Difficult Vascular Access
Alternative Approaches & Troubleshooting Tips

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There are many pieces of the puzzle to achieve success in obtaining vascular access in difficult cases.

- Choosing the best vascular site
- Implementing ultrasound technology
- Troubleshooting tips
Case #1

40 y/o man c/o chest pain and peaked T waves on EKG. He is a known dialysis patient with poor vascular access. You are unable to obtain a peripheral IV in his arms or legs.

Where do you try next to get rapid vascular access?
External Jugular Vein

Adapted from Netter’s *Atlas of Human Anatomy*, 1989
External Jugular Vein

Positioning
- Trendelenburg
- Slight neck rotation to stretch the vein
External Jugular Vein

Technique
- Valsalva maneuver
- Shallow angle needle (5-10 degrees)
External Jugular Vein

**Technique**
- Reduce vein-rolling (bifurcation site or side-puncture)
External Jugular Vein

Pearls
• May not have flashback of blood in catheter
• “Floating the IV” technique
• Secure the IV around the ear
External Jugular Vein

Pearls
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• Secure the IV around the ear
Deep Peripheral Veins

Deep Brachial Veins
- Medial and lateral to brachial artery
- Most superficial 1-2 cm superior to antecubital crease
- Not palpable or visible

Basilic Vein
- Proximal extension of deep brachial veins
- Forms axillary vein more proximally
- Not palpable or visible
Deep Peripheral Veins

Adapted from Netter’s Atlas of Human Anatomy, 1989
Deep Peripheral Veins

Positioning
• Arm in relaxed extension
• Abduct shoulder to access ulnar elbow.

Technique
• Tourniquet arm proximally.
• Use linear ultrasound transducer to find veins in transverse view.
• Use a 2-inch angiocatheter.
• Aim needle at 45° (not shallow angle).

2-in angiocath
1.25-in angiocath
Ultrasound 101

Use a high-frequency (7.5-10 MHZ) linear probe

Basic tenets:
1. Blood vessels are black (anechoic)
2. Veins are compressible and arteries are not
3. Marker on probe correlates with marker on screen
4. Hashmarks on screen are at 1 cm intervals.
Ultrasound 101

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Deep Peripheral Veins

Pearls

• Best if vein is $\geq 0.4 \text{ cm}$ and within $0.3-1.5 \text{ cm}$ depth. ¹

• Needle may puncture through anterior and posterior wall. Withdraw needle slowly may give you a flashback of blood.

¹ Witting, J Emerg Med, 2010
Deep Peripheral Veins

Pearls
• Complications with deep veins: studies without using U/S
  ▪ Paresthesias (18%)
  ▪ Brachial artery puncture (8%)
  ▪ Hematoma formation (1.6%)
  ▪ IV decannulation (8%)
Deep Peripheral Veins

Pearls

- Complications with deep veins: *studies without using U/S*
  - Paresthesias (18%)
  - Brachial artery puncture (8%)
  - Hematoma formation (1.6%)
  - IV decannulation (8%)

Consider using a single-lumen central line for added stability.
Case #2

35 y/o woman presents with necrotizing fasciitis and hypotension. You can’t get a peripheral IV because of her long IVDU history.

Where do you try next for vascular access?

Left antecubital fossa  
Right neck
Central Venous Access
Femoral, Internal Jugular, Subclavian

What’s the best site?
Central Venous Access

Merrer et al. *JAMA* study in 2001

Prospective study with 289 patients in 8 French ICU’s randomized to get a femoral or subclavian line.

<table>
<thead>
<tr>
<th></th>
<th>Femoral</th>
<th>Subclavian</th>
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</thead>
<tbody>
<tr>
<td>Thrombotic Complications</td>
<td>21.5%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Catheter Colonization</td>
<td>19.8%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Catheter-Related Clinical Sepsis</td>
<td>4.4%</td>
<td>1.5%</td>
</tr>
</tbody>
</table>
Central Venous Access
Thrombotic risks

Mian et al. *Acad Emerg Med* study in 1997

Prospective study with 42 patients

Patients underwent bilateral lower extremity ultrasounds within 7 days of femoral line placement.

**Result:** 26.2% had a DVT in that same extremity (versus 0% in the other leg without a femoral line)
Central Venous Access
Infectious risks
Parienti et al. *JAMA* study in 2008

Randomized study with 750 patients receiving either a femoral or IJ dialysis vascular catheter.

<table>
<thead>
<tr>
<th></th>
<th>Femoral</th>
<th>IJ</th>
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<tbody>
<tr>
<td>Catheter Colonization</td>
<td>25%</td>
<td>26%</td>
</tr>
<tr>
<td>Catheter-Rel Bloodstream Infxn</td>
<td>1%</td>
<td>2%</td>
</tr>
</tbody>
</table>

**Subgroup analysis:** Femoral lines had a greater colonization rate compared to IJ lines for obese patients (BMI >28.4).

**Study limitation:** IJ lines were NOT placed under ultrasound guidance (known higher infection rate).
Central Venous Access
Infectious risks

Gowardman et al. *Intensive Care Med* study in 2008

Prospective, non-randomized study of 605 central lines placed in single ICU.

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<th>IJ</th>
<th>Subclavian</th>
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<tr>
<td>Catheter-Related Bloodstream Infxn</td>
<td>0.5%</td>
<td>2%</td>
<td>2% (p&gt;0.05)</td>
</tr>
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</table>
Central Venous Access
Bottom line about choosing a site

Subclavian lines are best.

IJ lines are ok for short-term (<7 days) despite higher catheter colonization rate, because of higher risk of acute complications with subclavian lines.

Femoral lines should be avoided if possible.
Exceptions:
- Severe coagulopathy
- Patient in extremis
- Failed neck line attempt
- Patient likely to need dialysis catheter long term
Central Venous Access
Femoral line

Inguinal Canal
Femoral Nerve
Femoral Artery
Femoral Vein
Central Venous Access:
Femoral line troubleshooting

“V-Technique”
Locate the vein without a pulse
Central Venous Access: Femoral line troubleshooting

Difficulty feeding the guidewire

- Re-aspirate for blood
- Flatten needle angle
- Twirl guidewire
Central Venous Access:
Femoral line troubleshooting

Difficulty feeding the guidewire
Central Venous Access:
Femoral line troubleshooting

Guidewire
difficulty feeding the guidewire

Central line kit with guidewire hole in plunger
Central Venous Access:
Femoral line troubleshooting

Find the true inguinal ligament

Difficulty feeding the guidewire
Central Venous Access: Femoral line troubleshooting

Find the true inguinal ligament:
Do not cannulate the greater saphenous vein

Difficulty feeding the guidewire
Central Venous Access:
Internal jugular line
Central Venous Access:
Internal jugular line

Use ultrasound imaging for all IJ central lines, if time allows.

Anatomical variation:
High incidence of unexpected IJ vein location based on external landmarks
Central Venous Access:  
Internal jugular line

Use ultrasound imaging for all IJ central lines, if time allows.

It makes things faster and safer.

1. Meta-analysis: Lower failure rate (RR 0.14) \(^1\)

2. Studies: Better on all counts of … \(^2,3\)

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<tr>
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<th>U/S</th>
<th>Landmark</th>
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<tbody>
<tr>
<td>Time from skin puncture to blood flash</td>
<td>115 sec</td>
<td>512 sec</td>
</tr>
<tr>
<td># of attempts</td>
<td>1.6</td>
<td>3.5</td>
</tr>
<tr>
<td>Time to placement (“difficulty sticks”)</td>
<td>93 sec</td>
<td>463 sec</td>
</tr>
<tr>
<td>Arterial puncture</td>
<td>1.7%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Hematoma formation</td>
<td>0.2%</td>
<td>3.3%</td>
</tr>
</tbody>
</table>

3. Denys et al, Circulation, 1993
Central Venous Access: Internal jugular line

Ultrasonography of the IJ vein
Central Venous Access: Internal jugular line

Ultrasonography of the IJ vein
Central Venous Access:
Internal jugular line troubleshooting

Problem: Vein has a small diameter on ultrasound

- Trendelenburg patient over 15°
- If unable to Trendelenburg, have patient Valsalva or hum
- If still small diameter <0.7 mm, try a different site. An independent predictor of failed procedure.

2. Mey, Support Care Center, 2003
Central Venous Access:
Subclavian line
Central Venous Access:
Subclavian line
Central Venous Access: Subclavian line

Tip #1: Positioning
• No need to position in Trendelenburg
• Basic tip: Place small towel roll between scapulas
• Advanced tip: Abduct arm to flatten deltoid bulge
Central Venous Access:
Subclavian line
Central Venous Access:
Subclavian line

Tip #2: Prevent IJ Tip Placement
- Most common malpositioning of subclavian catheter (2-9%)
- Technique: ¹
  - Using the needle-stabilizing hand, place finger in supraclavicular fossa. Feed guidewire with other hand
  - Malpositioned tip in IJ: 6% (control) vs 0% (test case)
  - Patients with malpositioned catheter in IJ had ear pain or tickling throat sensation.

¹ Ambesh et al, 2002
Central Venous Access: Subclavian line

Tip #3: Supraclavicular line ("pocket shot")
• Landmark: 1 cm lateral to SCM and posterior to clavicle
• Aim anteriorly and for contralateral nipple
• Can use small linear or endocavitary ultrasound probe.
Central Venous Access:
Subclavian line

Advantages of supraclavicular line:
• No need for Trendelenburg
• No need for head turn
• Most successfully positioned neck line
Case #3

75 y/o man arrives in your ED with severe full-thickness burns to his body above the waist, including the neck, chest, and arms. Peripheral IV’s are unsuccessful.

You are having difficulty getting the central lines at various sites.

Where else can you try to get access?
Intraosseous Line

Commercially available kits
- EZ-IO Drill
- Bone Injection Gun (BIG)
- Fast Access in Shock and Trauma (FAST) - sternal

Sites
- Sternum
- Proximal tibia
- Proximal humerus
- Distal tibia (just superior to medial malleolus)
Intraosseous Line
How do you interpret IO blood?

Discard first 2 mL blood return

Correlates well with peripheral blood draw:
  • Albumen, total protein
  • BUN, creatinine
  • Glucose
  • Hematocrit, hemoglobin

IO blood may result in lower numbers:
  • CO2,
  • Platelets

IO blood may result in higher numbers:
  • WBC

Summary

1. Use ultrasound to improve your success in finding and cannulating the vein.

2. Central line site choice is important:
   Subclavian > internal jugular >>>> femoral

3. Remember your backup plans for vascular access.
   - External jugular vein
   - Deep brachial and basilic vein
   - Central venous access
   - Intraosseous line