Ultrasound Guided Vascular Access

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Why ultrasound guided?

- Landmark-based placement:
  - Multiple attempts
  - Excessive bleeding
  - Inadvertent arterial puncture
  - Vessel laceration
  - Pneumothorax
  - Hemothorax
  - Chylothorax

Why ultrasound guided?

- Agency for Healthcare Research and Quality strongly advocated the use of ultrasound in central venous cannulation
- National Institute for Clinical Excellence recommends that central venous catheters be inserted under ultrasound guidance
- Some hints that JCAHO may soon introduce ultrasound guidance for central lines as a core measure

Technical Considerations

Setup and Approach

- probe selection
- setup
- skin prep
- technique
  - one operator vs two operator
  - dynamic vs static
  - longitudinal vs transverse
Typical Vascular Probe

Linear array probe
- high frequency (4-10 MHz)
- very detailed images of superficial structures

Two-Operator Technique

Infection Precautions

- Central Venous Access
- Utilize sterile procedures
- gloves, probe covers
- Peripheral Venous Access
- Clean skin and transducer
- similar to standard IV placement
Terminology

- Static approach
  - use the ultrasound to confirm the predicted landmark-based anatomy
- Dynamic approach
  - the operator actually watches the needle enter the vessel under real-time vessel visualization

Technical Considerations

Transverse vs Longitudinal

**Transverse (short)**
- Easier to learn
- See other anatomy
- Risk overshoot
- ‘Ring-down’ artifact

**Longitudinal (long)**
- Harder to learn
- Safer (no overshoot)
- Depth and slope

Technical Considerations

Transverse Approach

place the probe so that the vein is in the middle of the screen
Technical Considerations

Transverse Approach

acoustic shadowing
reverberation artifact

risk of overshoot
Keep bevel up when entering the vein
prevents puncturing deep wall
facilitates guidewire placement
Central Venous Access

Why Use Ultrasound?

- Use of ultrasound:
  - decreases complications
  - quicker venous access

Variable position of IJ vein

Denys et al. (1991)

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>Landmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>100%</td>
<td>88.1%</td>
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<tr>
<td>First Attempt</td>
<td>78%</td>
<td>38%</td>
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<tr>
<td>Skin to vein</td>
<td>10 secs</td>
<td>44 secs</td>
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<tr>
<td>Carotid puncture</td>
<td>1.7%</td>
<td>8.3%</td>
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Denys et al. (1993)
- Standard gel (inside)
- Avoid air bubbles
- Sterile gel (outside)
Artery vs Vein

- Compression
- Color Flow
- Pulse wave doppler

Central Venous Access

Artery vs Vein

- Compression

Central Venous Access

Artery vs Vein

- Color Flow

increased color gain shows flow in vein
Artery vs Vein

- Color Flow

Veins may be pulsatile red vs blue

- Pulse wave doppler

Anatomic Sites

- Central
  - Internal jugular
  - Femoral
  - Subclavian (distal) - Advanced
  - Supraclavicular (IJ/SC confluence) - Advanced

Internal Jugular
Central Venous Access

Transverse Approach

Longitudinal Approach

Femoral
• Ultrasonography of the femoral vessel in the groin: Implications for vascular access
  • describes incidence of femoral artery over vein
  • all subjects have at least 50% overlap of femoral artery over vein 4cm from inguinal ligament
  • COMPLETE overlap of femoral artery over vein 4cm below inguinal ligament in 50% of patients

P Hughes et al, British Journal of Anaesthesia 2000;84:5:668-669
Central Venous Access

Supraclavicular

Central Venous Access

Supraclavicular

confluence of IJ and subclavian

Peripheral Venous Access

Why Use Ultrasound?

- Difficult IV access
- dialysis patients, IV drug users, obesity
- Central access not needed
Preparation

- clean skin and transducer
- similar to standard preparation for IV access
- have all materials readily accessible
- placement of ultrasound machine
- get comfortable!

Catheter Length

- Standard catheters are 1 inch (32mm).
- to cannulate a vein 7mm deep at a 45 degree angle “uses up” 10mm

- however at the shallower angle needed (22 degrees), 16mm are “used up” to reach the vein
- only leaves 1/2 inch in the vein
- stock 1.5-2 inch catheters
Peripheral Venous Access

Catheter Length

- consider using Seldinger technique for deeper veins

Peripheral Venous Access

Anatomy

superficial upper arm veins

cephalic
basilic
brachials

Peripheral Venous Access

Anatomy

Peripheral Venous Access

Anatomy
Artery vs Vein

- Compression
  - both arteries and veins may be compressible
  - arteries will usually still be pulsatile

Vein Selection

- Less than 1 cm deep
- At least 3cm long
  - relatively straight
- At least 3mm wide

Artery vs Vein

- Color Flow
  - arteries usually more pulsatile

Vein Selection

optimal vein
Vein Selection

Transverse Approach

make sure vein is relatively straight

Transverse Approach

Longitudinal Approach
Peripheral Venous Access

Longitudinal Approach

consider using Seldinger technique for deeper veins

Pearls and Pitfalls

Setup is Crucial

- Prepare all material before starting
- Sterile covers, flushes, syringes, etc
- Adjust ultrasound machine to a comfortable position
- Extra catheters available
- Position marker/monitor correctly
**Compression**

- Look for compression and expansion of soft tissue.

**Valsalva & Trendelenberg**

**Locate the Needle**

- Bouncing technique

**Angle of Approach**

- Posterior wall puncture
Angle of Approach

Pearls and Pitfalls

catheter kinks in vein

Thread the Catheter

Pearls and Pitfalls

Once you get a flash, advance to make sure the catheter is also in the vein

Thread the Catheter

Pearls and Pitfalls

Thread the Catheter
Ultrasound Guided Vascular Access

Final Thoughts

- Start out using the transverse approach. It is much easier for beginners to learn.
- First attempts should be on stable patients before more challenging patients.
- Peripheral lines require practice, but are a useful skill to master.