Central and Peripheral Venous Access

Gavin Budhram, MD
Department of Emergency Medicine
Baystate Medical Center

Why Use Ultrasound?

- Decreases complications
- Excessive bleeding, inadvertent arterial puncture, vessel laceration, pneumothorax, hemothorax
- Anatomic variation
- Quicker venous access
- Avoid multiple attempts

Disclosures

- I have nothing to disclose

Internal Jugular

Why Use Ultrasound?

- 982 US guided
- 302 landmark based

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<thead>
<tr>
<th></th>
<th>US</th>
<th>Landmark</th>
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<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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Central Venous Access

Technical Considerations

Vascular Probe

- Linear array probe
- High frequency (4-10 MHz)
- Very detailed images of superficial structures

Technical Considerations

Two-Operator Technique

- One person holds the ultrasound probe
- Other person places cannulates vessel
- Allows use of both hands for manipulating syringe
- Often preferred when first learning technique
One-Operator Technique

- Single operator controls probe and needle
- Allows greater precision
- Often preferred by advanced practitioners

Approach

- Static approach
  - Ultrasound used to confirm anatomy and mark position of vessel
- Dynamic approach
  - Operator actually watches the needle enter the vessel in real-time

Infection Precautions

- Central Venous Access
- Utilize sterile procedures
- Sterile gloves and probe covers
- Peripheral Venous Access
- Clean skin and transducer
- Similar to standard IV placement

Sterile Probe Covers

- Many commercially available probe covers
- Standard gel (inside)
- Avoid air bubbles
- Sterile gel (outside)
Central Venous Access

Artery vs Vein

- Shape
- Compression
- Color Flow

Artery vs Vein

- Shape
  - arteries: circular
  - veins: angular
- Compression

Artery vs Vein

- Color Flow
Artery vs Vein

- Color Flow
  - Veins may be pulsatile red vs blue

Central Venous Access

Transverse Approach

- Place the probe so that the vein is in the middle of the screen

The needle is aimed for the middle of the probe

- Needle not directly seen
- Localized by artifacts:
  - Reverberation
  - Shadowing
Transverse Approach

Risk of Overshoot:
Needle still appears to be in vessel

Longitudinal Approach
Transverse vs Longitudinal

Transverse
- Easier to learn
- See other anatomy
- Risk overshoot
- ‘Ring-down’ artifact

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

Anatomic Sites

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

Internal Jugular

external jugular vein
internal jugular vein
common carotid artery
subclavian vein
Internal Jugular Longitudinal Approach

Central Venous Access

Internal Jugular

Longitudinal Approach

carotid

Central Venous Access

Internal Jugular

Longitudinal Approach

Femoral

• In a study of femoral anatomy in 50 adult patients:
• At 4cm from the inguinal ligament:
  • all subjects have at least 50% overlap of femoral artery over vein
  • 50% of patients had COMPLETE overlap

Femoral compression used to differentiate arteries and veins. Color may be used but is not always reliable.

Central Venous Access

Subclavian

Transverse Orientation

Longitudinal Orientation

Transverse Orientation
Supraclavicular

Central Venous Access

Confluence of IJ and subclavian

Peripheral Venous Access

Why Use Ultrasound?

- Difficult IV access
- Dialysis patients, IV drug users, obesity
- Central access not needed
- Avoid multiple attempts
- Increase patient satisfaction
**Preparation**

- Similar to standard preparation for IV access
- Clean skin and transducer
- Have all materials readily accessible
- Placement of ultrasound machine
- Get comfortable!

**Catheter Length**

- In general, longer catheters are needed for ultrasound-guided IV's
- Deeper vessels usually cannulated

**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
- ED should stock 1.5-2 inch catheters

- sto
Anatomy

Superficial Upper Arm Veins

- Cephalic vein runs along anterior aspect of upper arm
- Basilic vein runs along superficial medial aspect of upper arm

Brachial Veins

- Brachial veins are deeper along medial aspect of upper arm
- Usually require a longer catheter
- Closer to radial artery and nerve

Artery vs Vein

- Compression
- Both arteries and veins may be compressible
- Arteries will usually still be pulsatile
Artery vs Vein

- Color Flow

arteries usually more pulsatile

Vein Selection

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

Vein Selection

Optimal Vein

Vein should be relatively straight
**Peripheral Venous Access**

**Transverse Approach**

- Needle not usually seen directly
- Location inferred by artifact and movement of surrounding tissues

**Longitudinal Approach**

- Needle slope and tip may be seen
- More technically challenging

**Transverse Approach**

“Bouncing” technique to localize needle

**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

Pearls and Pitfalls

Compression

Compression is the most reliable way to differentiate arteries and veins

Pearls and Pitfalls

Valsalva & Trendelenberg

Both maneuvers will significantly increase the size of internal jugular vein
**Locate the Needle**

Bouncing Technique

**Angle of Approach**

Steep angle of approach makes posterior wall puncture more likely

**Pearls and Pitfalls**

**Angle of Approach**

Steep angle of approach makes kinking of catheter more likely

**Thread the Catheter**

Once flash is obtained, advance needle to make sure catheter is in vein
Thread the Catheter

Visually check that catheter is inside vein before advancing.

Confirm Placement

Agitated saline “Bubble” Test

Quick Punch

A quick jabbing motion may be needed to pierce wall of the vein.

Echotip Needle

Commercially made “echotip” needles are available and may aid visualization.
Troubleshooting

“Guidewire will not thread”
Needle no longer in vessel

“IV has stopped working”
Clot has developed inside vein

Trouble-shooting

“IV has stopped working”
Clot has developed inside vein

Summary

Final Thoughts

- Ultrasound is safer, quicker
- Practice on stable patients
- Begin with transverse approach
- Peripheral lines are hard to master, but USEFUL!
Gavin Budhram, MD
Director of Emergency Ultrasound
Baystate Medical Center
Springfield, MA