

Sonography-Assisted Venous Access: Details of Technique, Pearls, Pitfalls

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Ultrasound technical and knobology issues

1. Depth
2. Frequency
3. Focus
4. Gain
5. Angle of insonation

Ultrasound beams are reflected back towards the transducer with maximum efficiency if the reflecting surface is at right angles to the beam. This is especially true of highly reflective surfaces (“specular reflectors”) such as a needle or a vessel wall. Therefore, to get the sharp images in sono-guided venous access, it’s necessary to rock the probe continually to optimize visualization of these structures, especially since there is usually at least a 30 degree angle between the needle and the vessel (i.e. they cannot both be imaged simultaneously with a 90 degree angle of insonation).

6. Important artifacts
 - a. Shadowing
 - b. Reverberation
 - c. Gain (“Black is Black”)

Transverse vs. longitudinal imaging of the vessel

1. Transverse

Advantages	Disadvantages
Needle and vessel never completely out of “plane”	Need to keep scanning back and forth to find location of needle tip. Cannot tell path of vessel or projected path of needle above or below plane of ultrasound.
Easier with less experience	

2. Longitudinal

Advantages	Disadvantages
Can see relationship of entire needle w vessel and progress of needle as it approaches and enters vessel. Advance needle /cath within vessel w/o contact w posterior wall under direct visualization.	If needle goes ‘out of plane’ of vessel, harder to determine adjustments needed to redirect
Favored by more experienced practitioners	

Techniques

1. One person, real-time

Advantages	Disadvantages
Real-time hand-brain-hand information	Takes a bit more practice
Can watch the needle through proximal wall and advanced within lumen without damage to distal wall	
Human resource issues	
Can more easily use both TRV and Longi views	

2. One person, localization, marking, then ‘anatomic’

Works for ascites and pleural taps, but for veins, “localization” w/o real time guidance is little better than plain LM technique (Armstrong 1993 Mansfield 1994¹).

3. One person using needle guides: practical impediments in the ED: stocking and cost issues.
4. Two person
Personnel / resource issues. Difficult without a sono-savvy assistant.

By far the easiest technique to master is single operator. From this point on, this is the technique that is discussed and advocated.

While starting out, especially if a preceptor is available, an assistant may be helpful to organize the space, adjust lighting, take the probe once the vein is entered, etc.

Choice of vein and location

1. Peripheral
 - a. In the very obese, will often be able to locate otherwise undetectable veins in usual locations: remember courses of cephalic and basilic veins in upper extremities.
 - b. In patients with damaged veins (chemo, IVDA, etc) often find the deep brachial intact: bicipital groove above antecubital fossa. Watch out for the nerve (easily identified by US).
2. Central
 - a. IJ is by far the most studied and easiest. If this is absent or unavailable, experienced operators find the supraclavicular approach to the IJ-subclavian confluence preferable to the subclavicular approach to the SC.
 - b. Lower IJ is more tethered, therefore more desirable access location, but closer to thorax, therefore often avoided (Denys 1993).

Issues of technique

... **prepare, prepare, prepare!**

90% preparation + 10% perspiration << 10% preparation + 90% perspiration!

1. Ergonomics.
 - a. Have the screen facing you at the patient's shoulder level. Make sure you have the probe oriented so that the transverse section demonstrated on the screen is spatially in the same orientation as the patient's anatomy (i.e. the left side of screen will refer to patient's right when doing peripheral, but patient's left doing IJ).
 - b. **Be comfortable:** this has a major impact on your chance of success!
 - i. For IJ, the patient needs to be in Trendelenburg. If they are on a civil war era gurney without this adjustment, change gurneys unless precluded by extreme exigency (i.e. need STAT access). *Would you want a central line started on your dehydrated family member subjecting them to increased risk of multiple sticks, venous trauma, and complications, just because their doctor couldn't be bothered to put them on the right stretcher?*
 - ii. Adjust the height of the gurney [ditto (i) re gurney choice].
 - iii. For peripheral vein cannulation, find a stool *with wheels*. This allows for maximal mobility with stability and comfort.
 - c. **Reconnoiter** prior to draping and prepping.
 - i. Is the vein present and compressible through it's entire length?
 - ii. Are there valves present?
 - iii. Does it take sudden turns?
 - iv. Are you sure you're not looking at an artery in a hypotensive patient (also compressible: use color flow if in doubt).
 - v. Especially important for peripheral access: you need to know where the vein runs in someone's arm to position yourself, to position the arm, and to position the machine.
 - vi. IJ has aberrant anatomy in 8.5% of cases and has very mobile anatomy w head motion (Denys 1993, Armstrong 1993). Aberrant IJ anatomy in 18% of kids (Alderson 1993).

- d. Again: **check compressibility**: avoid the multiple sticks I inflicted on 1 patient culminating in “failed” central venous access 2/2 venous thrombosis. Check for scarring and narrowing if h/o previous CV catheter.
2. Use probe cover and semi-sterile technique even with peripheral lines.
 - a. Probe cleanliness (NOT)
 - b. Patient protection
 - c. The value of the IV site and your time
 - d. Can use sterile glove (unpowdered) in a pinch.
 - e. Widely prep the skin as if for blood cultures.
 3. Applying the sterile probe cover. Note: Non-sterile sonographic gel ALWAYS needs to be applied INSIDE the cover, and STERILE gel always needs to be placed between the cover and patient’s skin.
 - a. If doing IJ with sterile technique
 - i. Open sterile probe cover package before donning gloves.
 - ii. Apply generous (NON-sterile gel) to probe
 - iii. Place probe in inverted cover
 - iv. Peel back cover over probe wire
 - v. Lay sterile probe on sterile field of CV access drapes.
 - vi. Caveats: probe easily slides from drapes ... gets contaminated or hits the floor (\$10,000!)
 - vii. If assistant available, place probe inside cover after you are gloved.
 - b. For peripheral sticks in patients who are venous access challenges, but who do not need a central line, do i–iii as above, apply sterile gel to the prepped skin, and proceed without touching the access site with anything except the needle, the gel, and the probe cover.
 4. Analgesia: USE IT! This is a WIN-WIN PROPOSITION for you and the patient. With peripheral lines, as with central lines, squirt 1-3 cc of 1% lido (TB syringe often works) into the venous access site. This has several advantages:
 - a. Patient comfort: many of these pt’s have already had many painful attempts, and the brachial vein is deep and painful to reach.
 - b. Operator comfort: if your puncture site is in the wrong place, or your approach to the vein is off-line, spare yourself the pressure of an anxious and irritated patient! They don’t need to feel this, and you’ll be a hero when you *“got the line in one shot ... and I didn’t feel a thing!”*
 - c. Patient cooperation ... patient stays still
 5. Needle and catheter length
 - a. Especially with brachial vein in obese patients, the standard 1.25” IV catheter is too short: the first time they shake their arm or bend it, the tip of the catheter is out of the lumen, in the subQ tissues.
 - b. Use at least 1.75 inch catheters
 - c. Consider use of 15cm catheters (pending Service Center supply)
 - d. If necessary, use A-line kits or long caths in central venous access kits w Seldinger technique.
 6. Artery vs. vein vs. nerve
 - a. In the upper extremity and neck all 3 are present.
 - i. Artery: pulsatile, usually not collapsible [careful w/ hypotension!], color flow + if available
 - ii. Veins usually not seen w/o tourniquet or Trendelenburg. Thinner walled, collapsible, larger than arteries.
 - iii. Nerves: can see stippled fascicular appearance when angle of insonation right. Non compressible. After application of tourniquet, veins do not show color flow.
 - b. Very light touch not to collapse veins.
 - c. In hypotensive pts, arteries may become collapsible w probe pressure.
 7. Probe manipulation
 - a. You will hold the probe in your non-dominant hand (the one normally used to stabilize the skin and-or palpate the vein).
 - b. Hypothenar surface of hand against pt skin to stabilize probe and avoid slippage, maintain correct pressure.

8. Angle of needle advance
 - a. May need to be steeper than for subcutaneous vessels: 30 degrees often optimal. This is both because the vessels are often deeper, and one doesn't want several inches of subcutaneous tunnel (and can't afford it with normal length catheters), and because a steep angle is needed to pierce the venous wall.
 - b. Steep angle of advance makes puncture of distal wall *more* likely. Use real-time sonographic visualization of proximal vessel wall entry and advance of needle within lumen.
 - c. Larger needles are more likely to cause penetration of posterior wall of vein.
 - d. Interventional radiologists favor a 90 degree approach to the IJ. I have yet to meet a clinician who is practiced in starting lines *without* imaging, choose this technique.

9. Vein entry
 - a. Watch the screen.

Don't bother to look for flash-back unless you're really unsure whether you're in the vein ... this is a sono-guided procedure ... you're probably in a darkened room anyway.
 - b. Once you have entered the vein, the job is only half done!

Continue to watch the needle as it is advanced far enough for the bevel and/or catheter to be completely through the vessel wall and inside the lumen. Lower inserting hand toward pt's skin: this raises the tip of the needle to avoid catching the back wall of the vein. Advance needle another 1 cm in vein under direct sono visualization.
 - c. Put the probe down in a place where it can't fall on the floor (preferably in its holster on the machine). With your free 2nd hand advance the catheter as for traditional access technique. Secure line as per usual.