EMS Subspecialty Certification Review Course

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

Version: 2017

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

Quiz Question

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
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
  - failed attempts
  - phlebitis (rare)

Venous Access

- Controversy:
  - value of and time to insertion of pre-hospital IV’s especially in trauma patients
  - type and amount of IVF for trauma resuscitation
- In trauma pts, speed of delivery to trauma eval likely most important, IV’s should be done en route
- Medical pts may benefit more from prehospital vascular access because of greater effectiveness of field therapy with medical complaints
- “Precautionary” IV starts should be monitored

Peripheral IVs

- Issues:
  - Difficult to gain access in chronically ill, IVDA, shock, moving ambulance, poor lighting
  - Low confidence in pediatric IV access
  - Risk of blood exposure
- Mechanics:
  - 14-24ga catheters, flow rate governed by Poiseuille’s Law
  \[
  Q = \frac{\pi Pr^4}{8\eta l}
  \]
  - In other words, short large catheters provide the greatest flow rate.
Vascular Access Sites

• Traditional peripheral IV site
  – Upper extremities

• Alternate Venous Access
  – External jugular vein
  – Central venous lines (Subclavian, IJ, femoral)
  – Intraosseous lines

Central Venous Catheters

• Mainly used in **air medical services** and rarely ground EMS
• Potential benefit:
  – Larger bore access
• **Risks:**
  – Infection: Limited sterile precautions possible in pre-hospital environment
  – Arterial cannulation
  – Pneumothorax
  – Thrombosis
  – Nerve damage
  – Bleeding

Intraosseous Vascular Access
Intraosseous Vascular Access

- Sites (United States approved—varies by device):
  - proximal humerus
  - proximal tibia
  - distal tibia
  - distal femur (peds only)
  - sternum
- Requires skin preparation using aseptic technique and proper land-marking for insertion
- Accesses the intraosseous space of long bones with vast “non-collapsible” vascular network with rapid central access and performance

Avoid growth plates
Vast “non-collapsible” vascular network of venules and arterioles that dump into central circulation

The canals of the compact bone lead from the marrow to the larger vessels outside the bone which lead to the central circulation. This passage from marrow through compact bone acts as an additional natural filter to the bloodstream.

The structure of the medullary space creates a non-collapsing vascular access point, it is also a non-expanding space; this is why we need a flush and on going pressure from a syringe, a pressure bag, a pump or an infuser to maximize flow.

Intraosseous Vascular Access

- ILCOR/AHA recommends
  - Adult: first alternative to failed peripheral IV access in cardiac arrest
  - Ped: first line access in critical patient
- 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
- Needle site is decided based on disease state and product used
Proximal humerus average of 5 l/hr
Proximal tibia average of 1 l/hr
Medication transit time from humerus shorter than tibia; especially important in non-perfusing patient
Adequate CPR determines coronary blood flow and thus intracerebral blood flow

Intraosseous Vascular Access

- **Indications**
  - Need for emergent vascular access
- **Complications**
  - Osteomyelitis
  - Fat emboli
  - Fracture
  - Growth plate injury
  - Compartment syndrome
  - Extravasation/infiltration
  - Dislodgement, slow flow, leakage, inability to flush

Intraosseous Vascular Access

- Most medications that can be given IV can be given IO
- Exceptions: effectively nonemergency drugs
  - Chemotherapeutic agents
  - TPN
  - Long term infusion of hypertonic agents
- Contraindications include:
  - Inability to identify landmarks for insertion
  - Fracture at site (incl CPR for sternal)
  - Infection at site
  - Previous orthopedic procedure at site (incl sternotomy) or IO within past 48 hours in target bone; prosthetic limb or joint
Intraosseous Flow Rates

- **Proximal humeral site**
  - can deliver 5L/hr (average)
  - delivers products to central circulation and right heart within 2 seconds
- **Proximal tibial site**
  - can deliver 1L/hr on average
  - delivers products to femoral circulation within 10-22 seconds
- **Sternal site**
  - can deliver 125cc/min (7.5L) under pressure and reaches heart within 2 seconds

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