality ingestions) 250ml 0.9% Saline aliquots
NOT after corrosives or petroleum products

Airway protection essential if impaired consciousness

Domestic violence (IMEESC 9.3)

Domestic Violence and Pregnancy

Domestic violence (partner violence) is reported in up to 1 in 5 pregnancies, often beginning or getting worse at this time. The risk of moderate-to-severe violence appears to be greatest in the post partum period. Battered women are at increased risk for miscarriage, premature labour, placental abruption, low birth weight infants, fetal injury and intra-uterine fetal death. As a result of violence, women are 5 times more likely to attempt suicide.

Injuries to the abdomen, genitals and breasts are most frequent in pregnancy but can be multiple affecting any part of the woman's body.

Recognising Domestic Violence in Pregnancy

Women who are being abused may be late and poor attendees at AN Clinics. They may attend repeatedly with trivial symptoms and appear reluctant to be discharged home. The partner may be constantly present not allowing for private discussion. The woman may seem reluctant to speak in front of or contradict her partner.

Any signs of violence on the woman's body will be minimised. As with child abuse, the mechanism of injury often does not fit with the apparent injury. There may be untended injuries of different ages or the late presentation of injuries. A history of behavioral problems or abuse in children in the family may be indicative.

Diagnosing Domestic Violence

Routinely ask mothers if they have been subject to violence. Questions such as the following may allow the woman to disclose that she is subject 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 with you?
- How does your partner act when drinking or on drugs?

Other strategies such as questionnaires in the Ladies' toilets may help those women whose husbands are constantly by their sides. Community midwives and TBAs visiting women at home may have the 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 mothers subject to violence should be advocated for by all health professionals undertaking maternal and child healthcare.

Life threatening child abuse (IMEESC 5.2)

Introduction

The following injuries/apparent illnesses may occur as part of child abuse and can result in life-threatening emergencies.

Directly:	asphyxial event: suffocation, hanging, strangulation subdural haemorrhage poisoning and other induced illness (eg septicaemia) ruptured abdominal viscus cervical spine injury rib cage and long bone fractures drowning burns
Indirectly:	sexual abuse and severe emotional abuse (through later self poisoning or other suicidal acts

Suffocation

Suffocation can result in death or life threatening events with hypoxic ischaemic injury after prolonged episodes

Features suggesting that an Apparent Life Threatening Event (ALTE) is due to suffocation include:

- bleeding from the nose and/or mouth at the time of the ALTE (highly specific)
- petechial haemorrhages around the face
- strangulation marks
- recurrent severe apnoeic or cyanotic episodes with their onset always in the presence of one person
- events in infants over 6 months post term age
- Some of the following features (usually not known at time of presentation) in the possible perpetrator may indicate a predisposition to induce such an illness in their child:
    - Fabrication or induction of illness in themselves
    - History of false allegations of physical or sexual assault
    - Previous self-harm
    - Severely disrupted care in own childhood
    - Antisocial acts such as arson, domestic violence, violent crime, abuse of pets

Sub-dural haemorrhage in infancy

Presentation:	o sudden onset of impaired consciousness in an infant o sudden fits in an infant o Apnoeic or cyanotic episode o Intractable vomiting o Unexplained anaemia
On examination:	o Obvious head injury (unusual - suggests impact injury as well as shaking) o impaired consciousness o meningitic picture o bulging fontanellele o retinal haemorrhages

Ruptured abdominal viscus

Presentation:	o shock o severe abdominal or chest/shoulder pain o vomiting
On examination:	o shock o peritonism o abdominal bruising (uncommon) o haematuria o rectal bleeding

Indicators of abuse which although themselves are not life threatening indicate the possibility of future life threatening abuse

- torn frenulum
- extreme passivity and frozen watchfulness
- bruises indicating abusive behaviour by a carer (particularly in an infant)

- fractures particularly in an infant with X ray changes of multiple fractures of different ages
- cigarette burns
- genital injuries

Management of life threatening child abuse

1. ABCD depending on systems affected
2. Think of the possibility of abuse
3. Think of possibility of poisoning
4. Make diagnosis (good quality history, carefully recorded notes of history and examination, careful collection and labelling of forensic specimens, photographs of injuries, and x-rays, consider additional investigations such as covert video surveillance)
5. Check child protection register (if one exists)
6. Refer to child protection team (doctor, social services, police) if one exists; if not, advocate for Government to establish one

Section 13 Quiz 16

Which of the following statements are true concerning a child who has been poisoned?

a) Always inducing vomiting
b) Airway protection must be provided if there is decreased conscious level
c) Check the blood glucose
d) Give Naloxone if opiate ingestion
e) Phenytoin and Sodium bicarbonate are helpful if tricyclic antidepressant poisoning

Section 13 Quiz 17

Which of the following statements are true concerning Life threatening abuse?

a) In pregnancy leads to an increased risk of miscarriage, placental abruption and intrauterine fetal death
b) Questions should be routinely asked of pregnant women when they are alone
c) In children a bruise over the abdomen may indicate a dangerous intra-abdominal injury
d) In children should be suspected if the history does not fit with findings on examination
e) In infants may be suspected if there are x-ray changes of fractures of different ages

ANSWERS

16. bcde **17.** abcde

Appendix

Basic Information to help with managing sick children

Estimate of Weight

Infant = up to 12 months old
Birth weight - doubles by 5 months
- triples by 1 year
- quadruples by 2 years

After 12 months, the formula can be applied, but needs to be modified according to whether the child is small or large compared with the average

Weight (Kg) = 2 (age in years + 4)

Normal vital signs by age

Age (years)	**Heart Rate** (bpm)	**Systolic BP** (mmHg)	**Respiratory rate** (per min)
≤ 1	110 - 160	70 – 90	30 - 40
1 - 2	100 - 150	80 – 95	25 - 35
2 - 5	95 - 145	80 – 100	25 - 30
5 - 12	80 - 120	90 – 110	20 - 25
≥ 12	60 - 100	100 – 120	15 - 20

Airway adjuncts

Un-cuffed tubes in children < 25kg weight (age 6 – 7 years)

ETT (internal diameter mm)

- Full term baby size 3.0 – 3.5
- Infant (< 1year) size 4.0 – 4.5
- > 1 year size of tube = Age / 4 + 4

Length of tube

$\frac{\text{Age}}{2}$ + 12 cm (oral tube)
+ 14 cm (nasal tube)

Circulation

- **Circulating blood volume**
  - 100 ml / kg at birth
  - 80 ml / kg at 1 year
  - 70 ml / kg at 12 years

- **Systolic blood pressure**
  - 80 + (age in years x 2)

- **Capillary refill**
  - ≤ 3 seconds

- **Urine output**
  - Infants 2 ml / kg / hr
  - Child 1 ml / kg /hr

Fluid management

- **Rehydration**

Fluid deficit + normal fluid requirements + additional losses (sweat, diarrhoea, vomit etc)

- **Fluid deficit (ml)** = % dehydration x weight (kg) x 10

Normal requirements fluid & electrolytes (unless excessive losses)

Body weight	Fluid /24 hrs	Fluid/hr	Na mmol/24 hours/Kg	K	Energy Kcal/24hrs	Protein G/24hrs
First 10Kg	100ml	4ml	2-4	1.5-2.5	110	3
Second 10Kg	50ml	2ml	1-2	0.5-1.5	75	1
Subsequent Kg	20ml	1ml	0.5-1	0.2-0.7	30	0.75

On-going losses

- After each loose stool
  - age < 2 yrs; 50m – 100 ml
  - age ≥2 yrs ; 100-200 ml
- After each vomit – 2ml / kg body weight

Calculating drip rates

- 1 ml = 20 drops in standard giving set
- drops / min = $\frac{\text{ml / hr}}{3}$ with a standard giving set

With a micro-dropper infusion giving set 1ml = 60 micro-drops

Disability

- **A - ALERT**
- **V - Responds to VOICE**
- **P - Responds to PAIN = Glasgow Coma score 8 or less**
- **U - UNRESPONSIVE**

Blood glucose conversion 1 mmol/litre =19 mg/dl

Table 35. WHO/NCHS normalized reference weight-for-length (49–84 cm) and weight-for-height (85–110 cm), by sex

Boys' weight (kg)						Girls' weight (kg)				
-4SD 60%	-3SD 70%	-2SD 80%	-1SD 90%	Median	Length (cm)	Median	-1SD 90%	-2SD 80%	-3SD 70%	-4SD 60%
1.8	2.1	2.5	2.8	3.1	**49**	3.3	2.9	2.6	2.2	1.8
1.8	2.2	2.5	2.9	3.3	**50**	3.4	3	2.6	2.3	1.9
1.8	2.2	2.6	3.1	3.5	**51**	3.5	3.1	2.7	2.3	1.9
1.9	2.3	2.8	3.2	3.7	**52**	3.7	3.3	2.8	2.4	2
1.9	2.4	2.9	3.4	3.9	**53**	3.9	3.4	3	2.5	2.1
2	2.6	3.1	3.6	4.1	**54**	4.1	3.6	3.1	2.7	2.2
2.2	2.7	3.3	3.8	4.3	**55**	4.3	3.8	3.3	2.8	2.3
2.3	2.9	3.5	4	4.6	**56**	4.5	4	3.5	3	2.4
2.5	3.1	3.7	4.3	4.8	**57**	4.8	4.2	3.7	3.1	2.6
2.7	3.3	3.9	4.5	5.1	**58**	5	4.4	3.9	3.3	2.7
2.9	3.5	4.1	4.8	5.4	**59**	5.3	4.7	4.1	3.5	2.9
3.1	3.7	4.4	5	5.7	**60**	5.5	4.9	4.3	3.7	3.1
3.3	4	4.6	5.3	5.9	**61**	5.8	5.2	4.6	3.9	3.3
3.5	4.2	4.9	5.6	6.2	**62**	6.1	5.4	4.8	4.1	3.5
3.8	4.5	5.2	5.8	6.5	**63**	6.4	5.7	5	4.4	3.7
4	4.7	5.4	6.1	6.8	**64**	6.7	6	5.3	4.6	3.9
4.3	5	5.7	6.4	7.1	**65**	7	6.3	5.5	4.8	4.1
4.5	5.3	6	6.7	7.4	**66**	7.3	6.5	5.8	5.1	4.3
4.8	5.5	6.2	7	7.7	**67**	7.5	6.8	6	5.3	4.5
5.1	5.8	6.5	7.3	8	**68**	7.8	7.1	6.3	5.5	4.8
5.3	6	6.8	7.5	8.3	**69**	8.1	7.3	6.5	5.8	5
5.5	6.3	7	7.8	8.5	**70**	8.4	7.6	6.8	6	5.2
5.8	6.5	7.3	8.1	8.8	**71**	8.6	7.8	7	6.2	5.4
6	6.8	7.5	8.3	9.1	**72**	8.9	8.1	7.2	6.4	5.6
6.2	7	7.8	8.6	9.3	**73**	9.1	8.3	7.5	6.6	5.8
6.4	7.2	8	8.8	9.6	**74**	9.4	8.5	7.7	6.8	6
6.6	7.4	8.2	9	9.8	**75**	9.6	8.7	7.9	7	6.2
6.8	7.6	8.4	9.2	10	**76**	9.8	8.9	8.1	7.2	6.4
7	7.8	8.6	9.4	10.3	**77**	10	9.1	8.3	7.4	6.6
7.1	8	8.8	9.7	10.5	**78**	10.2	9.3	8.5	7.6	6.7
7.3	8.2	9	9.9	10.7	**79**	10.4	9.5	8.7	7.8	6.9
7.5	8.3	9.2	10.1	10.9	**80**	10.6	9.7	8.8	8	7.1

WEIGHT/HEIGHT

CALCULATING THE CHILD'S WEIGHT-FOR-LENGTH

Boys' weight (kg)						Girls' weight (kg)				
-4SD 60%	-3SD 70%	-2SD 80%	-1SD 90%	Median	Length (cm)	Median	-1SD 90%	-2SD 80%	-3SD 70%	-4SD 60%
7.6	8.5	9.4	10.2	11.1	**81**	10.8	9.9	9	8.1	7.2
7.8	8.7	9.6	10.4	11.3	**82**	11	10.1	9.2	8.3	7.4
7.9	8.8	9.7	10.6	11.5	**83**	11.2	10.3	9.4	8.5	7.6
8.1	9	9.9	10.8	11.7	**84**	11.4	10.5	9.6	8.7	7.7
7.8	8.9	9.9	11	12.1	**85**	11.8	10.8	9.7	8.6	7.6
7.9	9	10.1	11.2	12.3	**86**	12	11	9.9	8.8	7.7
8.1	9.2	10.3	11.5	12.6	**87**	12.3	11.2	10.1	9	7.9
8.3	9.4	10.5	11.7	12.8	**88**	12.5	11.4	10.3	9.2	8.1
8.4	9.6	10.7	11.9	13	**89**	12.7	11.6	10.5	9.3	8.2
8.6	9.8	10.9	12.1	13.3	**90**	12.9	11.8	10.7	9.5	8.4
8.8	9.9	11.1	12..3	13.5	**91**	13.2	12	10.8	9.7	8.5
8.9	10.1	11.3	12.5	13.7	**92**	13.4	12.2	11	9.9	8.7
9.1	10.3	11.5	12.8	14	**93**	13.6	12.4	11.2	10	8.8
9.2	10.5	11.7	13	14.2	**94**	13.9	12.6	11.4	10.2	9
9.4	10.7	11.9	13.2	14.5	**95**	14.1	12.9	11.6	10.4	9.1
9.6	10.9	12.1	13.4	14.7	**96**	14.3	13.1	11.8	10.6	9.3
9.7	11	12.4	13.7	15	**97**	14.6	13.3	12	10.7	9.5
9.9	11.2	12.6	13.9	15.2	**98**	14.9	13.5	12.2	10.9	9.6
10.1	11.4	12.8	14.1	15.5	**99**	15.1	13.8	12.4	11.1	9.8
10.3	11.6	13	14.4	15.7	**100**	15.4	14	12.7	11.3	9.9
10.4	11.8	13.2	14.6	16	**101**	15.6	14.3	12.9	11.5	10.1
10.6	12	13.4	14.9	16.3	**102**	15.9	14.5	13.1	11.7	10.3
10.8	12.2	13.7	15.1	16.6	**103**	16.2	14.7	13.3	11.9	10.5
11	12.4	13.9	15.4	16.9	**104**	16.5	15	13.5	12.1	10.6
11.2	12.7	14.2	15.6	17.1	**105**	16.7	15.3	13.8	12.3	10.8
11.4	12.9	14.4	15.9	17.4	**106**	17	15.5	14	12.5	11
11.6	13.1	14.7	16.2	17.7	**107**	17.3	15.8	14.3	12.7	11.2
11.8	13.4	14.9	16.5	18	**108**	17.6	16.1	14.5	13	11.4
12	13.6	15.2	16.8	18.3	**109**	17.9	16.4	14.8	13.2	11.6
12.2	13.8	15.4	17.1	18.7	**110**	18.2	16.6	15	13.4	11.9

SD = standard deviation score or Z-score; although the interpretation of a fixed percent-of-median value varies across age and height, and generally the two scales cannot be compared; the approximate percent-of-the median values for -1 and -2SD are 90% and 80% of median respectively (*Bulletin of the World Health Organization*, 1994, **72**: 273–283).

Length is measured below 85 cm; height is measured 85 cm and above. Recumbent length is on average 0.5 cm greater than standing height, although the difference is of no importance to the individual child. A correction may be made by deducting 0.5 cm from all lengths above 84.9 cm if standing height cannot be measured.