Bier Block (Intravenous Regional Anesthesia)

History

August Bier introduced this block in 1908. Early methods included the use of two separate tourniquets and procaine was the local anesthetic of choice. Initial popularity waned and it fell into disuse as new methods were found for anesthetizing the upper extremities. In 1963, Holmes popularized the Bier Block.

The basic idea behind the Bier block is to exsanguinate the extremity, apply an arterial tourniquet to isolate it from circulation, and inject local anesthetic into the extremities venous system, inducing anesthesia.

Indications

The Bier block is a suitable technique for the following:

- Surgical procedures involving the arm below the elbow (open procedures or closed reductions)
- Surgical procedures involving the leg below the knee (open procedures or closed reductions)
- Surgical procedures that will be completed within 40-60 minutes

Advantages & Disadvantages of the Bier block

Advantages include the following:

- Easy to administer
- Low incidence of block failure
- Safe technique when used appropriately
- Rapid onset and recovery
- Muscle relaxation for the surgeon

Disadvantages include the following:

- Should be used for only short procedures
- Patient may experience tourniquet pain after 20-30 minutes
- Sudden cardiovascular collapse or seizures may occur if local anesthetic is released into the circulation too early.

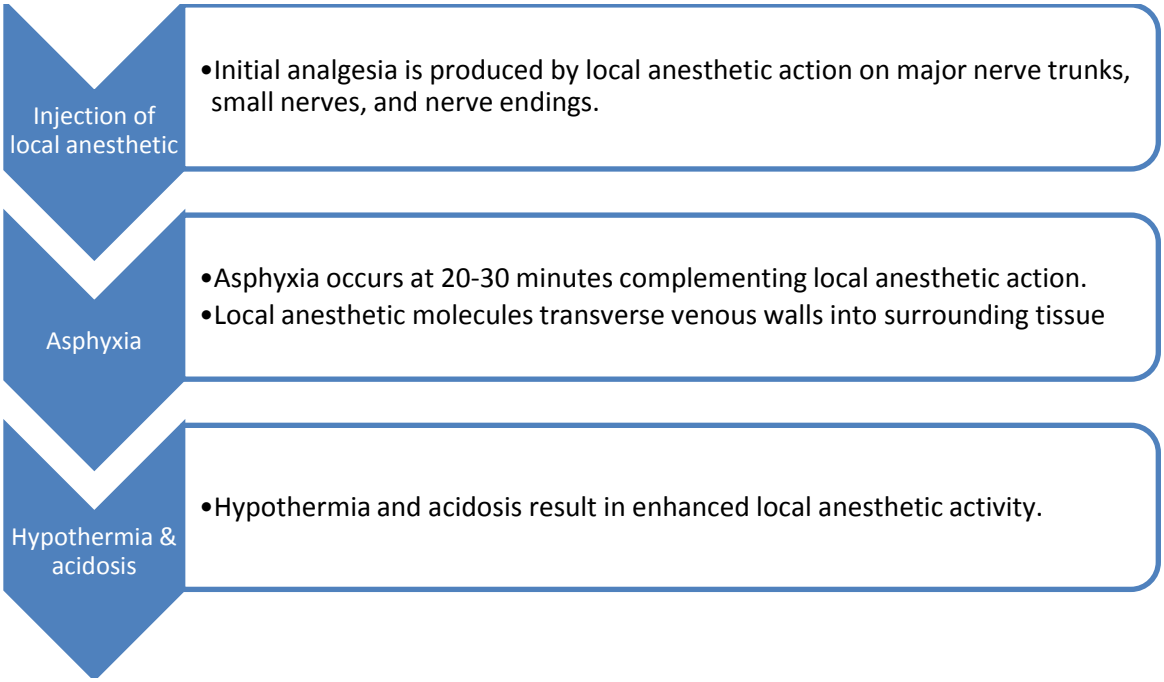
Contraindications

Patients with the following conditions:

- Reynaud's disease
- Homozygous sickle cell disease
- Crush injuries
- Young children
- Unreliable or inadequate tourniquets.

Mechanism of Action

The exact mechanism of action for intravenous regional anesthesia is not clearly understood. There appears to be multiple and complementary mechanisms for producing analgesia and anesthesia. It would be too simplistic to state that a large volume of dilute anesthetic is entirely responsible for anesthesia. Ischemia, asphyxia, hypothermia, and acidosis play an important role. Prior to the advent of local anesthetics ancient civilizations utilized nerve ischemia through compression of nerve trunks to produce regional anesthesia and subsequent surgical procedures. The following sequence events appear to result in anesthesia and analgesia:



Adapted from Rosenberg and Heavner, 1985.

Equipment

- Double tourniquet. Prior to use test the tourniquet to ensure proper function.
- Eschmark bandage or an elastic rubber bandage to exsanguinate (remove blood) from the arm
- IV catheter (dorsum of the operative hand/foot is preferred)
- A running IV in the non operative arm to administer sedatives, analgesics, and emergency medications
- Resuscitation equipment should be available

Local Anesthetic Choice

Preservative free prilocaine and lidocaine are acceptable choices. Both have relatively low toxicity and a high therapeutic index. The concentration for both should be 0.5%. Never substitute other local anesthetics. The local anesthetic should NOT contain epinephrine, it

should be plain. The recommended dose of lidocaine should not exceed 3 mg/kg. For a 70 kg adult this would be 50 ml of 0.5% plain lidocaine. The recommended dose for prilocaine should not exceed 6 mg/kg. The usual dose for an adult is 40 ml of 0.5% prilocaine. Lower extremity surgery may require larger volumes. For patients that weigh less than 70 kg, adjust the dose according to their weight. Do not increase the dose for larger patients. Never use higher doses/concentrations of prilocaine or lidocaine because of the risk of toxicity. One complication of prilocaine is methemoglobinemia (see chapter one). Prilocaine is metabolized to o-toluidine derivatives, which converts hemoglobin to methemoglobin. This generally occurs at high doses (>10 mg/kg) and should not occur with routine use at accepted doses.

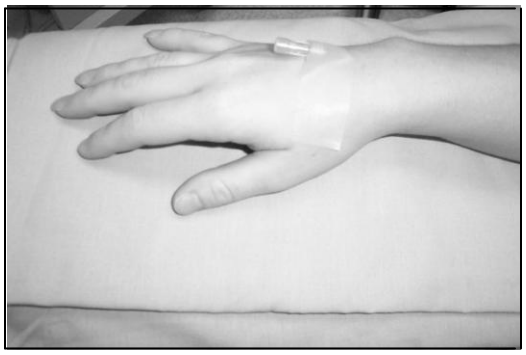
0.5 % Lidocaine Preservative Free
5 mg/ml
Suitable for infiltration and intravenous regional anesthesia.

XYZ Drug Company
Expiration Date: Month/Year

Read the label. Ensure it is the correct local anesthetic, concentration, and formulated for intravenous regional anesthesia.

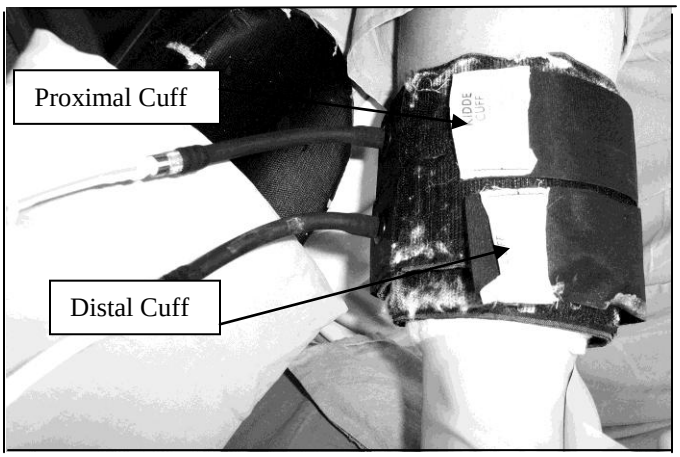
Technique

- Prepare the required materials
- Ensure that the 0.5% prilocaine or 0.5% lidocaine is preservative free, formulated for intravenous regional anesthesia, and does NOT contain epinephrine.
- Ensure proper tourniquet function
- Ensure that the patient has been fasting for an appropriate period of time.
- Attach routine monitors including ECG, blood pressure, and pulse oximetry.
- Place the IV catheter as distally possible on the operative limb. Place a running IV in the non operative arm.



IV lock in the operative hand

- Double tourniquet placed on operative limb.



Double Tourniquet

- Have the patient hold the operative limb up. Exsanguinate the extremity with an Eschmark or rubber bandage. Exsanguination should occur from distal (hand/foot) to proximal (towards the tourniquet).

Exsanguation of the arm with an elastic bandage

- After exsanguination, the proximal tourniquet should be inflated to approximately 100 mmHg higher than the patient's systolic blood pressure.
- The Eschmark/rubber bandage should be removed. Confirm the absence of an arterial pulse (radial for arm/dorsalis pedis for leg).

Confirming the absence of a radial pulse

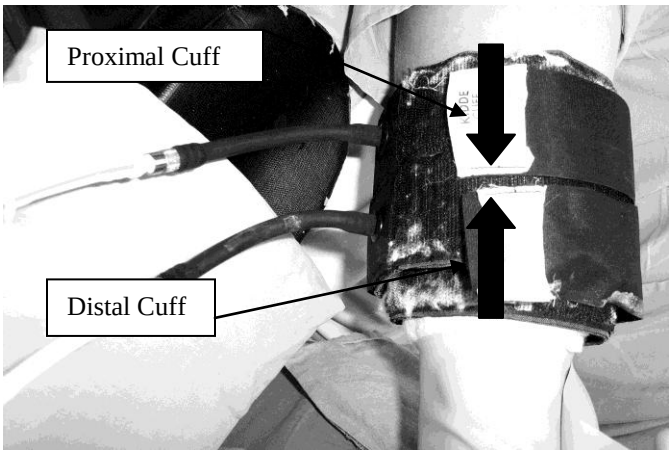
- Inject the local anesthetic slowly (0.5% prilocaine or 0.5% lidocaine). Do not exceed the maximum dose.

Injection of 0.5% lidocaine

- Once the injection is complete, remove the IV catheter and hold pressure at the site.

Removal of IV lock and pressure held on the site

- Now the OR staff can prep the arm. The onset of anesthesia will occur within 5 minutes.
- Inform the patient that the limb will feel numb or tingle. The limb may appear mottled. This is normal.
- When the patient complains of tourniquet pain, inflate the distal tourniquet. Once the distal tourniquet has been inflated deflate the proximal cuff.



First inflate the distal cuff. After successful inflation deflate the proximal cuff

- Analgesics should be administered for discomfort as needed
- Leave the tourniquet inflated for a minimum of 20-25 minutes. Releasing the tourniquet early may result in a large amount of local anesthetic being released, increasing the risk of toxicity.
- When releasing the tourniquet cyclic deflations/inflations in 10 second intervals will decrease peak levels of local anesthetic.
- Continue to monitor ECG, blood pressure, and pulse oximetry for 10 minutes after deflation.

Complications

- Tourniquet discomfort
- Rapid return of sensation after tourniquet release, resulting in subsequent pain
- Toxic reactions from malfunctioning tourniquets or deflating the tourniquet prior to 20-25 minutes.

Local Anesthetic Toxicity

- Signs and symptoms may include nausea, vomiting, dizziness, ringing of the ears (tinnitus), funny sensation around the mouth, loss of consciousness, and seizures.

Local Anesthetic Toxicity Management

Use the A, B, C's for the management of local anesthetic toxicity.

- A= airway. Maintain a patent airway, administer 100% oxygen.
- B= breathing. May need to assist the patient with positive pressure ventilation or intubation.

- C= circulation. Check for a pulse. If no pulse, initiate CPR.
- Seizures. Diazepam in doses of 5 mg, or alternatively sodium pentothal in doses of 50-200 mg will decrease or terminate seizures.
- Hypotension. Treat with ephedrine (typically 5 mg) IV, open up intravenous fluids, place the patient in a head down position (Trendelenburg). If hypotension is refractory to ephedrine, treat the patient with epinephrine (5-10 mcg). Repeat and escalate the dose as necessary.

The use of lipids in the treatment of local anesthetic toxicity has shown promise. There are currently no established methods and research continues. For updates please refer to http://lipidrescue.squarespace.com.

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