Cardiovascular: Placement of IV and IO Lines

Cardiovascular 1.4.2.2
Placement of peripheral IV lines 1.4.2.2.1
Access or Placement of Central Venous Lines in the field 1.4.2.2.2
Intraosseous lines 1.4.2.2.3.
Adult 1.4.2.2.3.1
Pediatrics 1.4.2.2.3.2

2025

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Learning Objectives

Upon the completion of this program participants will be able to:

-identify the different types of prehospital vascular access

-explain the risk and benefits of each type of vascular access

-Be able to identify the environment that each type of access is most utilized

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Quiz Questions

- There is controversy regarding gaining IV/IO access in the prehospital setting in which types of patients?
  a) Pediatric
  b) Medical
  c) Trauma
  d) Medical and Trauma

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Quiz

- Gaining central access is an integral part of pre-hospital venous access in the medical and trauma patient?
  1) True
  2)False

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Quiz

- Which of the following sites for IO insertion have been approved for use by the FDA with **most** devices on the market?
  a) Proximal tibia
  b) Proximal humerus
  c) Sternal
  d) Distal tibia
  e) a, b and d

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Placement of Peripheral IVs

- Traditional vascular access route for EMS
- Sites are usually upper extremities, but EXTERNAL JUGULAR used as well
- Complications are local infiltration, dislodgement and failed attempts
- Rare phlebitis

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Venous Access

- Controversy regarding time to insertion of pre-hospital IV's especially in trauma patients
- Debate about type and amount of IVF exists for trauma resuscitation
- Speed of delivery of the trauma patient may be more important than starting IV's unless done en route in the trauma patient
- Effectiveness of field therapy in the medical patient may be more critical requiring pre-hospital IV/IO access

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Peripheral IVs

- Finding a "good vein" in chronically ill, IV drug abusers, patients in shock states often challenging
- Paramedics have low confidence in IV access in pediatrics often due to low exposure to pediatric patients requiring vascular access in the field

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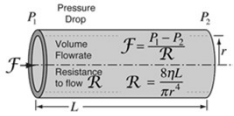
Peripheral IVs

- Most systems carry 24-14g catheters
- A short (1.25 in) 14g delivers the highest volume over the shortest period of time
- ***Poiseuille's law***: The principle that the volume of a homogeneous fluid movement per unit time with laminar flow is directly proportional to the pressure difference between its ends and to the fourth power of its internal radius, and inversely proportional to its length and to the viscosity of the fluid.



Flow Increases with:	Flow Decreases with:
↓ length	↑ length
↑ pressure differential	↓ pressure differential
↑ radius ^4	↓ radius 4

http://hyperphysics.phy-astr.gsu.edu/hbase/ppois.html

More fluid with shorter/larger catheters

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Peripheral IVs

- Difficult in:
  - Low/no light areas
  - Moving vehicles (ambulances/air)
  - Provider at risk of blood-borne exposures during cannulation because of austere conditions
  - Requires significant practice to become adept at starting IVs in pre-hospital setting
  - Moving patients multiple times also makes infiltration and dislodgement common

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Peripheral IV's

- Traditional IV site
  - Upper extremities
- Alternate Venous Access
  - External jugular vein
  - Central venous lines
  - Intraosseous lines

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Central Venous Catheters

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Central Venous Catheters

- Mainly used in ***air medical services*** and rarely ground EMS

- Complications:
  - Infection
  - Arterial cannulation
  - Pneumothorax (if subclavian or IJ)
- No wide sterile draping or maximum barrier precautions possible in pre-hospital environment

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Central Venous Catheters

- Several sites are considered:
  - Subclavian
  - Internal Jugular
  - Femoral
- Infection rates have not been studied in pre-hospital setting
- Ultrasound guided pre-hospital placement of IJ CVC not prevalent, time sensitive or studied

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Central Venous Catheters

- Cost: $162/procedure
- Recommendation (1A CDC) to avoid femoral central venous lines
- Recent studies show no statistical difference in CRBSI between all three sites (critical care med 2012)
- Use of full drapes, gowns, masks, sterile gloves, hand hygiene, chlorhexadine preparation with strict adherence to aseptic precautions, antimicrobial catheters, and use of US guidance are all recommended (Marik, P, Flemmer, M, et al: "The risk of catheter-related bloodstream infection…" Critical Care Med 2012 Vol 40, No. 8)
- Not feasible in pre-hospital setting

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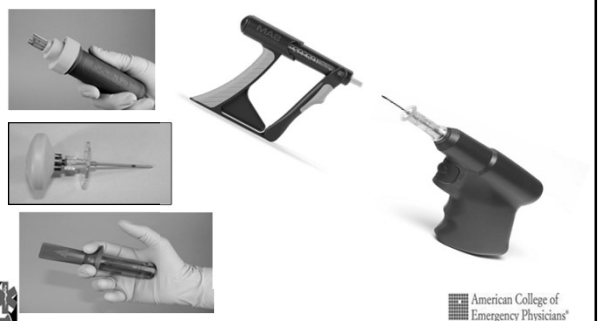
Intraosseous Vascular Access



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Intraosseous Vascular Access

- Accesses the intraosseous space of long bones
- Vast "non-collapsible" network of venules and arterioles that dump into central circulation
- Sites include: proximal humerus, proximal tibia, distal tibia and sternum in United States (distal femur – recent)
- Requires skin preparation using aseptic technique and proper landmarking for insertion
- Peripheral insertion with central performance

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Intraosseous Vascular Access

- ILCOR/AHA recommends this as first alternative to failed peripheral IV access in cardiac arrest
- May consider after failed IV attempts in adults and pediatrics in need of vascular access in all time sensitive illnesses
- Needle selection is based on tissue depth, not age
- Needle site is decided based on access needs: volume vs. meds, potential for dislodgement

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Intraosseous Vascular Access

- Indications
  - Inability to obtain vascular access in 2 sticks or 90 seconds in a patient requiring emergent, urgent or medically necessary vascular access
- Complications
  - Extravasation/infiltration
  - Compartment syndrome (lower leg)
  - Dislodgement
  - Slow flow
  - Leakage
  - Inability to flush
  - Infection/swelling at site (rare)

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Intraosseous Vascular Access

- Most medications that can be given IV can be given IO
- Exceptions: chemotherapeutic agents, TPN, long term infusion of hypertonic agents
- Contraindications include:
  - Inability to identify landmarks for insertion
  - Fracture at site
  - Infection at site
  - Previous orthopedic procedure at site or IO within past 48 hours in target bone; prosthetic limb or joint

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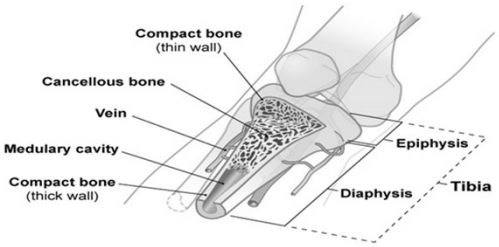
Anatomy of Long Bones



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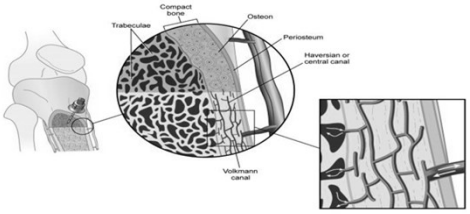
Anatomy of Intraosseous Access



Thousands of small veins lead from the medullary space to the central circulation

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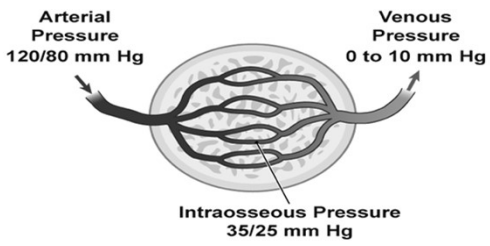
Intrinsic IO Pressure



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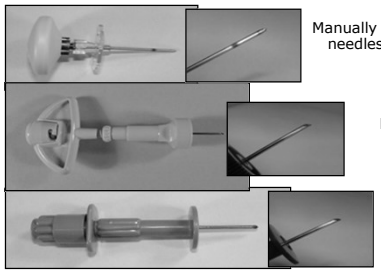
Manual IO Needles



Manually inserted handheld infusion needles have been available for years

Used primarily for pediatrics because their bones are soft

Insertion technique can lead to extravasation

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FAST 1
(fast access for shock and trauma)

- Sternal application
- FDA cleared for use in patients 12 years and older
- Impact driven

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BIG (Bone Injection Gun)

- Adult and pediatric versions
- FDA cleared for use in proximal tibia and proximal humerus

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"Bone Drill"

Designed for 500 human insertions

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Intraosseous Vascular Access

- Proximal humeral site can deliver 5 L/hr (average)
- Proximal tibial site can deliver 1 L/hr on average
- Proximal humerus delivers drugs, fluids and blood products to central circulation and right heart within 2 seconds
- Proximal tibia delivers drugs, fluids and blood products to femoral circulation within 10-22 seconds
- Sternal site can deliver 125cc/min under pressure and reaches heart within 2 seconds

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Intraosseous Vascular Access

- Recommended anesthesia for infusion with ***2% preservative free, epinephrine free cardiac lidocaine (for IV use only)*** administered over 2 minutes for patients who perceive pain when time allows.
- Suggested ***Adult Dose*** is 20-40mg (1-2cc) initially followed by a 10cc flush and re-administration of 20mg (1cc); may re-dose as needed to max dose of 3mg/kg total (tibial site requires higher doses)
- Suggested ***Pediatric Dose*** is .5mg/kg

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Intraosseous Vascular Access

- ***FDA approved/cleared sites***:
  - Manual: pediatrics proximal tibia
  - FAST-1: sternum age 12 and older
  - Bone Injection Gun (BIG; spring loaded):pediatric device is for proximal tibia up to age 12 and adult device is for proximal humerus and tibia in adult
  - EZ-IO (drill driven): proximal humerus, proximal and distal tibia in adults and pediatrics

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Quiz

- The preferred site for IV access in a prehospital setting is:
  a) External jugular
  b) Foot
  c) Scalp vein
  d) Upper extremities

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Quiz #2

- Central venous catheter placement can result in the following complications:
  a) Arterial cannulation
  b) Pneumothorax
  c) Thrombosis
  d) Infection
  e) All of the above

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Quiz #3-Post

- Intraosseous Vascular Access can be performed on the following patient types with high success rates:
  a) Pediatrics
  b) Adults
  c) IV drug abusers
  d) Vasculopaths
  e) All of the above

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Quiz #4 Post

- IO access may be quicker than peripheral IV or central venous access?
  a) True
  b) False

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