Intravenous Regional Anesthesia
(Biers block)
objectives

• Definition.
• Mechanism of action
• Indications and contraindications.
• Procedure.
• Complications.
• Prevention and treatment.
• Was first introduced by the German surgeon August Bier in 1908, but became popular in the 1960s when it was reintroduced by Holmes.

• A Bier block essentially consists of injecting local anesthetic solutions into the venous system of an upper or lower extremity that has been exsanguinated by compression or gravity and that has been isolated by means of a tourniquet from the central circulation (mechanical impending of venous return).
Mechanism of action

although the exact mechanism isn’t clearly understood there appear to be multiple and complimentary mechanisms for producing analgesia & anesthesia. Ischemia, asphyxia, hypothermia & acidosis play an important role.

Local anaesthetic diffuses into the small veins surrounding the nerves and then into the vasa nervorum and capillary plexus of the nerves, leading to a core to mantle (centrifugal) conduction block in the nerves involved. Local anaesthetic then diffuses into the small nerves in the skin, blocking their conduction. The tourniquet produces ischaemia, which contributes to the analgesic action of the local anaesthetic by blocking nerve conduction and motor endplate function. 20 minutes after tourniquet application alone there will be analgesia to pinprick without the injection of any local anaesthetic. However, the speed of onset and the density of anaesthesia are greater with injection of local anaesthetic.
Indications:

It is used for short surgeries (45-60min) of upper and lower extremities.

**Upper limb:**

1. (Volar ganglionic cyst of wrist). 1-ganglionectomy
2. Palmar fasciotomy.
3. Dupuytren’s contracture surgery.
4. Reduction of fractures.
5. Tendon grafting.
6. Manipulations of the ulnar, median or radial nerves (may cause paresthesias, which may require the use of adjuvant parenteral analgesics or sedatives).

**Lower limb:**

1. Excision of a mass.
2. Digital nerve repair.
4. Accessory navicular excision.
5. Any fracture requiring 45min.
I.V.R.A is of greater acceptance in upper extremity because tourniquet problems and other safety issues seem to arise more frequently when it’s used on the lower extremities.

Upper extremity IVRA has been utilized occasionally for prolonged analgesia/anesthesia (ie, surgeries expected to persist for longer than 1 hour), with a mandatory tourniquet deflation period of at least 1 minute prior to reestablishing the anesthetized state.
Contraindication:

1. Patient refusal.
2. Allergy to local anesthetic.
3. Sickle cell disease.
5. Local skin infection.
7. Severe hypertension & peripheral vascular disease.
8. Skeletal muscle disorders.
9. Paget’s disease (local anaesthetic may spread to the systemic circulation via venous channels in bone).
10. Scleroderma.
12. Inability to locate peripheral veins.
Procedure:

First the pt. should be:
- Starved for 6h.
- Monitored closely (ECG, BP, HR, O2 sat, RR, TEMP).
- Adequate explanation to the pt. & obtain an informed consent.

Equipment required for IVRA:
- 2x iv cannula
- Double cuff tourniquet (should be tested).
- High P compressed air.
- Esmarch bandage or Rhys-Davis exsanguinator.
- Local anaesthetic solution.
- Functioning resuscitation equipment and drugs.

Anatomy:
- The location and distribution of the veins of the hand, of the antecubital fossa, and of the foot and ankle region.
Choice of drug:

Many local anaesthetic drugs, with or without additives, have been used for IVRA. 0.5% prilocaine, 3–6 mg/kg, is the drug of choice (often 40ml dose for upper limb and up to 100ml for lower limb).

1- It has less systemic toxicity.

2- Partially taken up in the lungs before reaching the systemic circulation.

3- The largest therapeutic index.

If not available use lidocaine, 3mg/kg.

It’s contraindicated to use:

1- Bupivacaine and etidocaine (they are protein bound with high risk for cardiac toxicity).

2- Adrenaline.
Technique:

1- An indwelling plastic catheter is inserted in the dorsum of the hand or foot:
   - on the limb requiring the biers block.
   - on the contralateral limb for fluid, sedatives, analgesia, ER medications.

2- A double-pneumatic tourniquet is placed on the proximal cuff high in the upper arm or thigh.
   - never apply it to the forearm or lower leg as adequate arterial compression cannot be obtained.

3- Elevate the arm and wrap the esmarch rubber bandage very tightly in a distal to proximal direction.

4- Inflate the proximal cuff (50–100 mm Hg above the systolic arterial BP)

5- Remove the esmarch bandage.
Technique: cont...

6-constrict proximal to the injection site and release all 40 ml of lidocaine – there should be no resistance or swelling.

7-when there is 5ml left release the constriction p to allow lidocaine to infiltrate the rest of the arm, then take off the catheter.

- Anesthesia start in 5-10min and can start the surgery

8- About 25–30 minutes after the onset of anesthesia or when a patient complains of tourniquet pain, the distal cuff is inflated and the proximal cuff is deflated to minimize the development of tourniquet pain.

9-even for very short surgical procedure, the tourniquet must be left inflated for at least 15-20min and removed slowly to avoid a rapid iv bolus of local anesthetic resulting in systemic toxicity.
Complications of IVRA

Despite it provides safe, easy, fast anesthesia and recovery, muscle relaxation with a low rate of block failure, however, it only can be used for short procedures, develops pain in (20-30min) & high risk of sudden CVS collapse and seizures in case of rapid release of local anesthetic into circulation.
Complications due to IVRA may be classified either as

**Drug** (depend on the agents, including local anesthetics and adjuvants, being administered directly into the vascular system).

or **Equipment** (ie, tourniquet) related (include all devices and techniques used to isolate the vascular space from the systemic circulation).

Inadvertent or unintentional deflation of the cuff, cuff failure, a sudden increase in venous pressure within the occluded tissue to a level higher than cuff pressure, and an intact interosseous circulation may all contribute to complications of IVRA.
Reducing Complications

- Appropriate Drug Selection
- Minimize Leakage of Drug Across the Tourniquet
  1. Ensure adequate exsanguination of the limb before tourniquet inflation, a process facilitated by the limb elevation and the application of an Esmarch bandage.
  2. Maintain the tourniquet pressure at a level sufficient to prevent venous congestion in the isolated segment of the limb
  3. Do not use excessive volumes of local anesthetic solution
  4. Inject the local anesthetic solution over at least 90 seconds.
  5. Inject the solution as far distal to the tourniquet as practical.
- Reduce the Incidence of Tourniquet Pain (double-cuff tourniquet)
Deflate the Tourniquet Appropriately

- An interval of at least 20 minutes between drug administration and tourniquet deflation (the lidocaine becomes tissue bound in 30 min and will not flood the systemic circulation)
- “cyclical” fashion (minimizing the possibility of a sudden, sustained increase in the blood level of the local anesthetic)

maintaining the previously anesthetized extremity quiescent for some time immediately following tourniquet deflation

About 70% of the administered lidocaine dose remains within the tissues of the isolated limb after tourniquet deflation, the remaining 30% enters the systemic circulation during the ensuing 45 minutes. Much more drug is released from the tissues of the isolated limb into the circulation after tourniquet deflation if the limb is inadvertently exercised.
Deflation of the Tourniquet

Tourniquet deflation after IVRA is associated with signs and symptoms of systemic local anesthetic toxicity, ranging from mild events related to the central nervous system, such as tinnitus and perioral numbness, to seizures, and finally to devastating cardiovascular collapse. These correlate with local anesthetic concentrations in arterial blood and not to venous concentrations.
Compartment syndrome
(is an increase in pressure within a muscular compartment
to a value greater than perfusion pressure, leading to tissue ischemia)
may occur rarely following IVRA, especially when IVRA is used for
reduction of long-bone lower extremity fractures, and may be due
both to the large volume of local anesthetic injected to effect
analgesia and to inadequate or incomplete exsanguination of the
limb prior to performing the block.

Neurologic complications (very rare)
including damage to the median, ulnar, and musculocutaneous nerves, are
associated with IVRA. The cause of such complications appears to be direct
pressure of the tourniquet applied to these nerves, which subsequently
exhibit histologic changes resembling crush injuries.