Central and Peripheral Venous Access

March 19-21, 2014
Sonoma, CA

Gavin Budhram, MD
Department of Emergency Medicine
Baystate Medical Center

UCSF
University of California
San Francisco

Disclosures

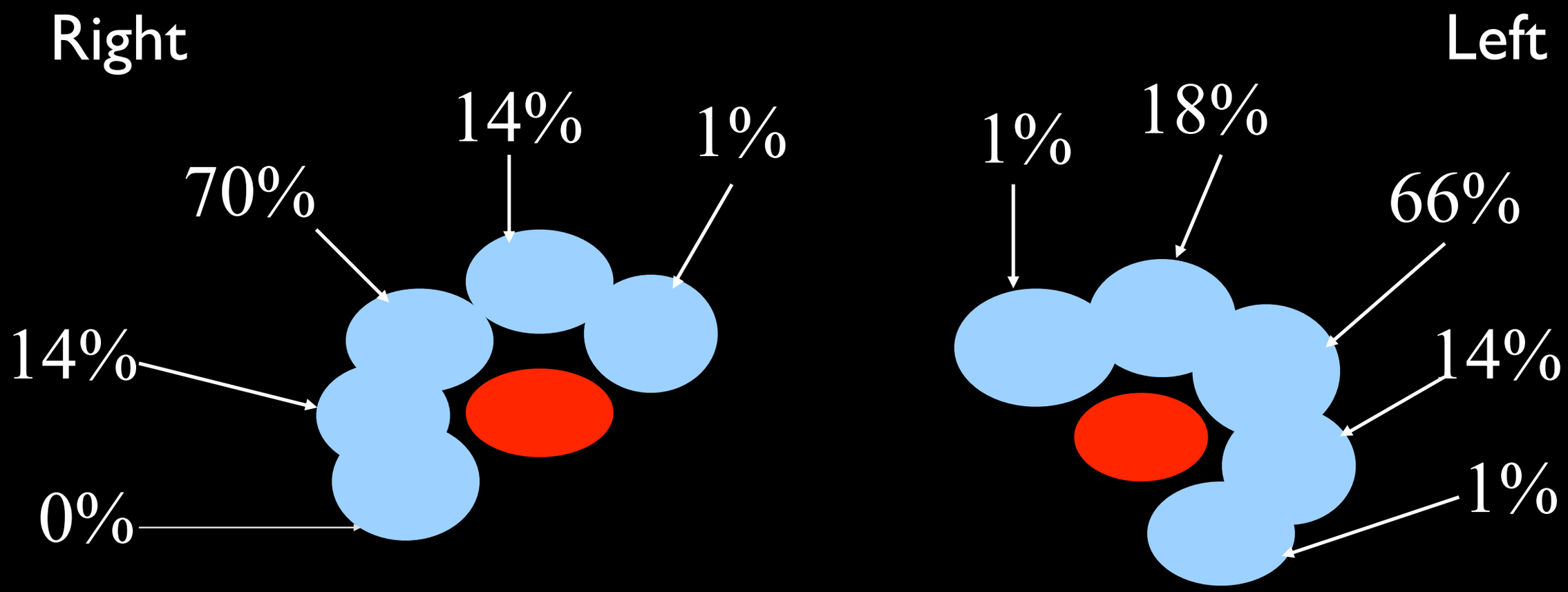
- I have nothing to disclose

Why Use Ultrasound?

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

Central Venous Access

Internal Jugular



Variable position of IJ vein

Denys *et al.* Anatomical variations of internal jugular vein location: impact on central venous access. *Crit Care Med,* 1991; 19(12):1516-9

Why Use Ultrasound?

- 982 US guided
- 302 landmark based

	US	Landmark
Success	100%	88.1%
First Attempt	78%	38%
Skin to vein	10 secs	44 secs
Carotid puncture	1.7%	8.3%

Denys *et al.* Ultrasound-assisted cannulation of the internal jugular vein. A prospective comparison to the external landmark-guided technique. *Circulation,* 1993; 87(5):1557-62.

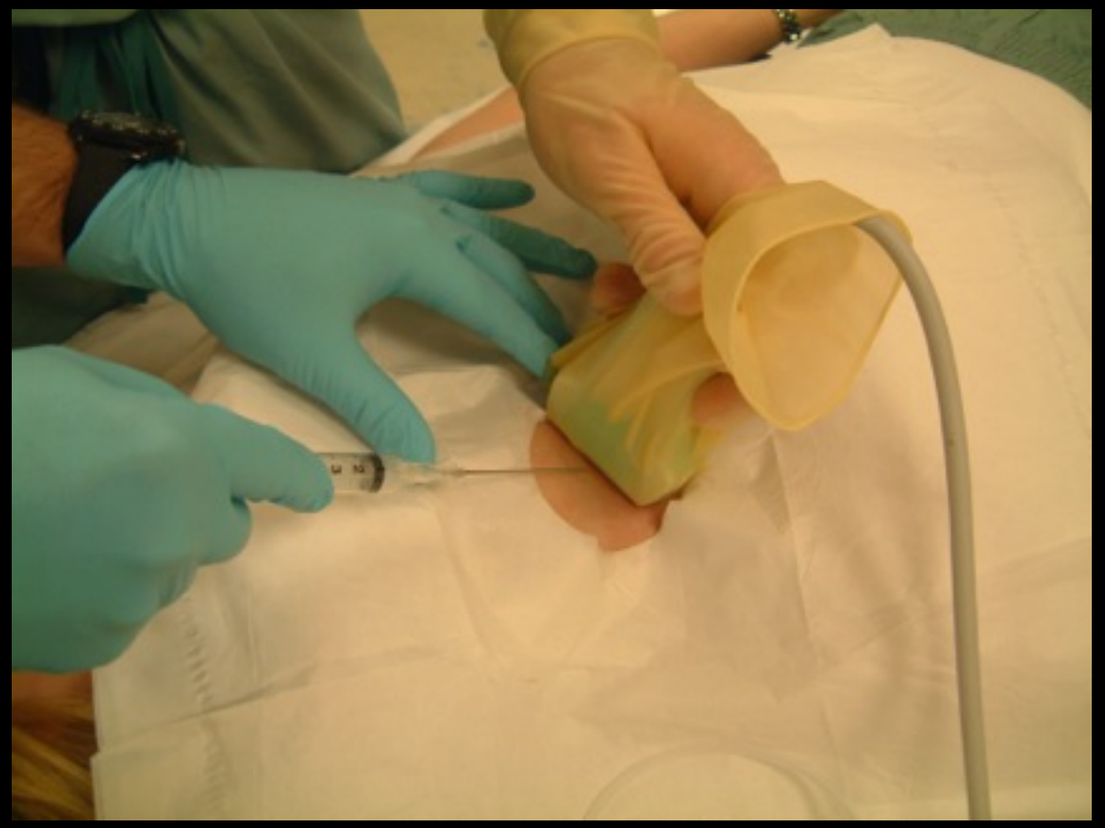
Technical Considerations

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

Technical Considerations

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

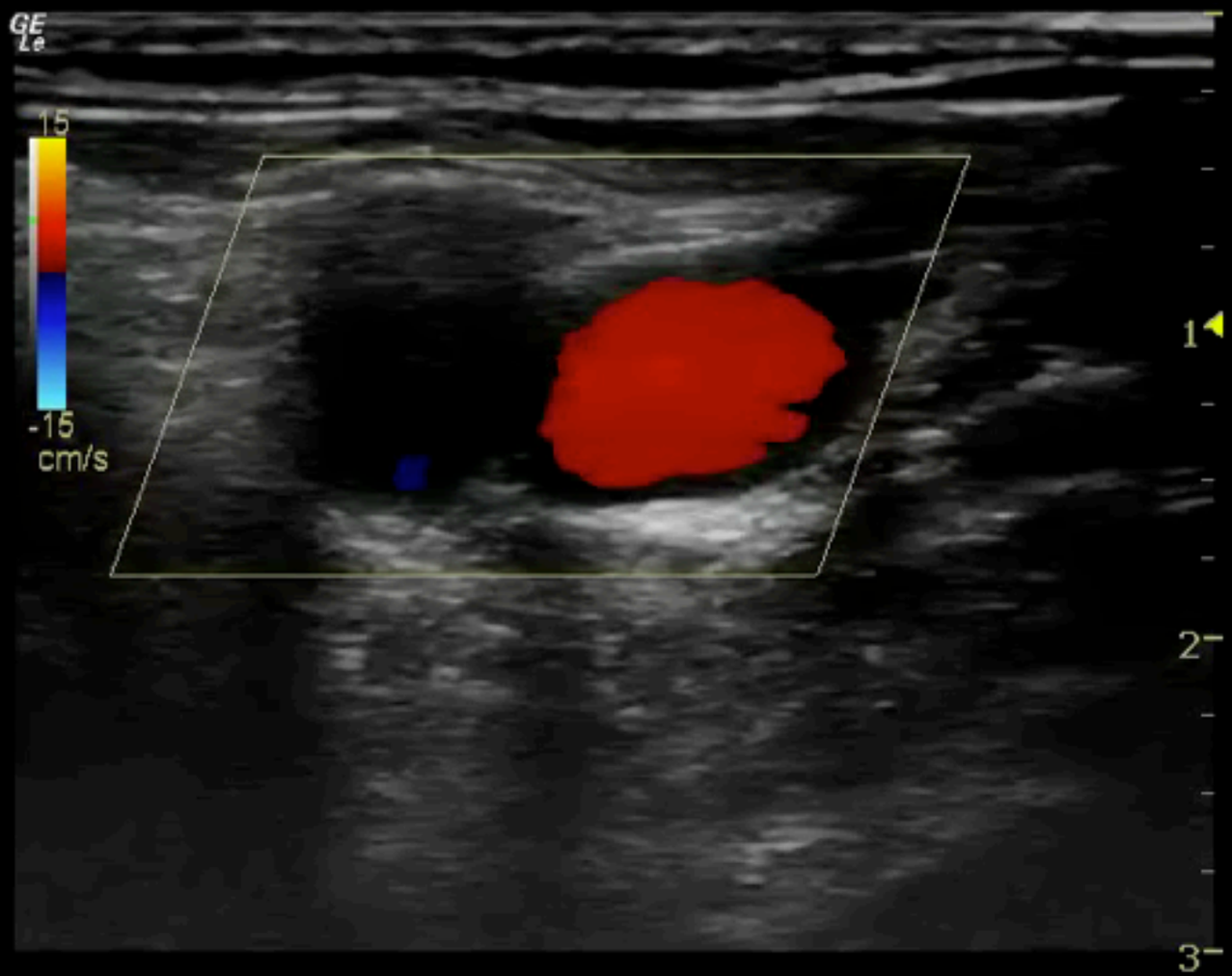
- Shape
  - arteries: circular
  - veins: angular
- Compression

Artery vs Vein

- Color Flow

Artery vs Vein

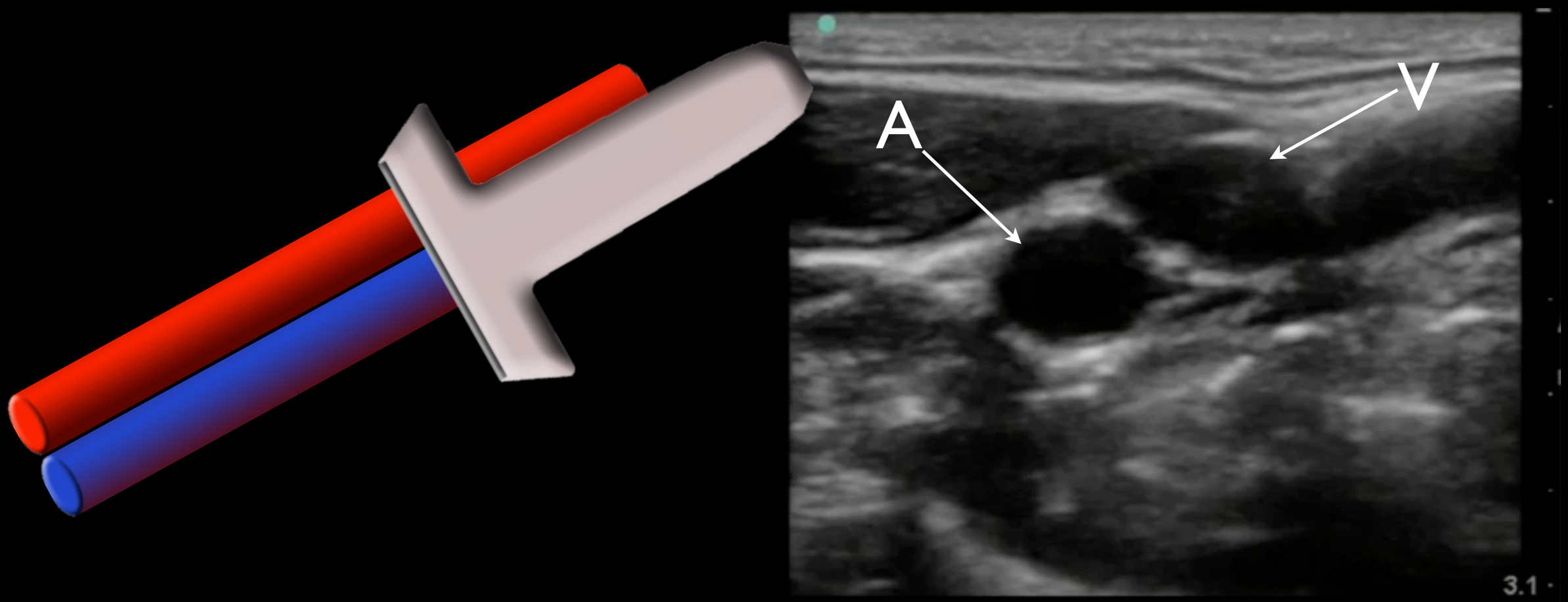
- Color Flow



veins may be pulsatile
red vs blue

Central Venous Access

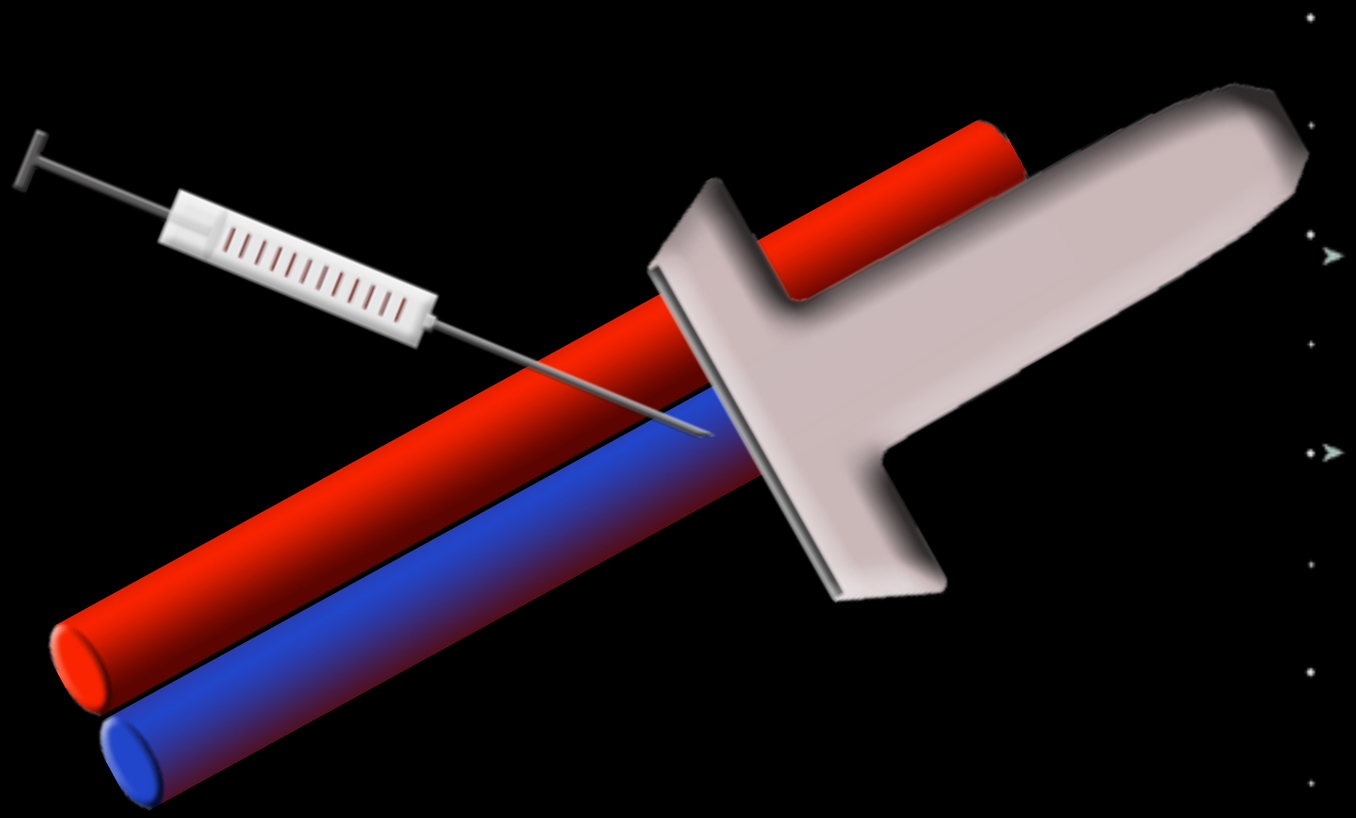
Transverse Approach

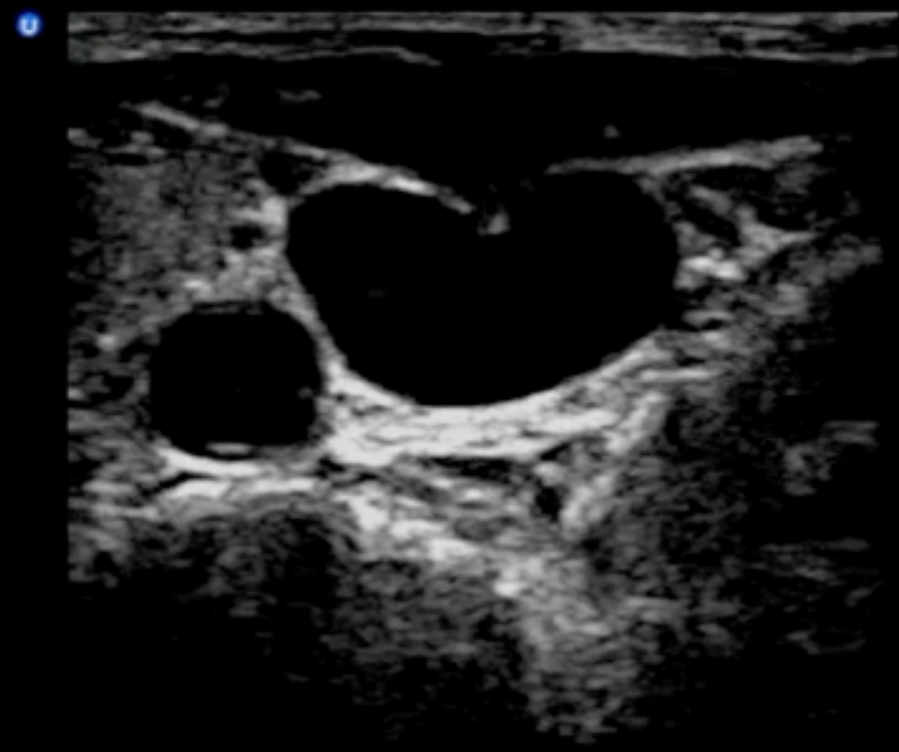


place the probe so that the vein is in the middle of the screen

Central Venous Access

Transverse Approach



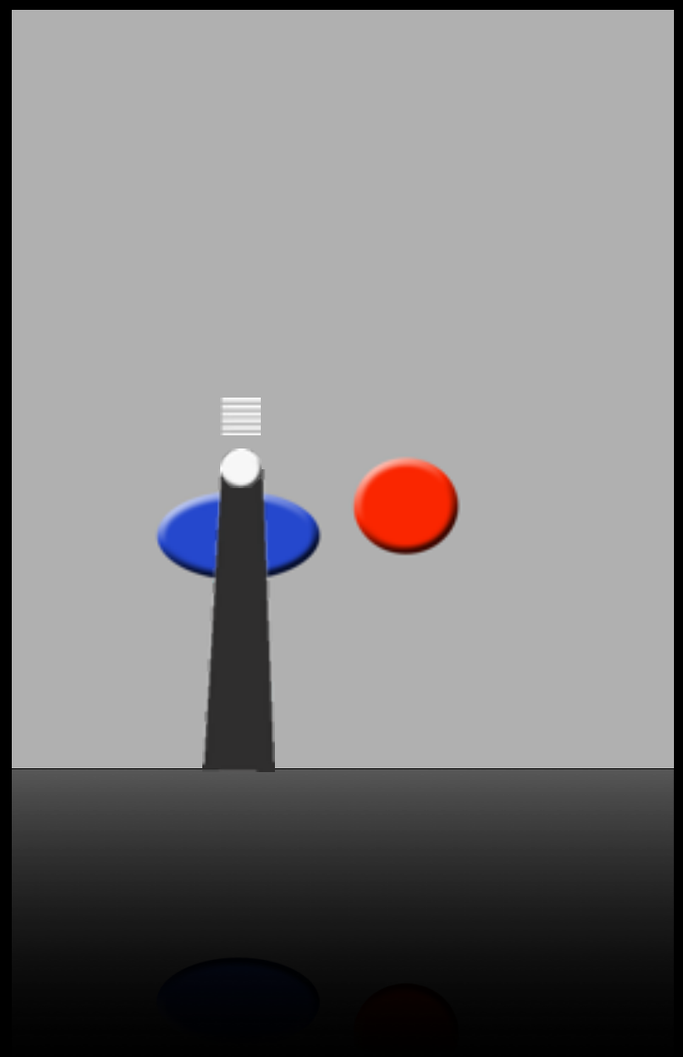


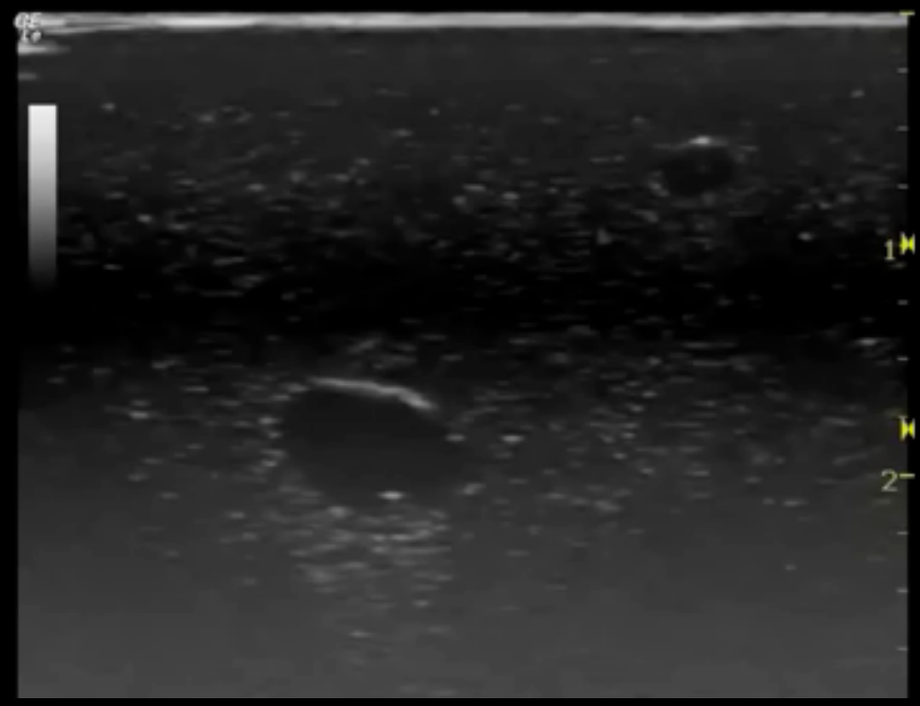
The needle is aimed for the middle of the probe

Central Venous Access

Transverse Approach

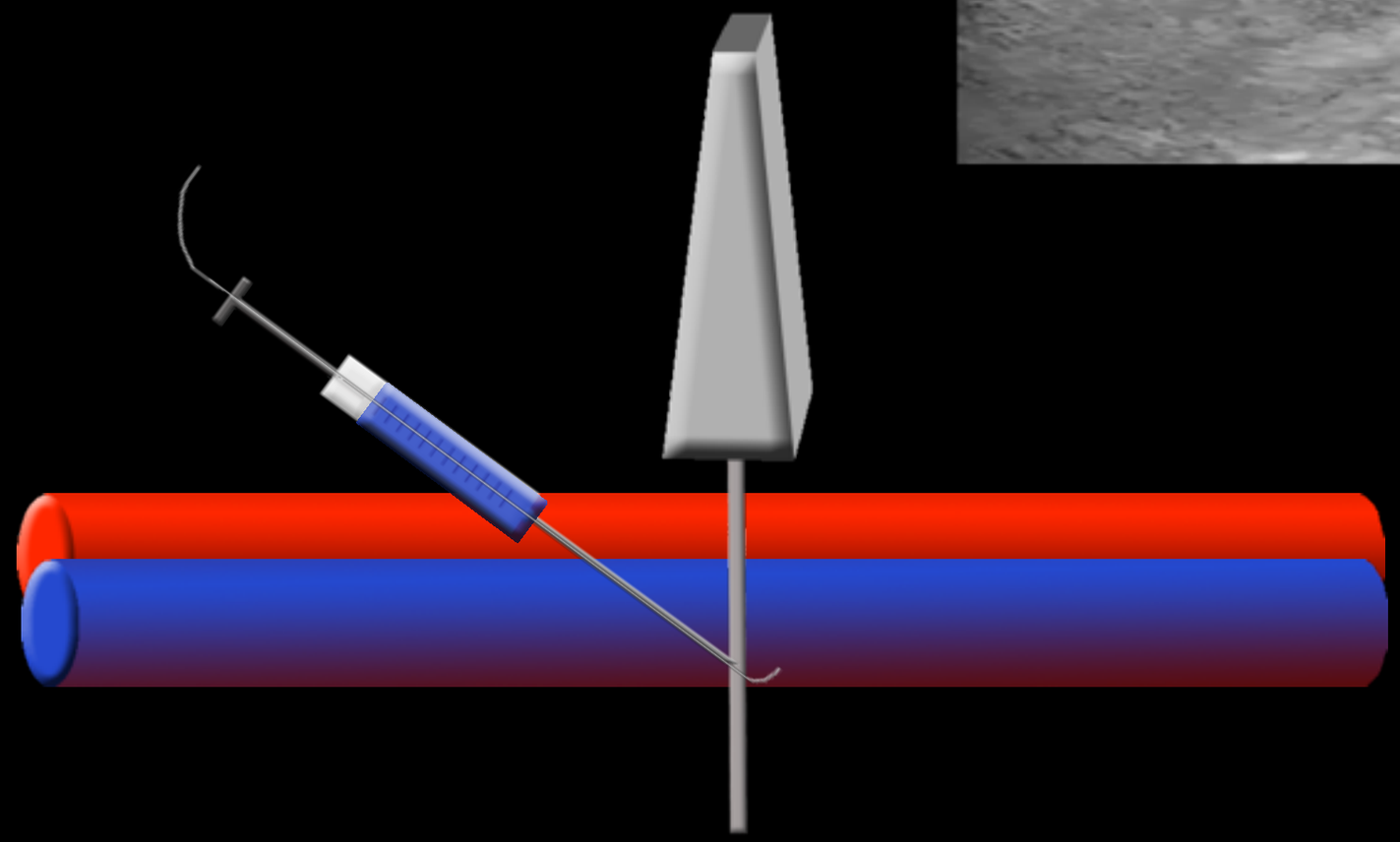
- needle not directly seen
  - localized by artifacts:
    - reverberation
    - shadowing



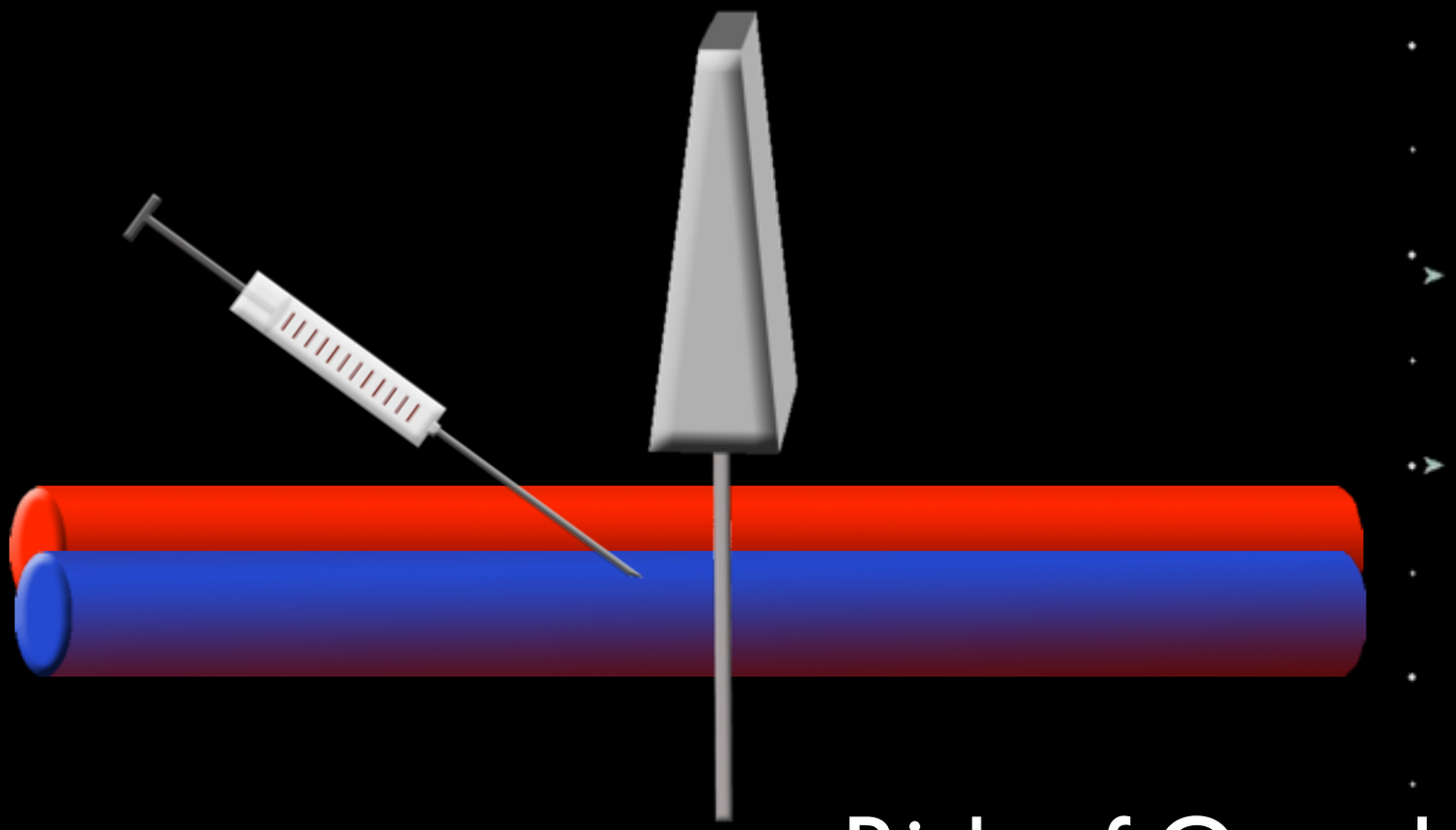


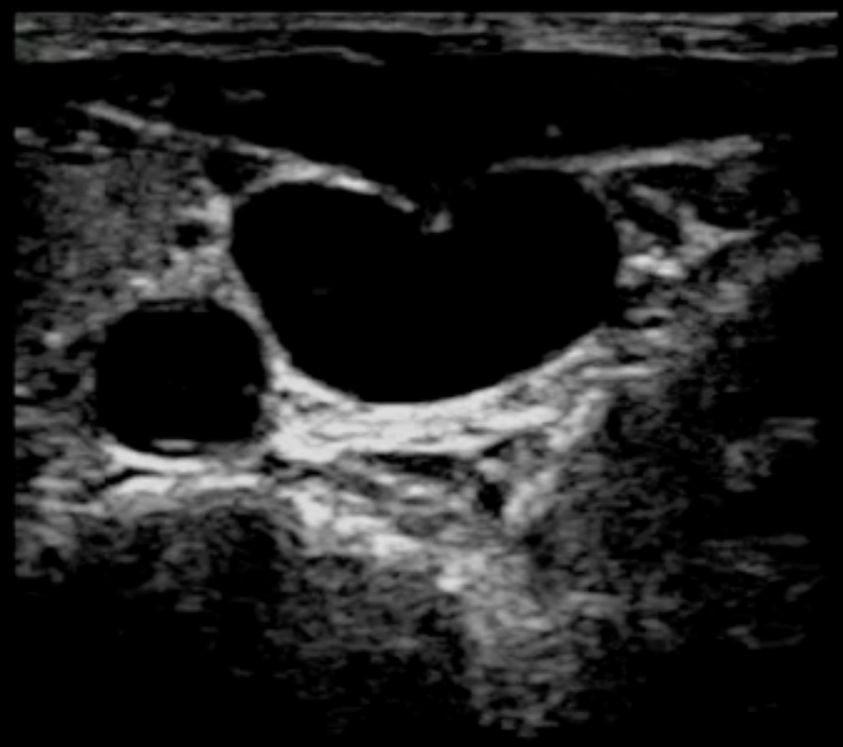
Central Venous Access

Transverse Approach



Transverse Approach

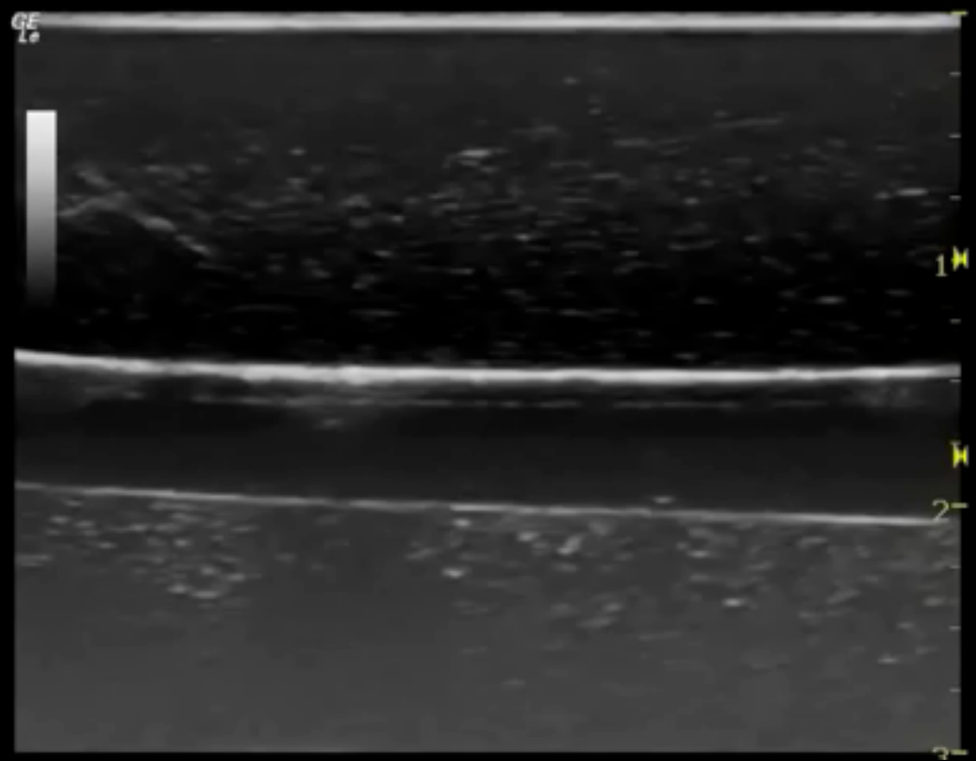


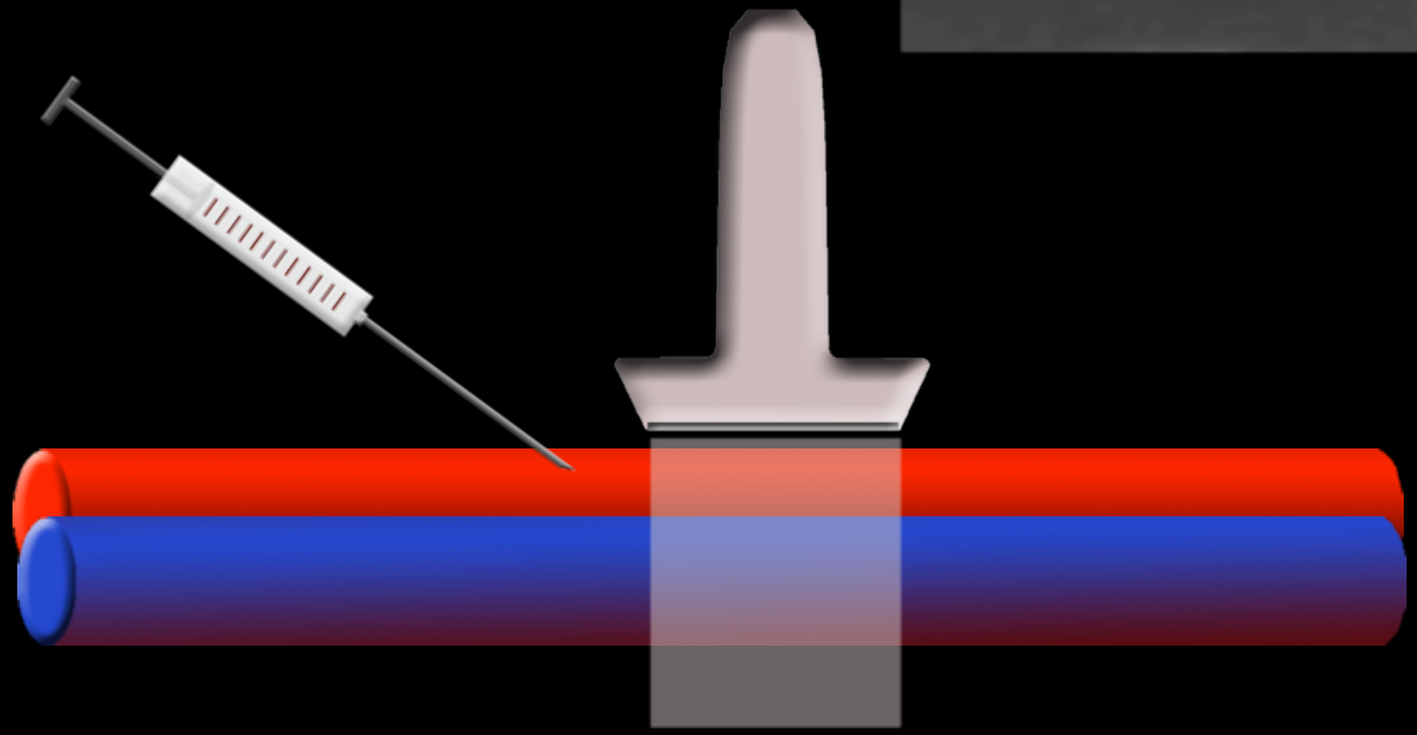


Risk of Overshoot:
Needle still appears to be in vessel

Central Venous Access

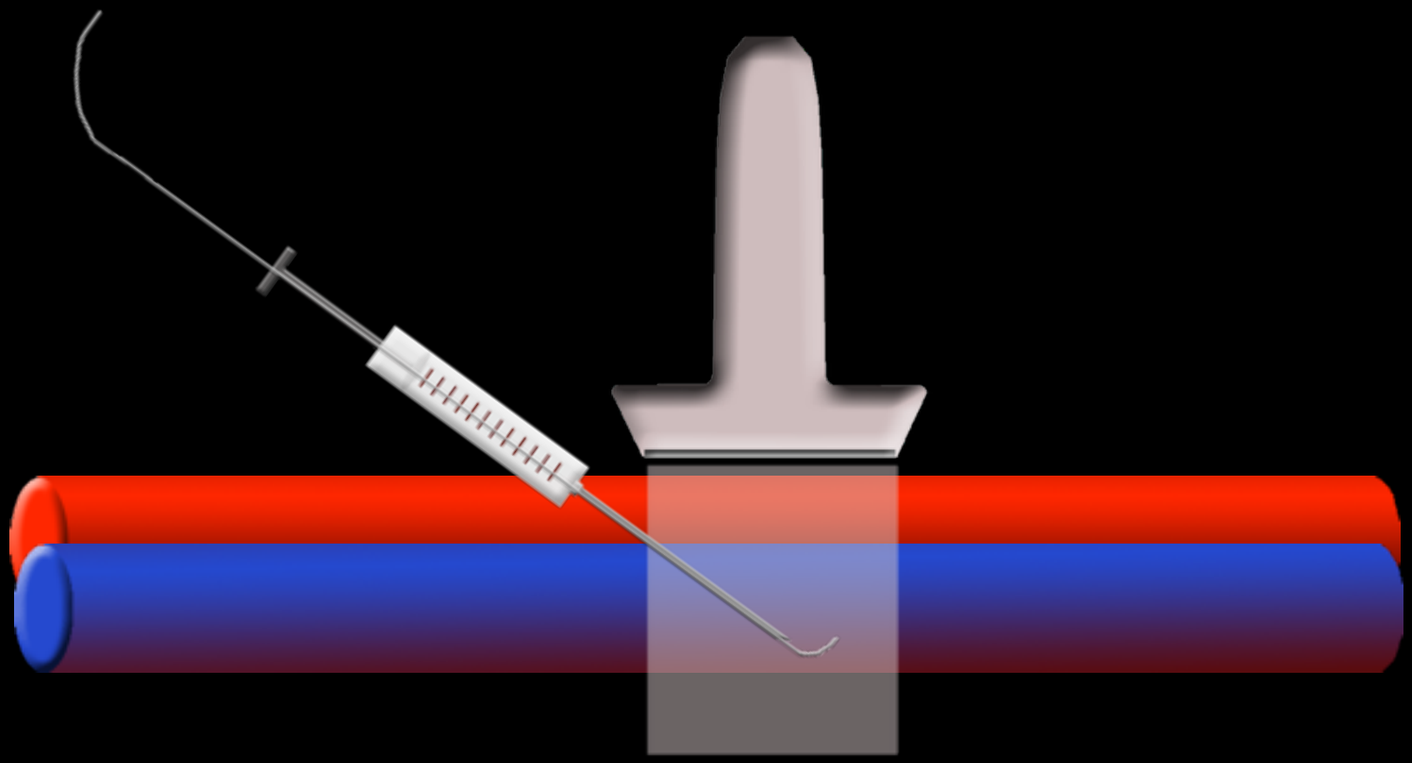
Longitudinal Approach

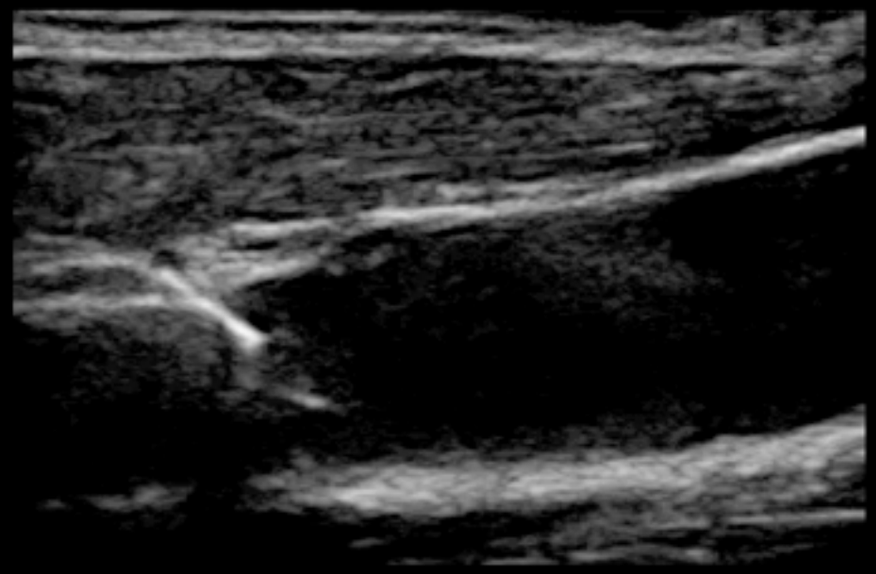




Central Venous Access

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

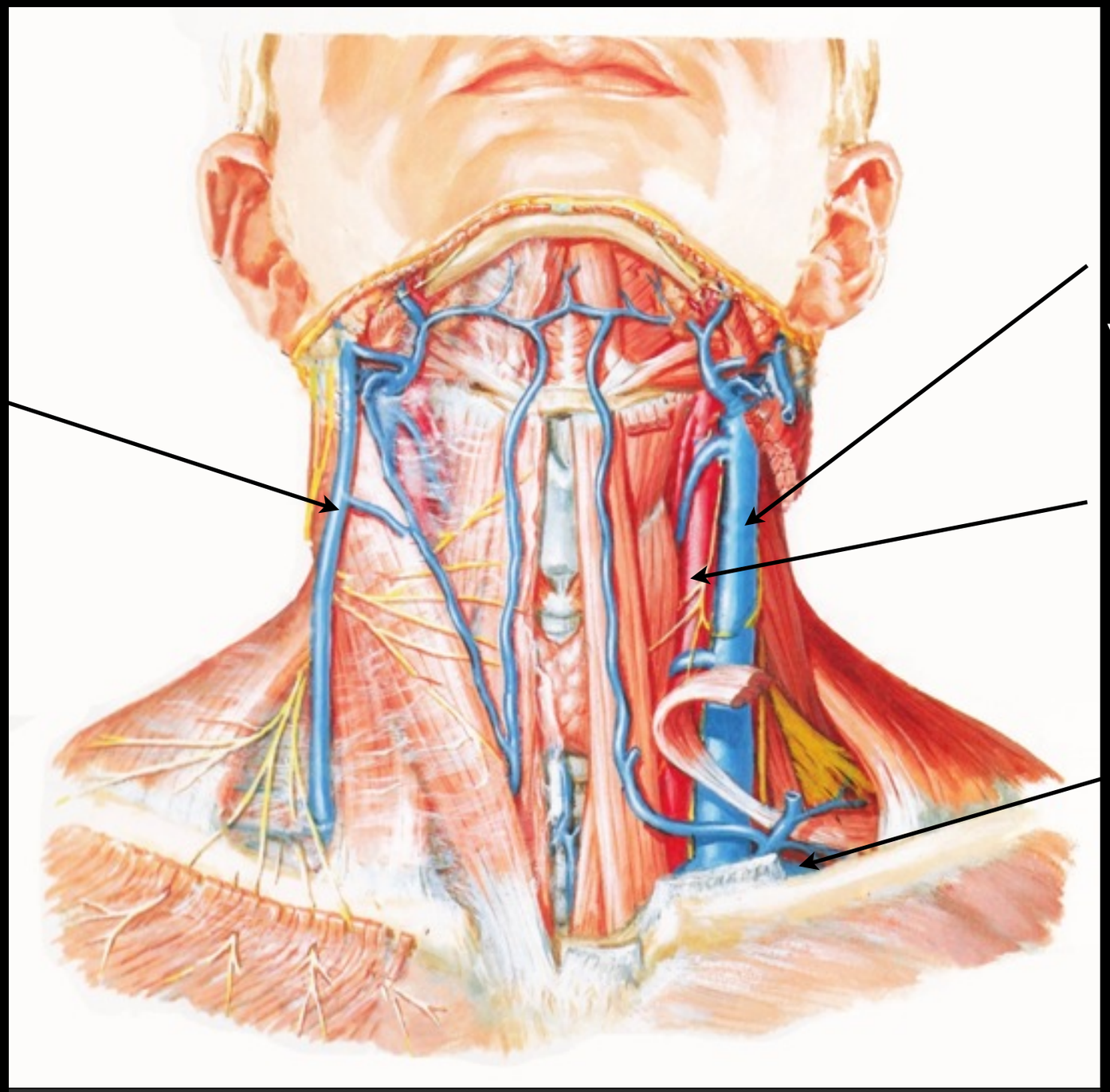
Anatomic Sites

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

Central Venous Access

Internal Jugular

external jugular vein



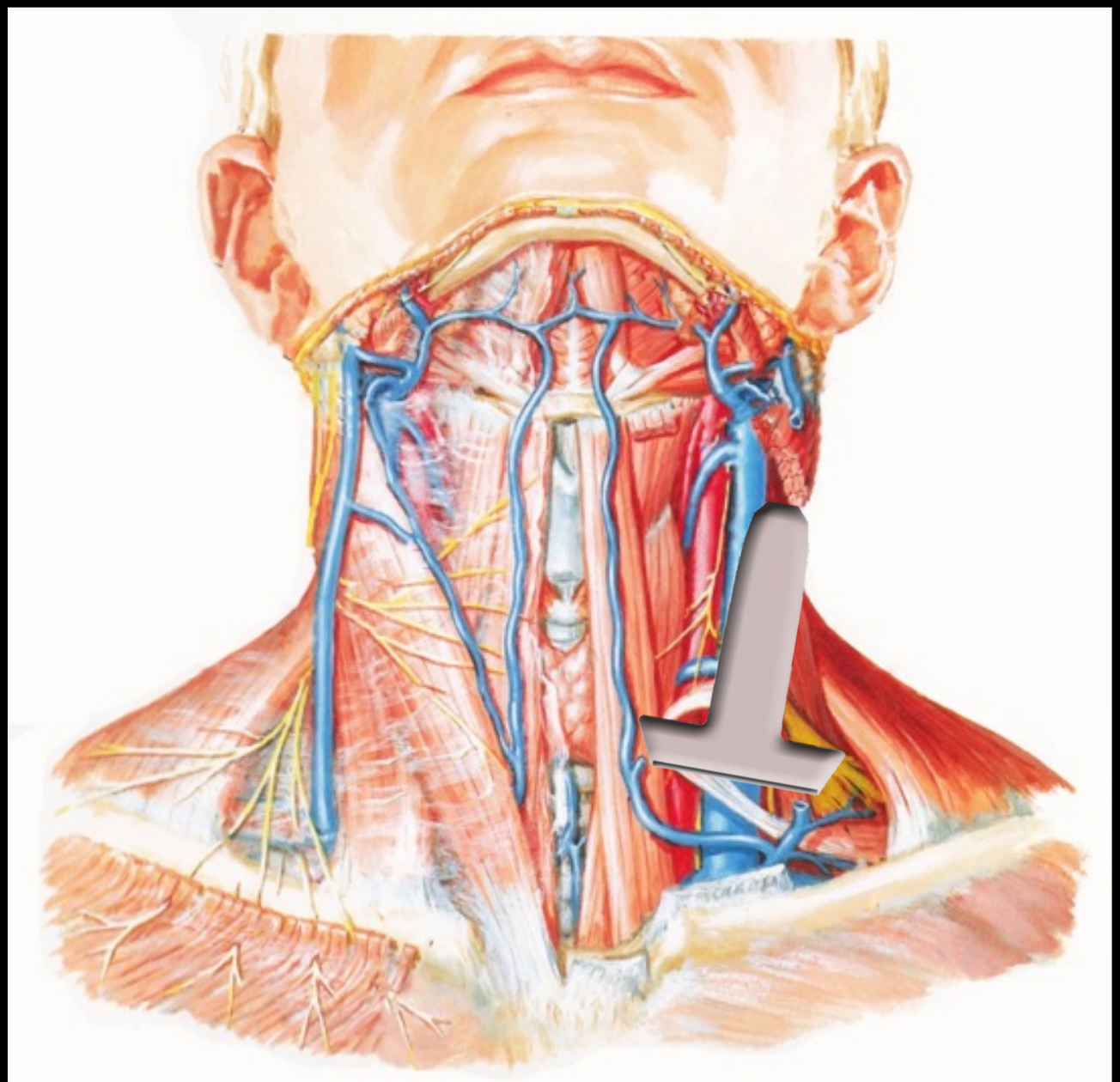
internal jugular vein

common carotid artery

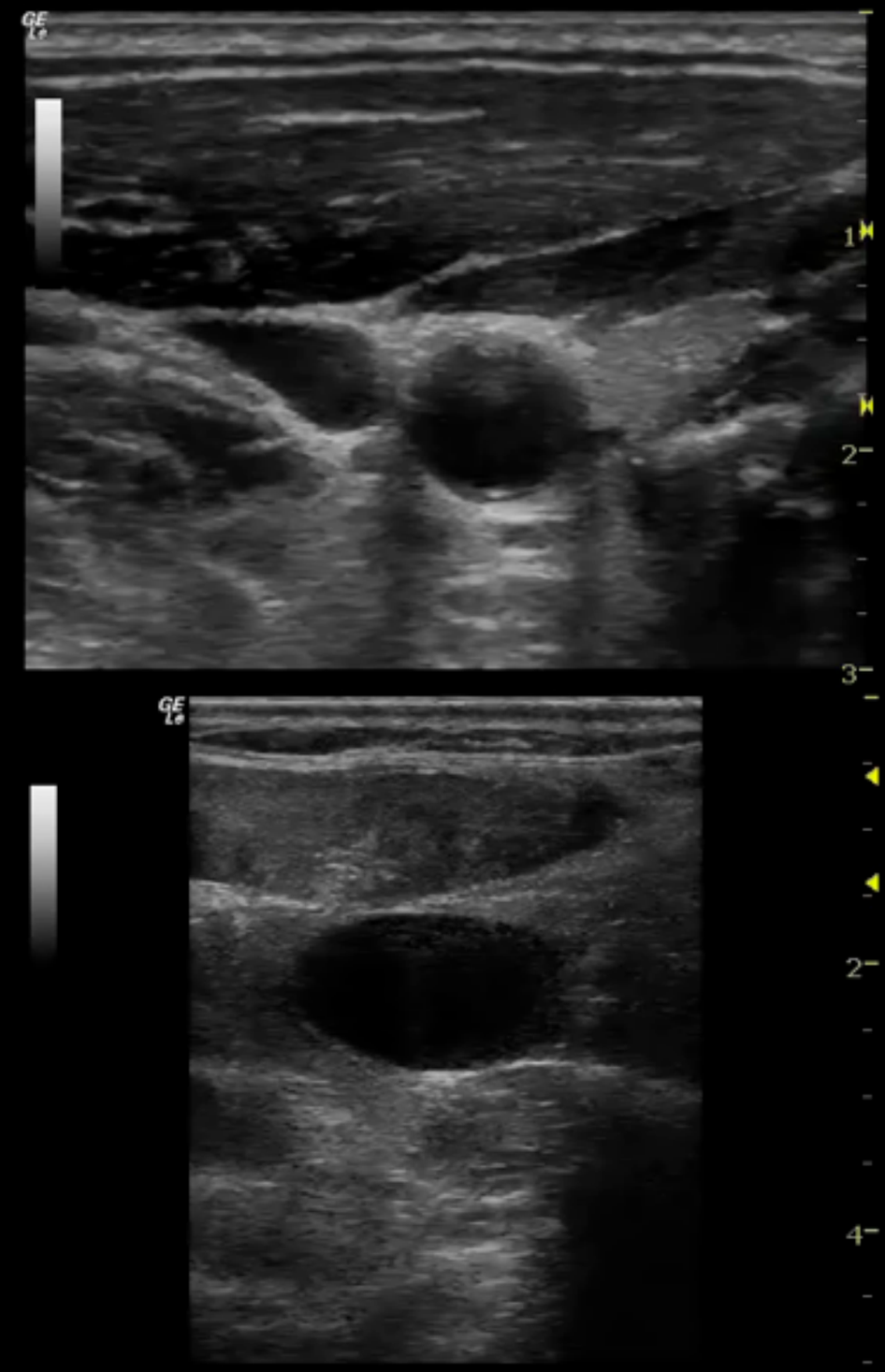
subclavian vein

Central Venous Access

Internal Jugular

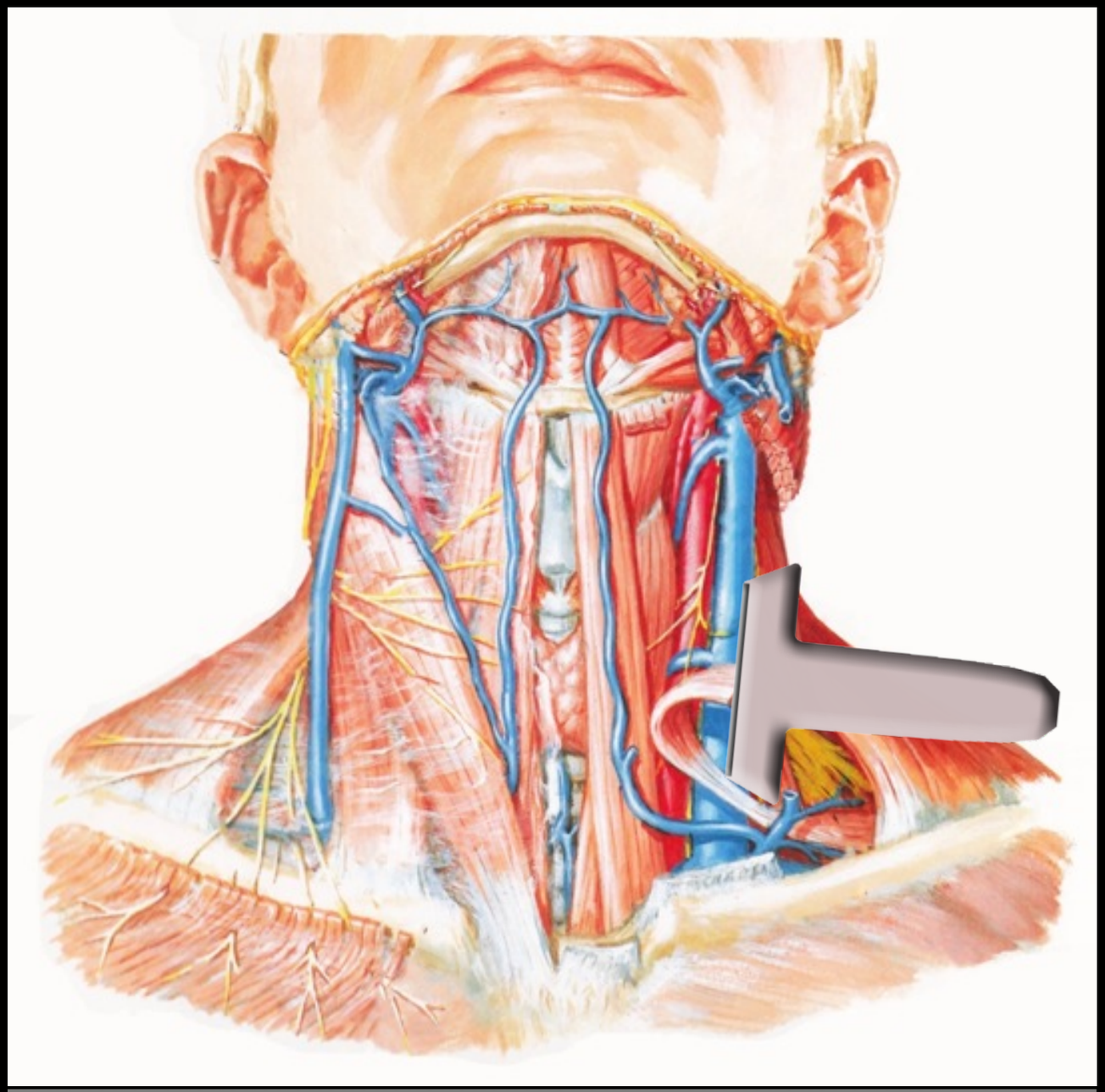


Transverse Approach

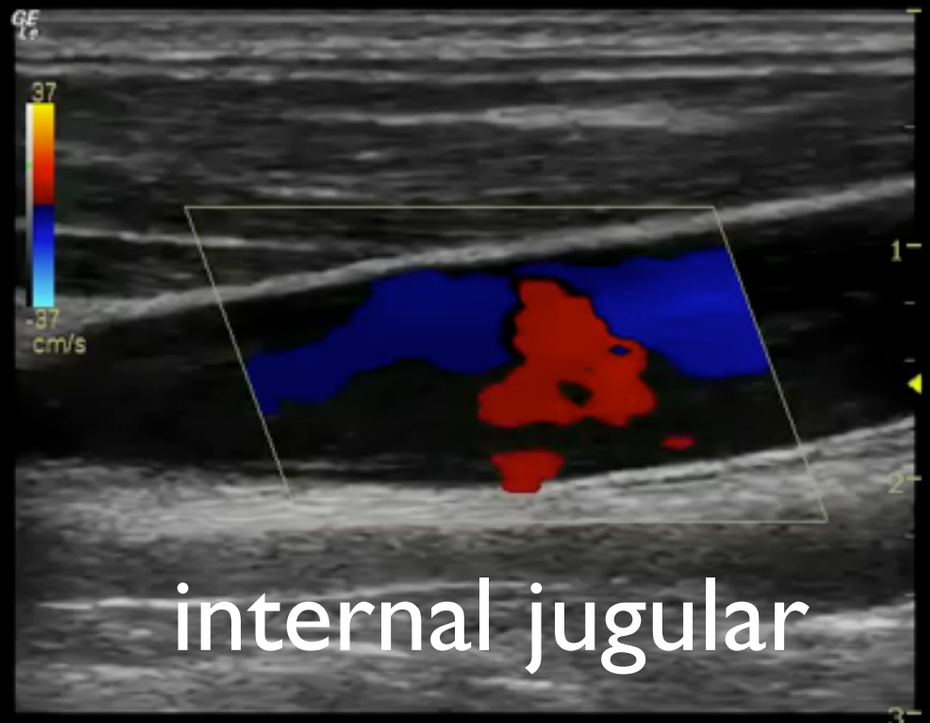


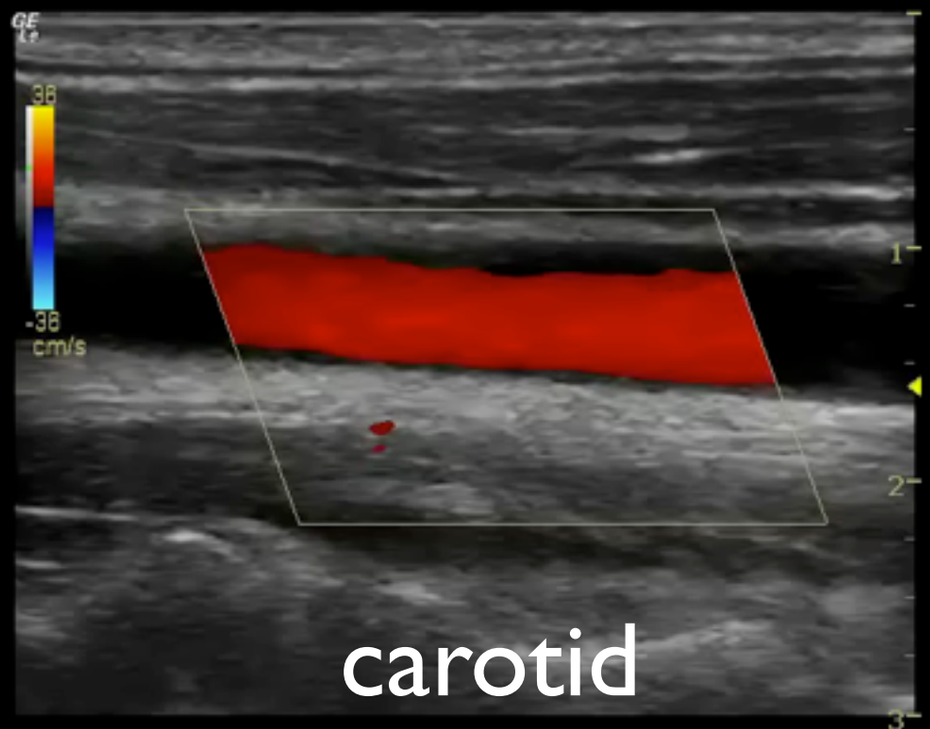
Central Venous Access

Internal Jugular



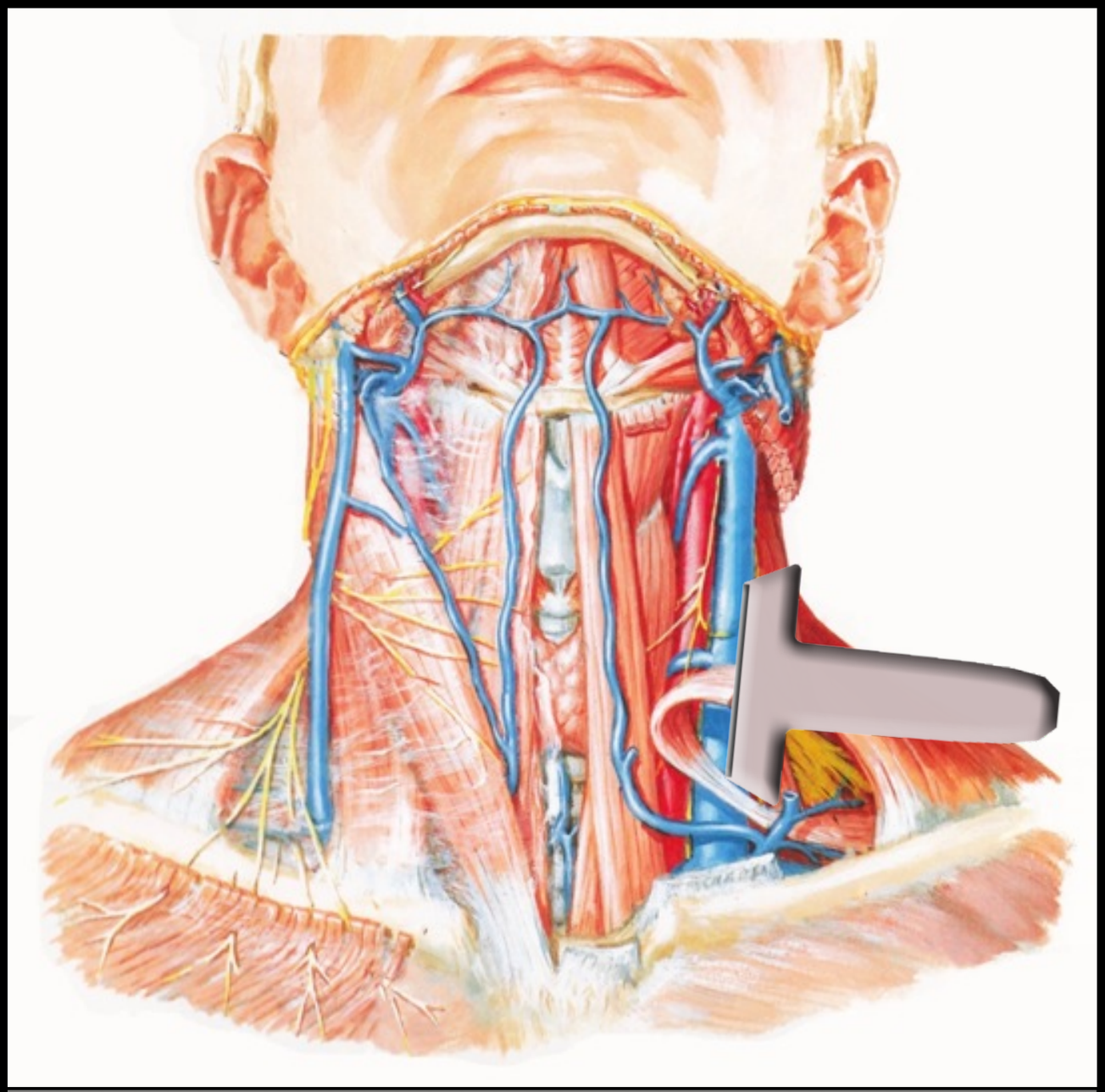
Longitudinal Approach



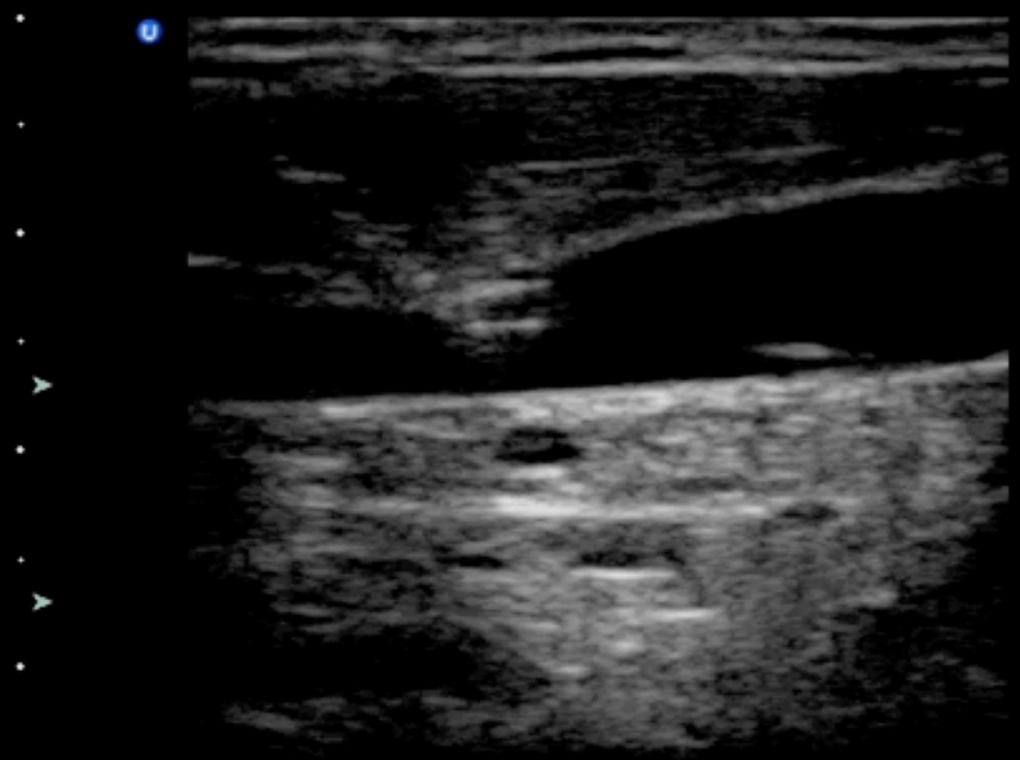


Central Venous Access

Internal Jugular



Longitudinal Approach



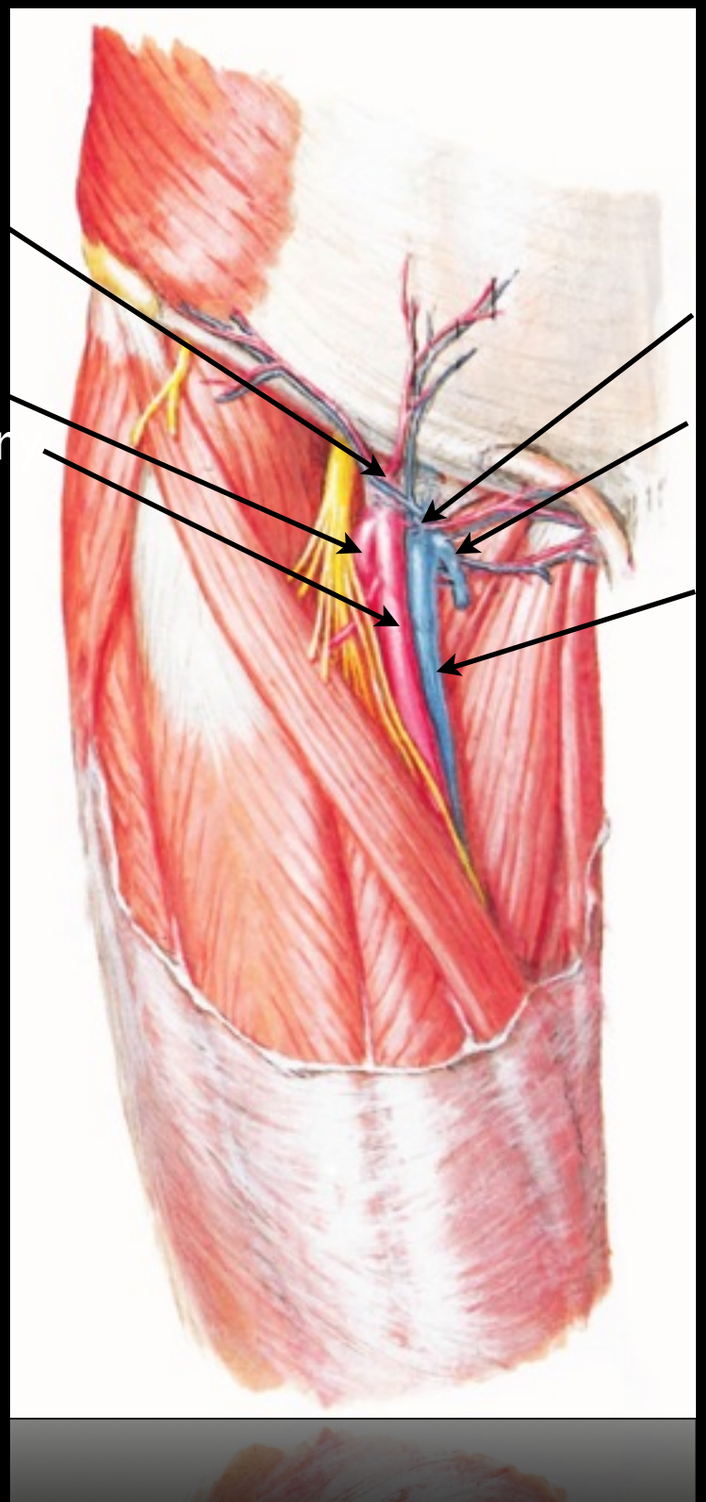
Central Venous Access

Femoral

common femoral artery

deep femoral artery

superficial femoral arter



common femoral vein

saphenous vein

superficial femoral vein

deep femoral vein
(not pictured)

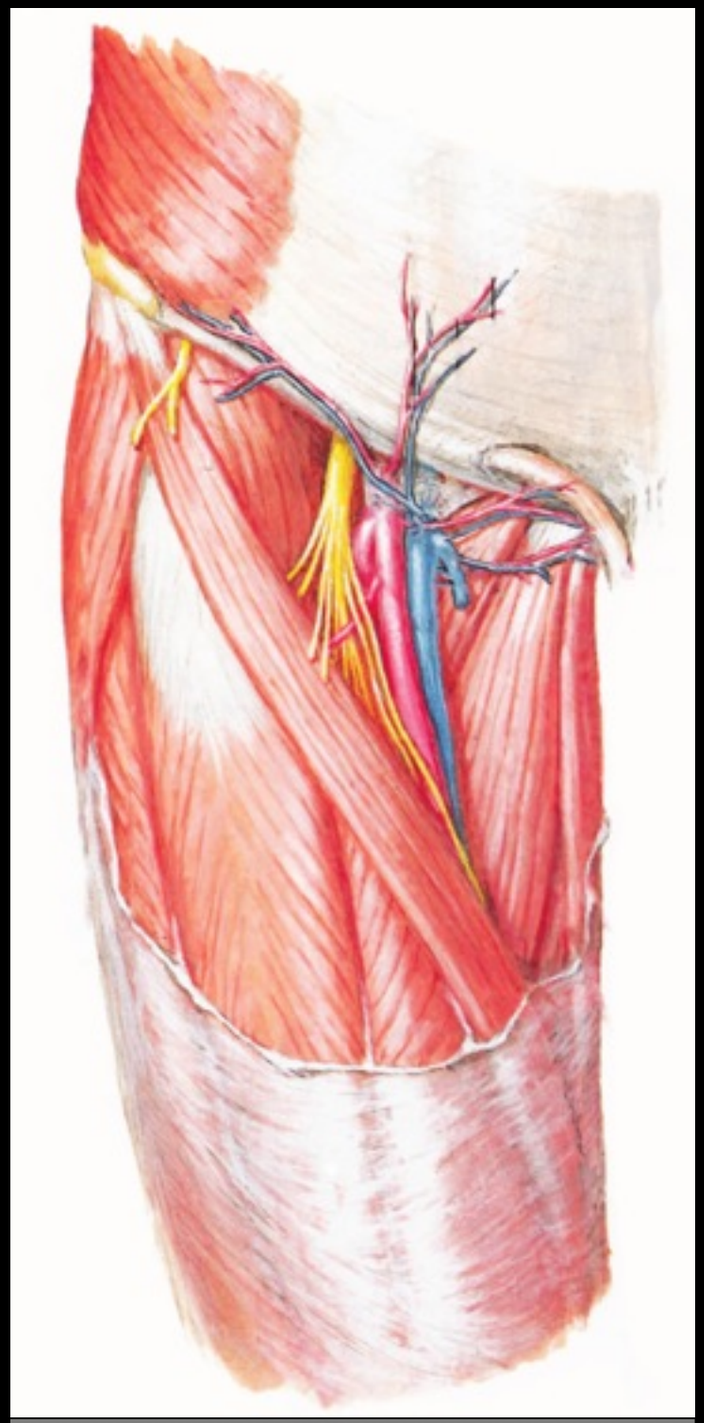
Femoral

- 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

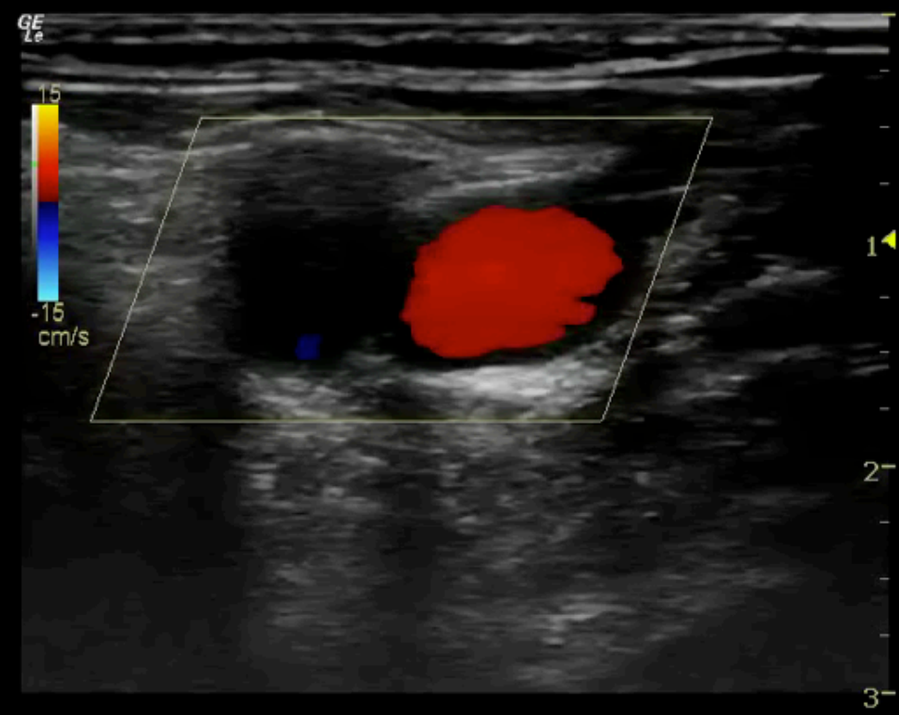
Hughes P *et al.* Ultrasonography of the femoral vessels in the groin: implications for vascular access. Anaesthesia 2000, Dec; 55(12): 1198-202.

Central Venous Access

Femoral



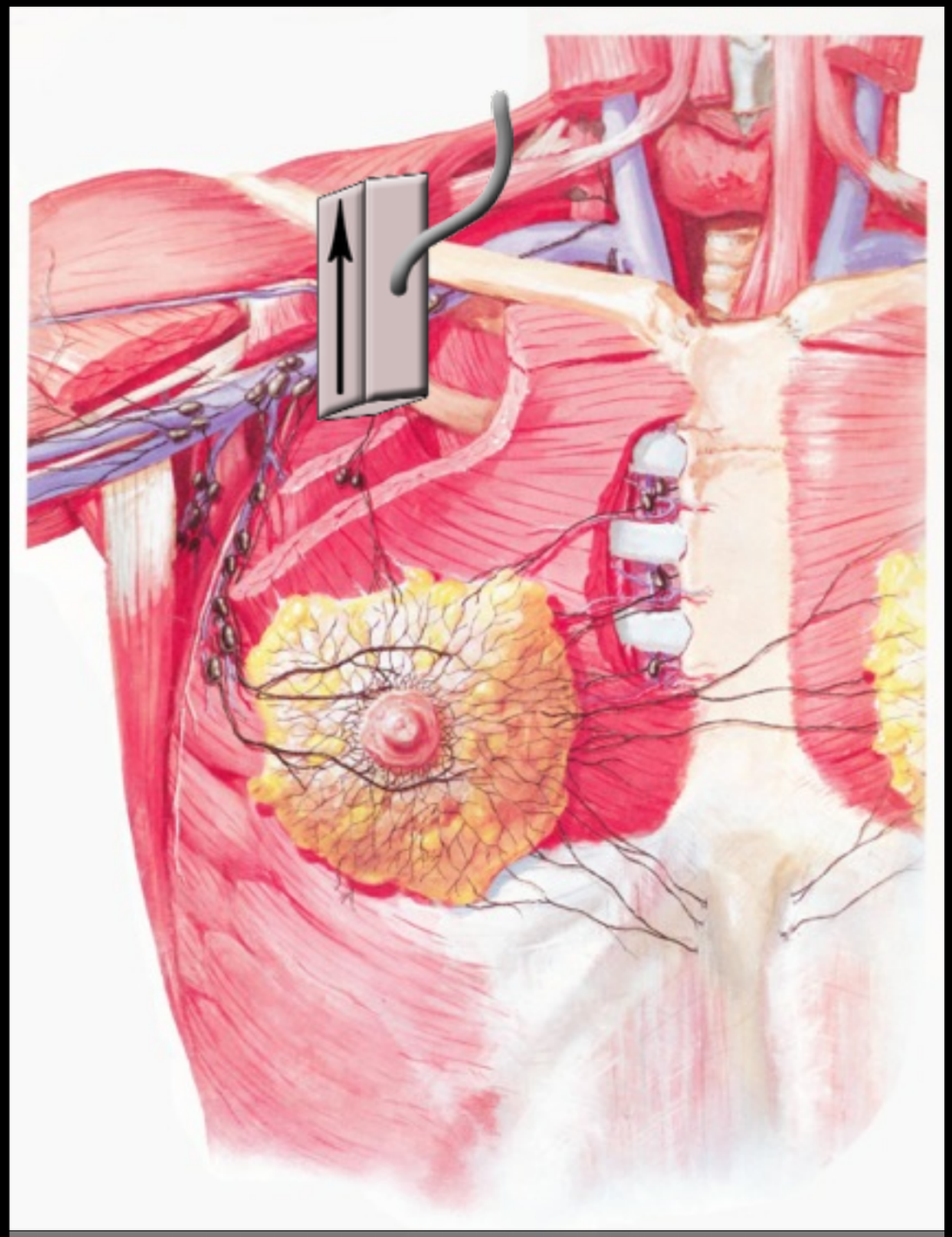
compression used to differentiate arteries and veins

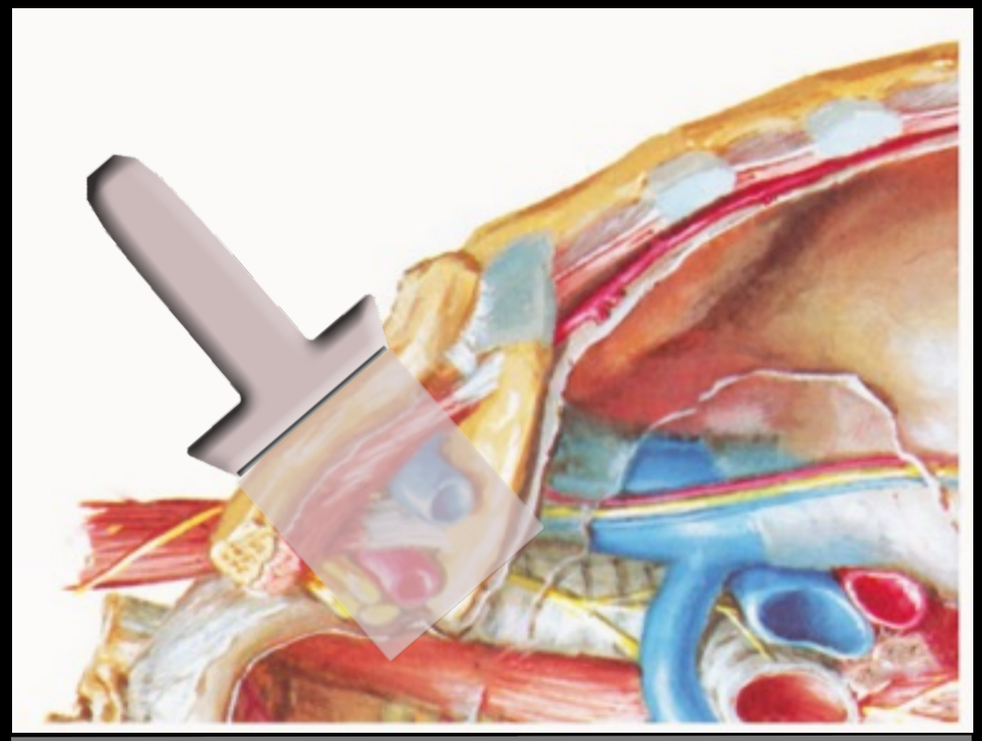


color may be used but is not always reliable

Central Venous Access

Subclavian

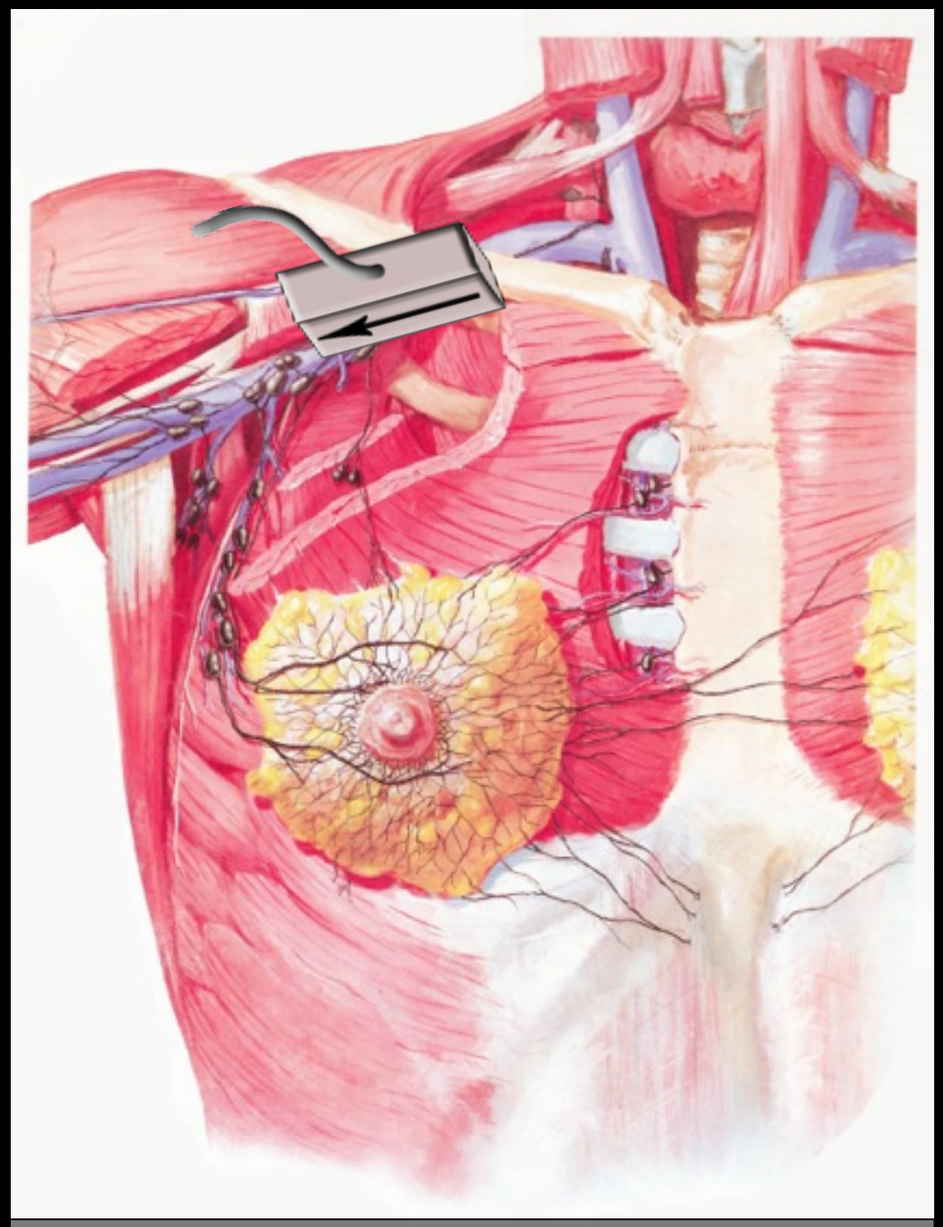


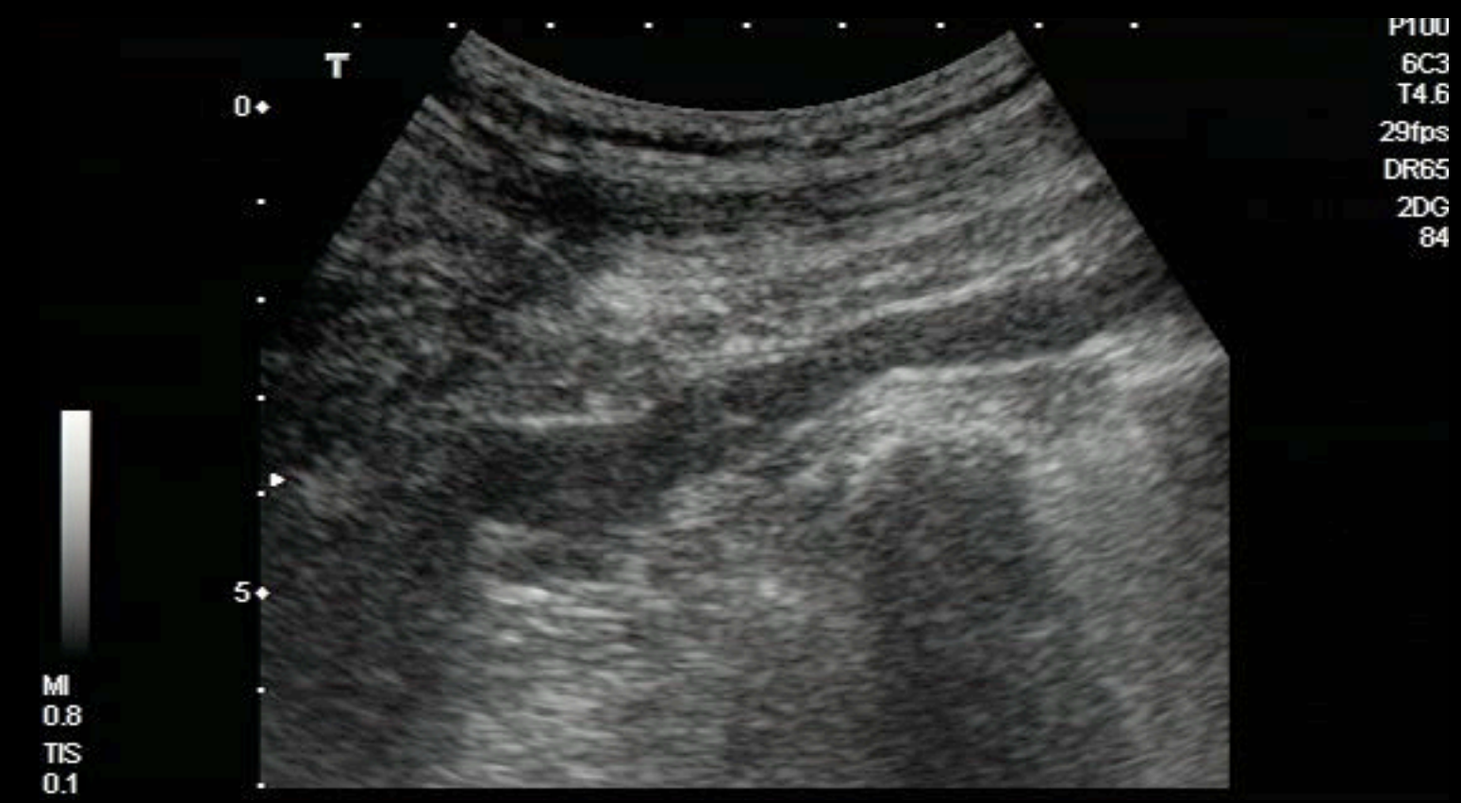


Transverse Orientation

Central Venous Access

Subclavian

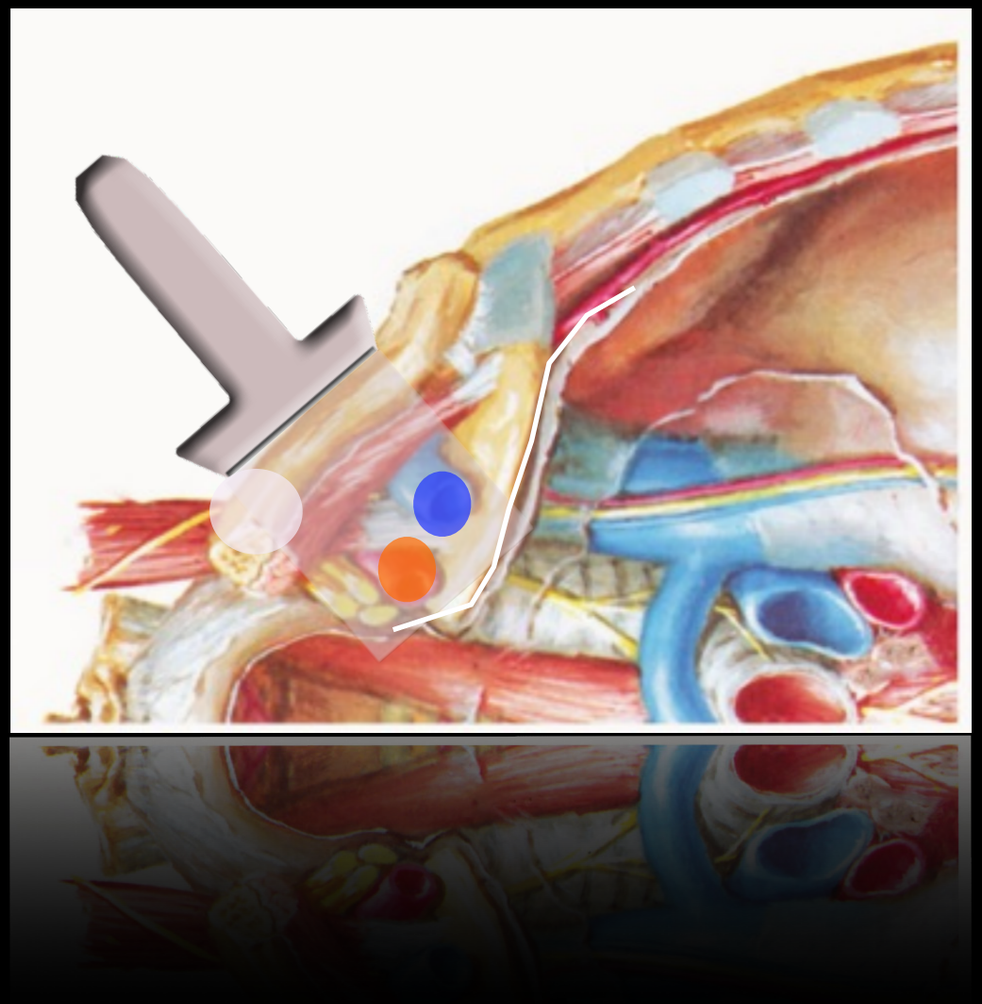


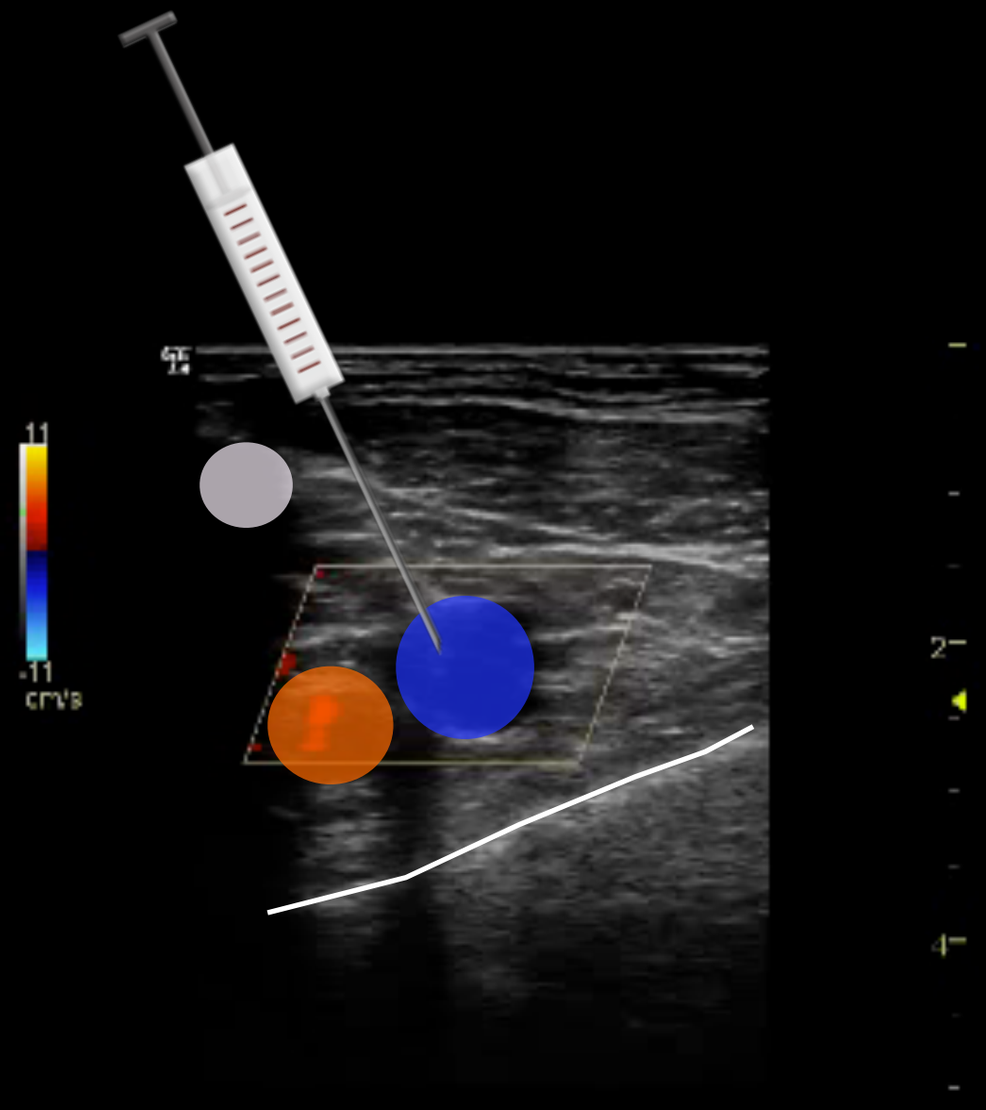


Longitudinal Orientation

Central Venous Access

Subclavian

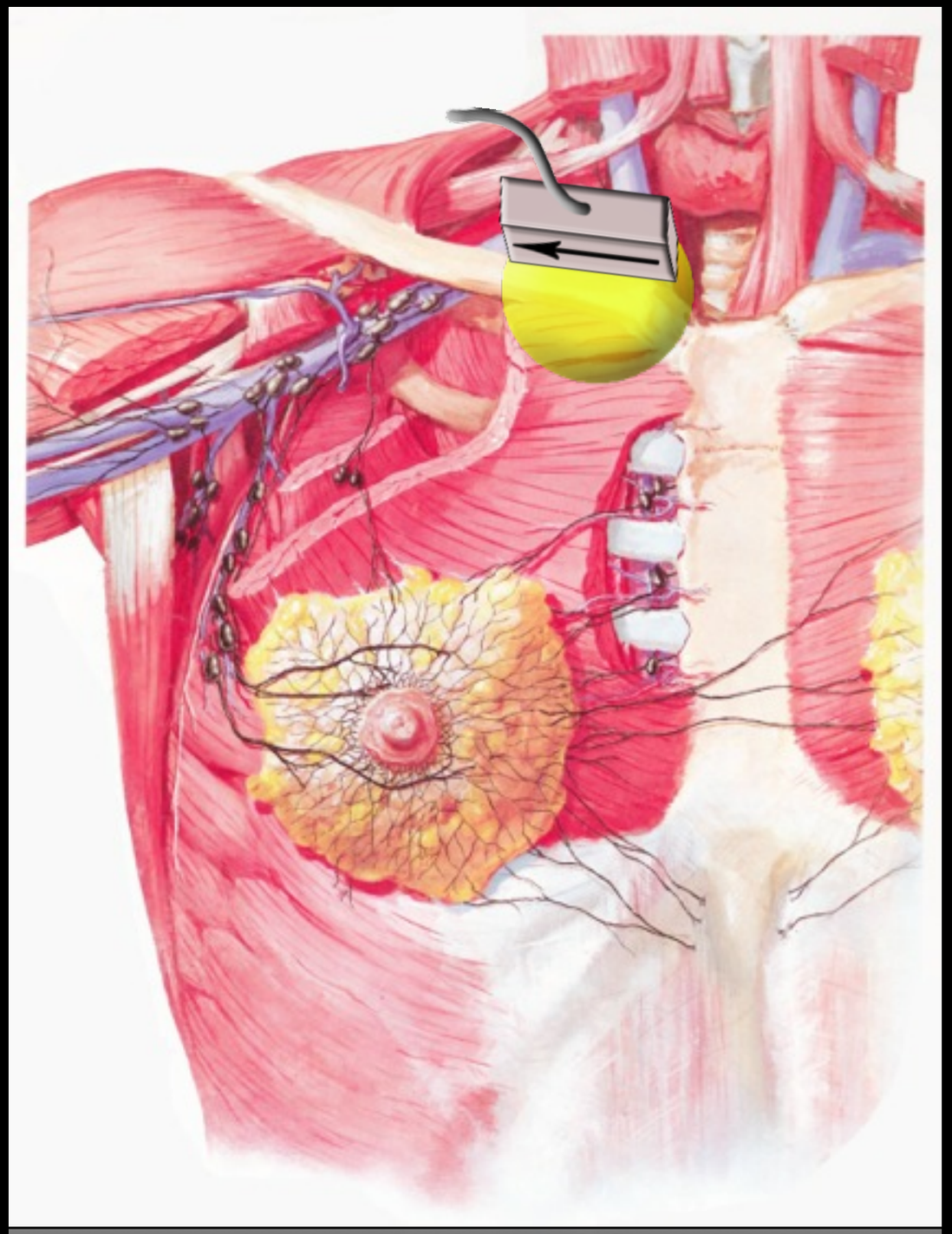




Transverse Orientation

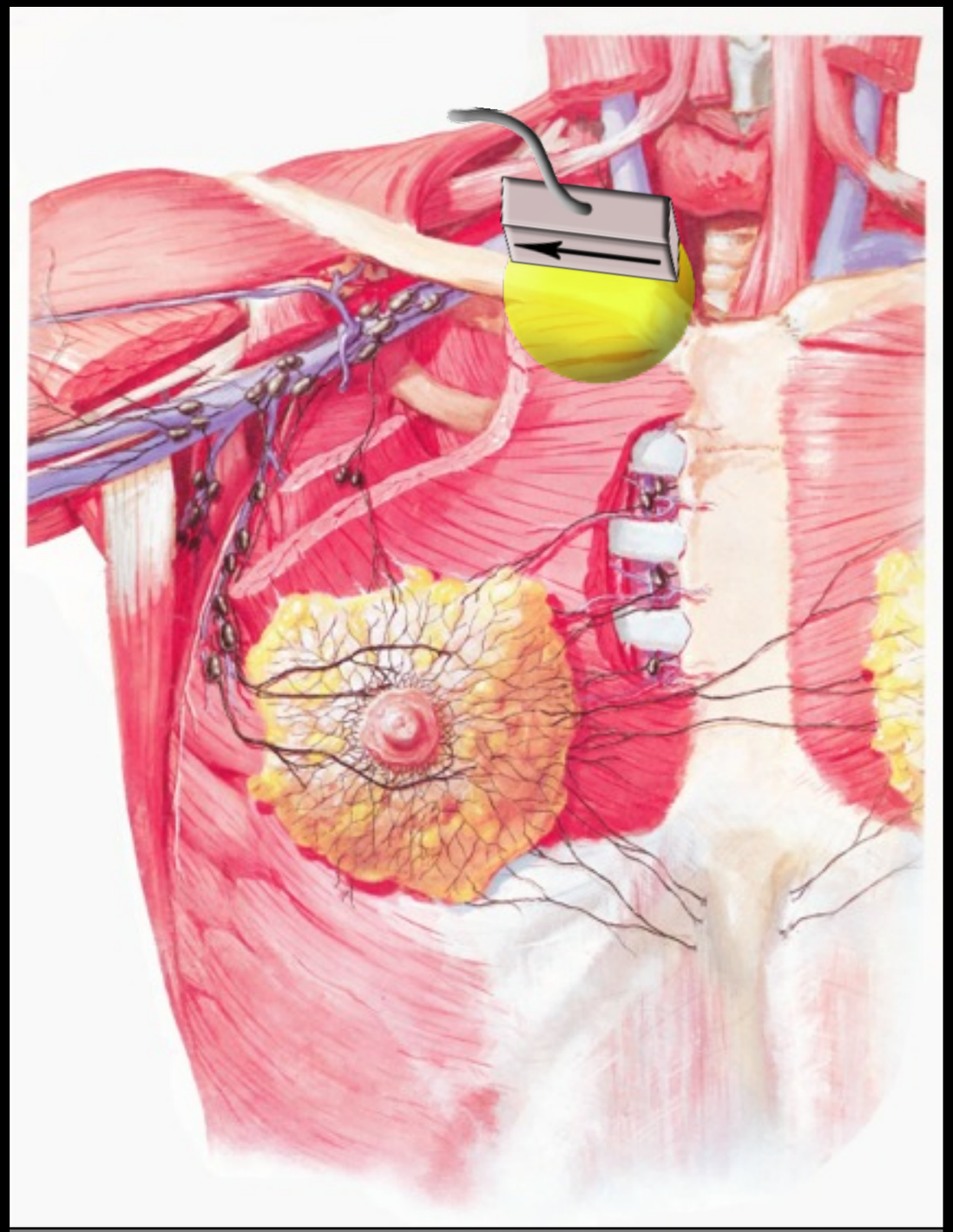
Central Venous Access

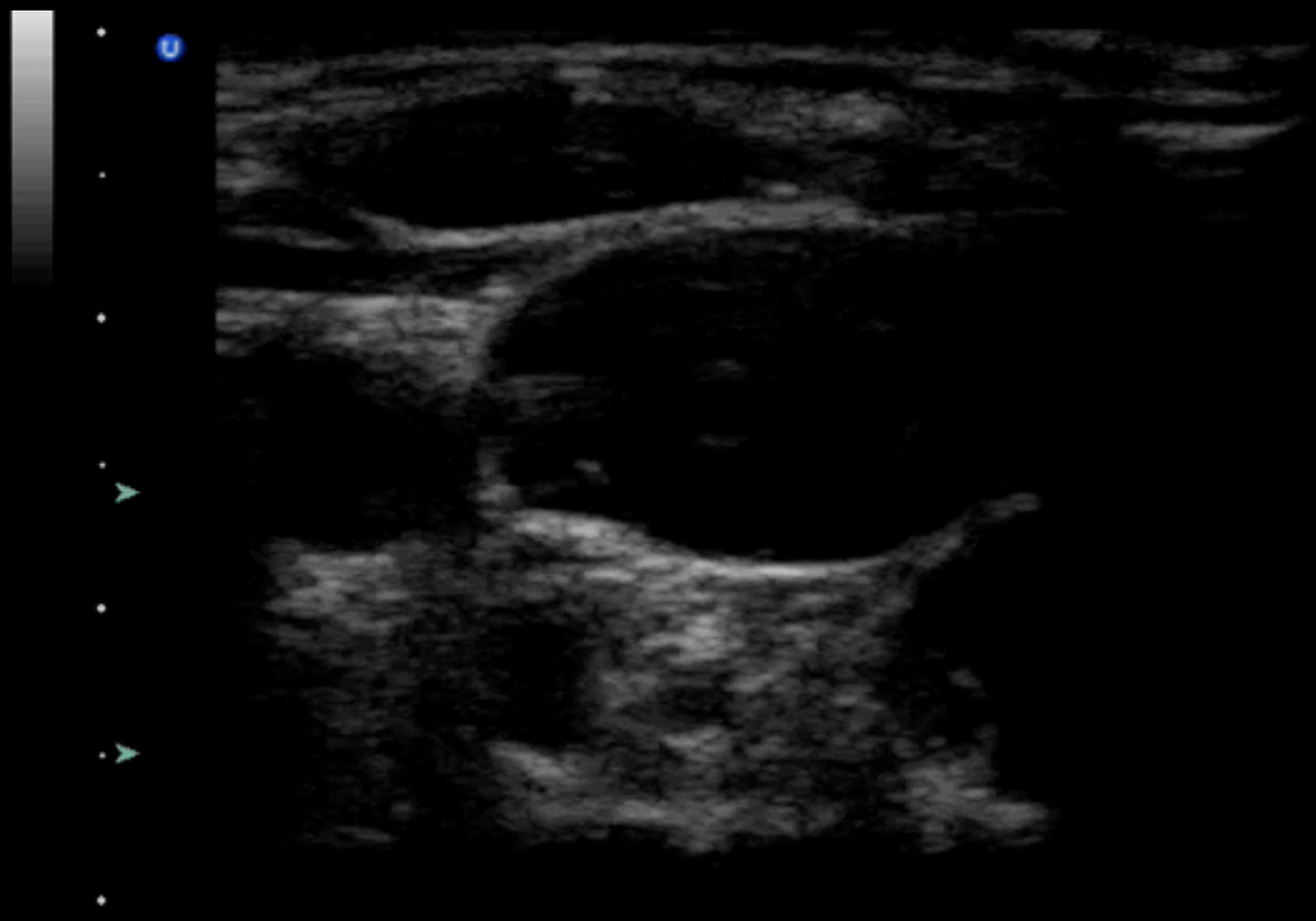
Supraclavicular



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
- 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!

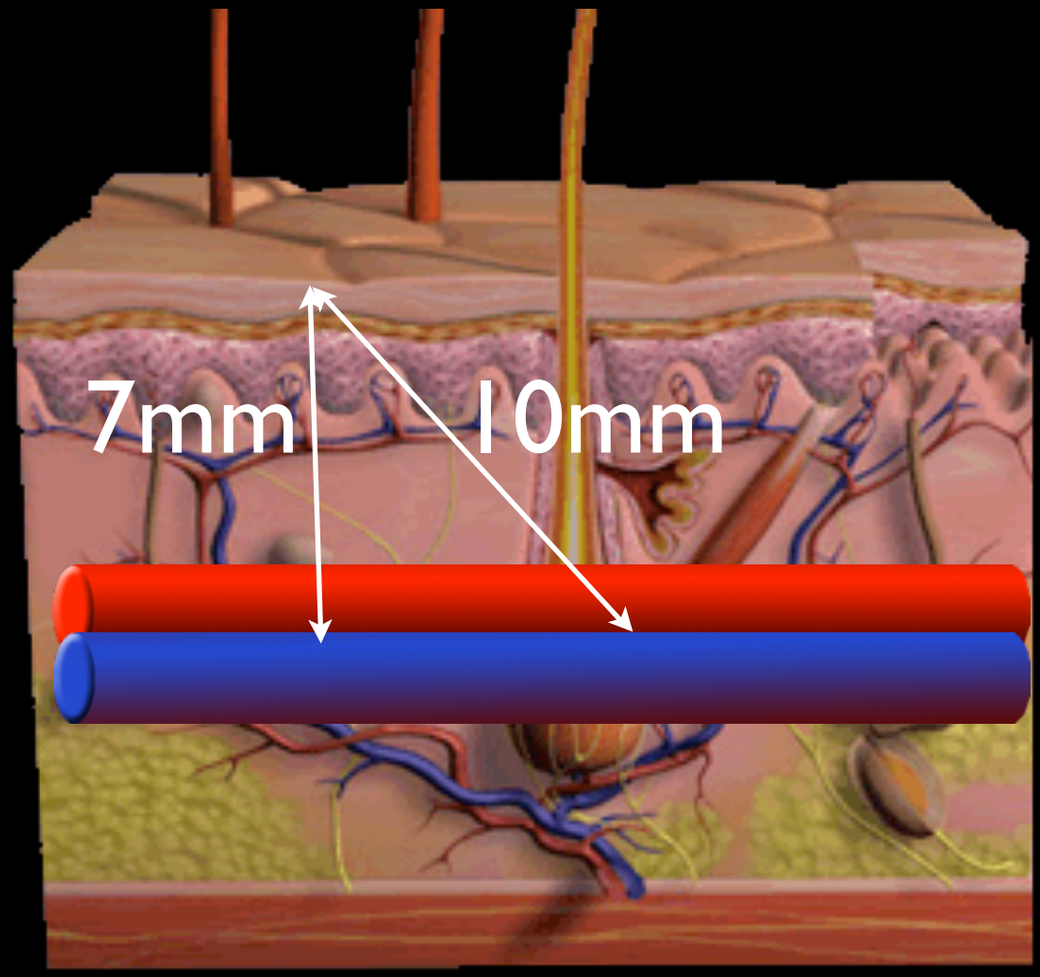
Catheter Length

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

Peripheral Venous Access

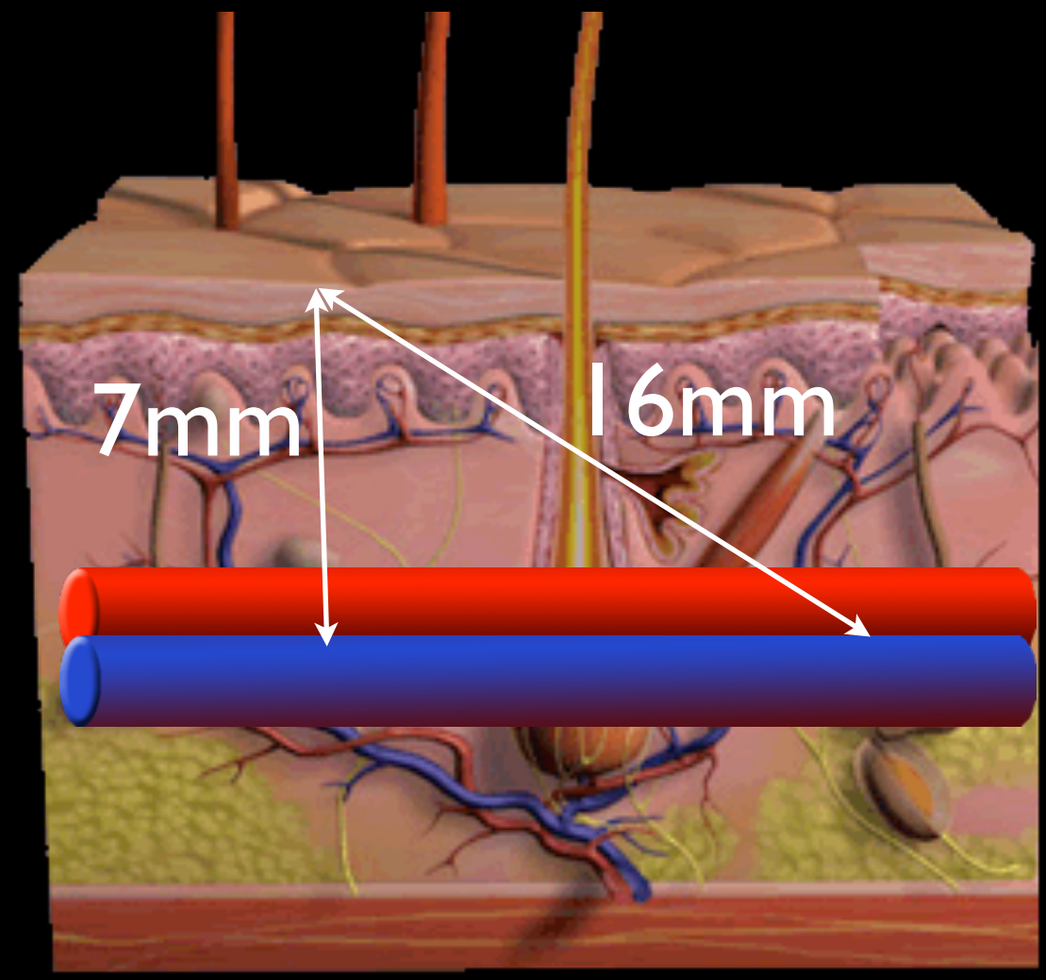
Catheter Length

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

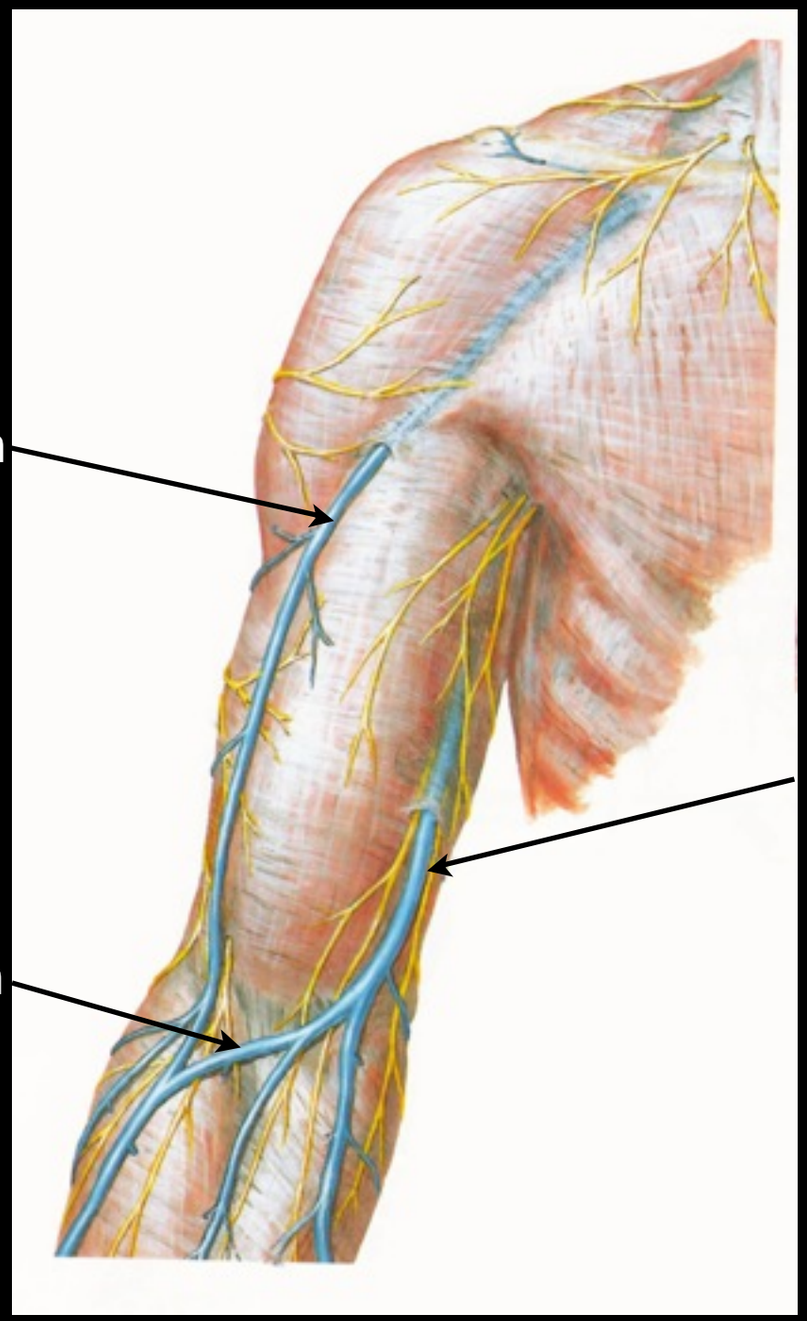


Catheter Length

- 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



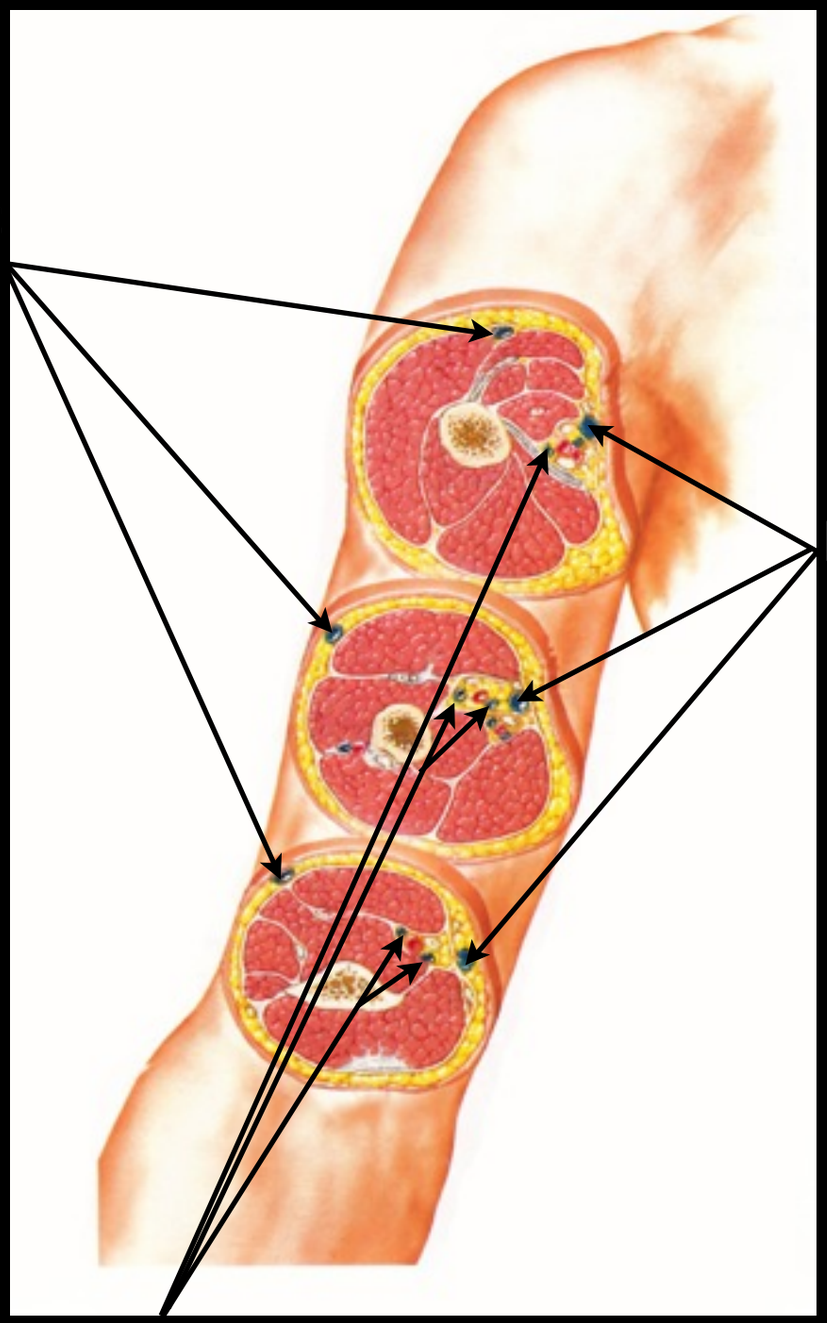
Anatomy



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

Superficial Upper Arm Veins

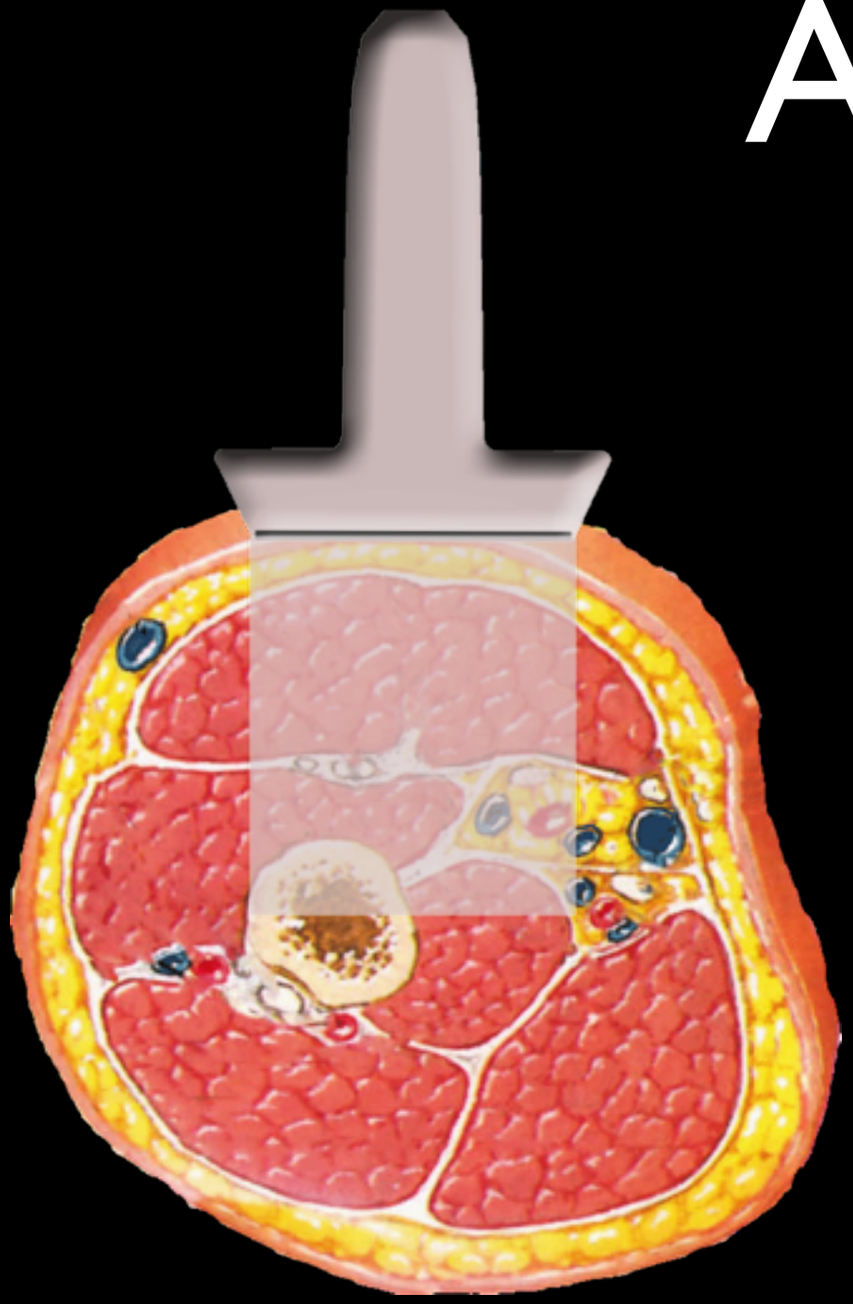
Anatomy

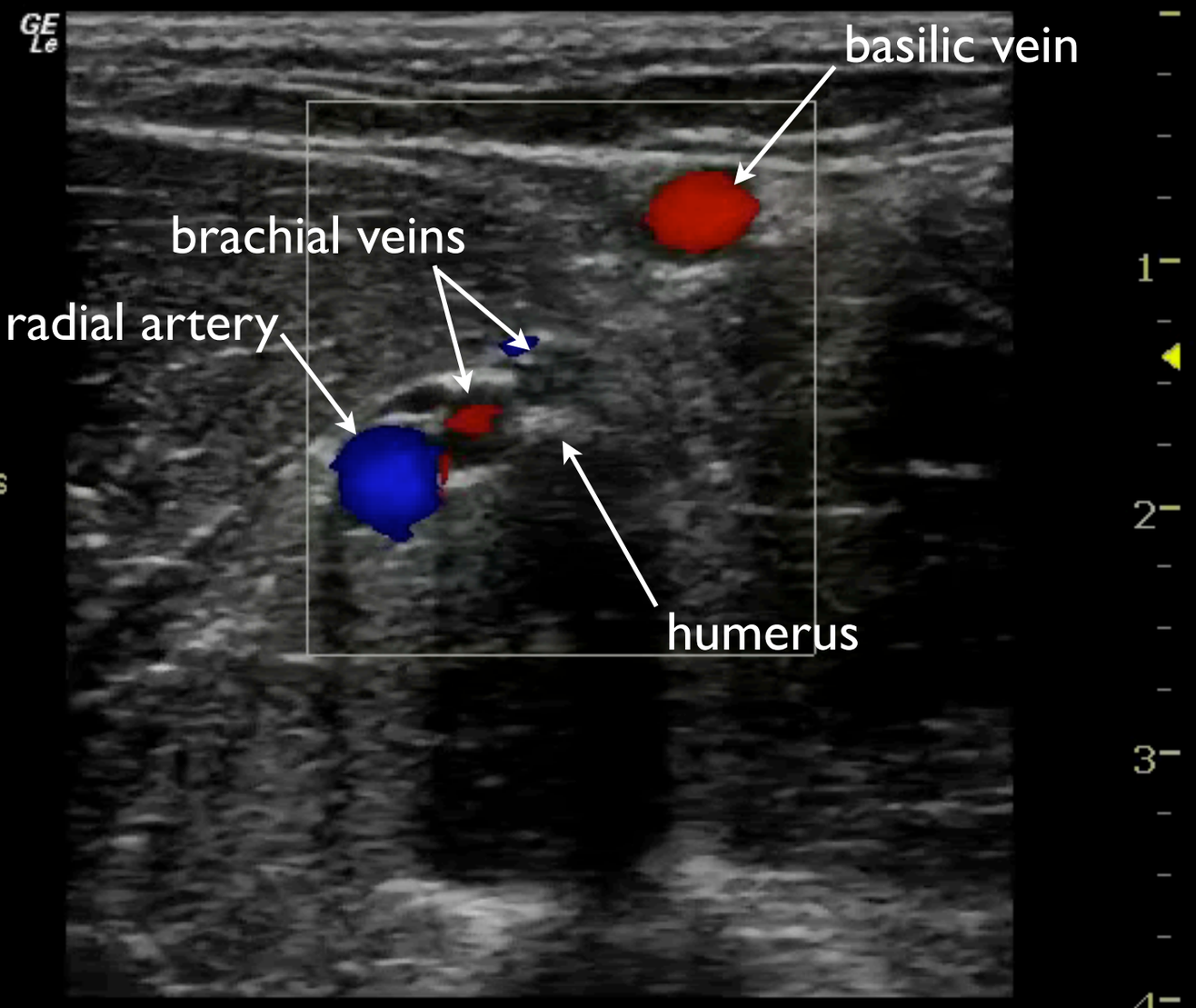


- Brachial veins are deeper along medial aspect of upper arm
- Usually require a longer catheter
- Closer to radial artery and nerve

Peripheral Venous Access

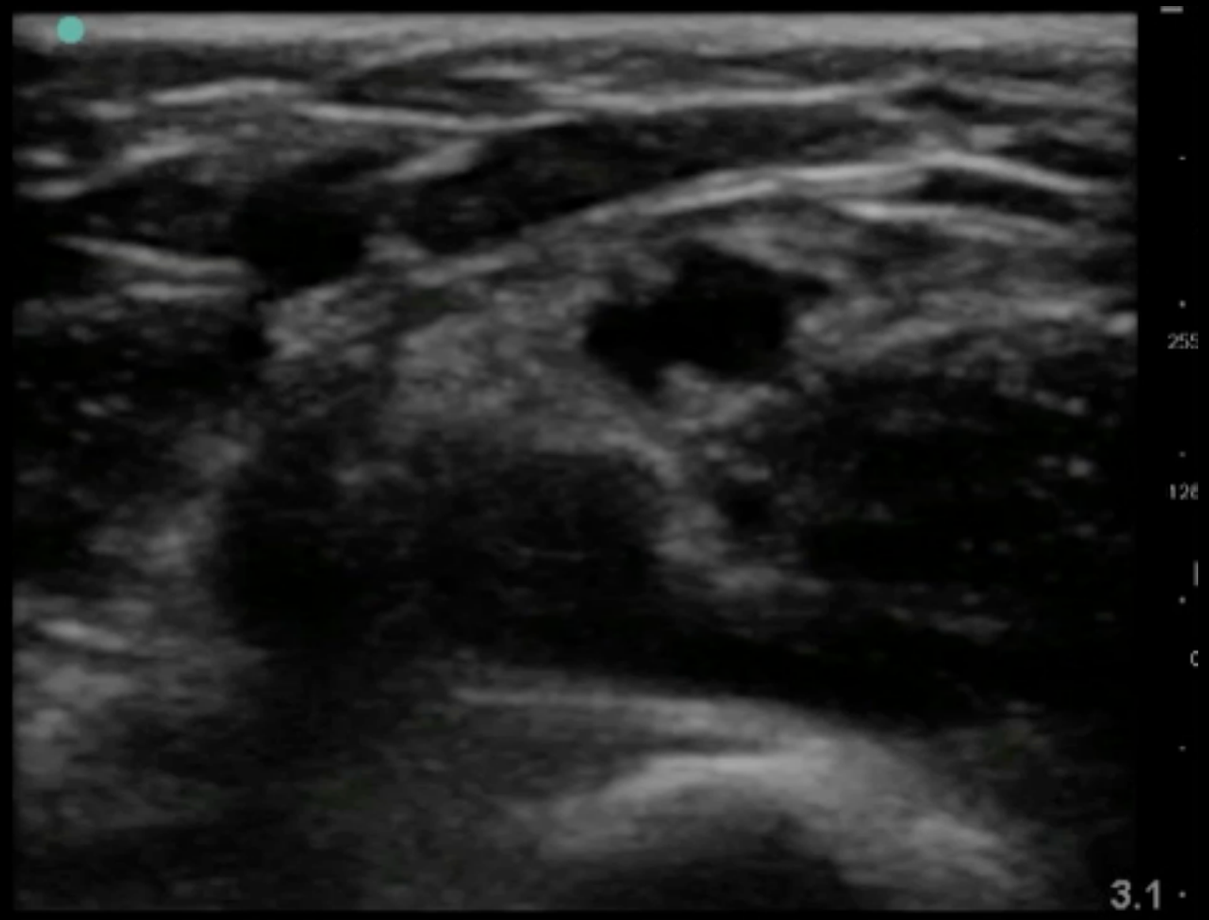
Anatomy





Artery vs Vein

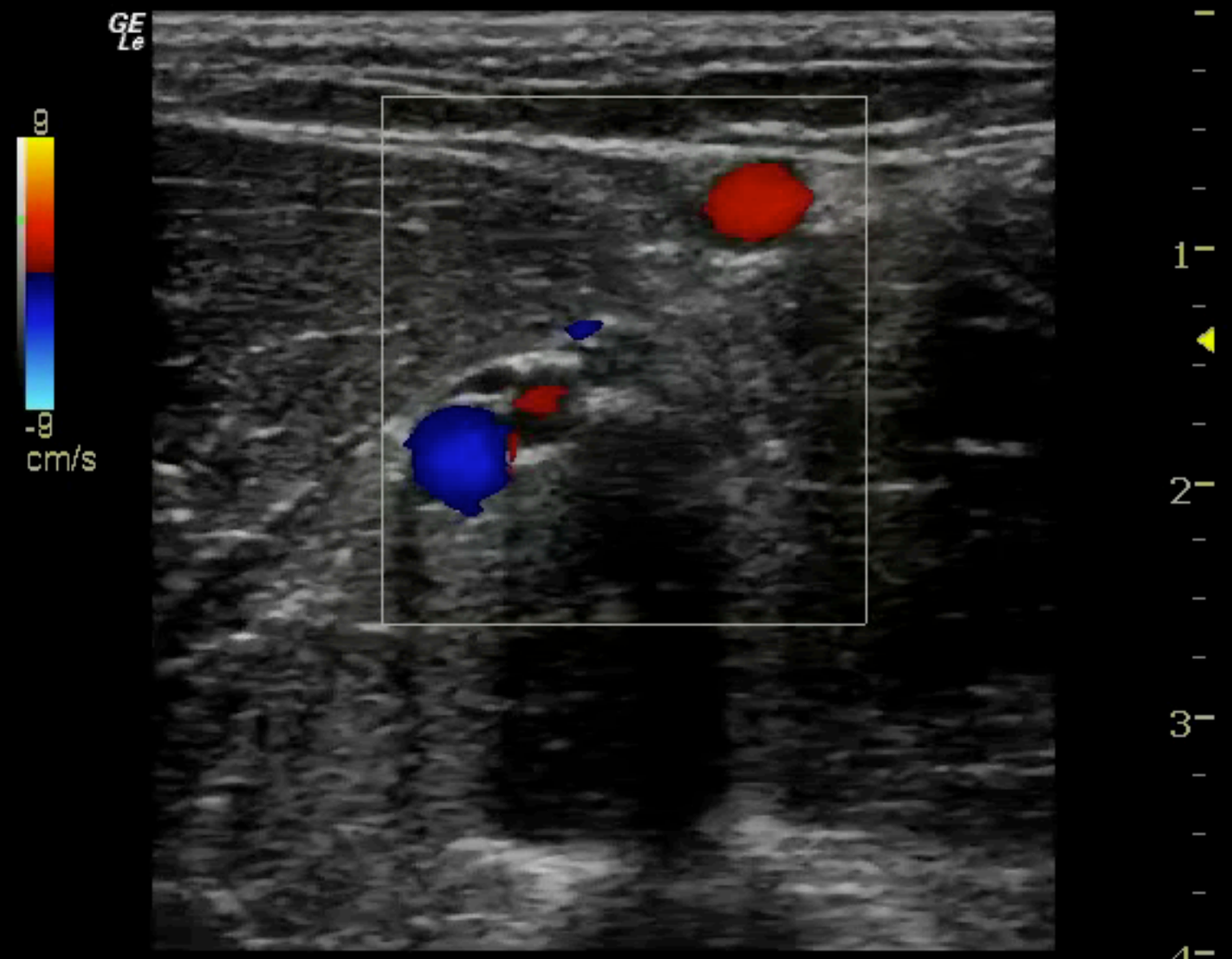
- Compression
  - Both arteries and veins may be compressible
  - Arteries will usually still be pulsatile



Peripheral Venous Access

Artery vs Vein

- Color Flow



arteries usually more pulsatile

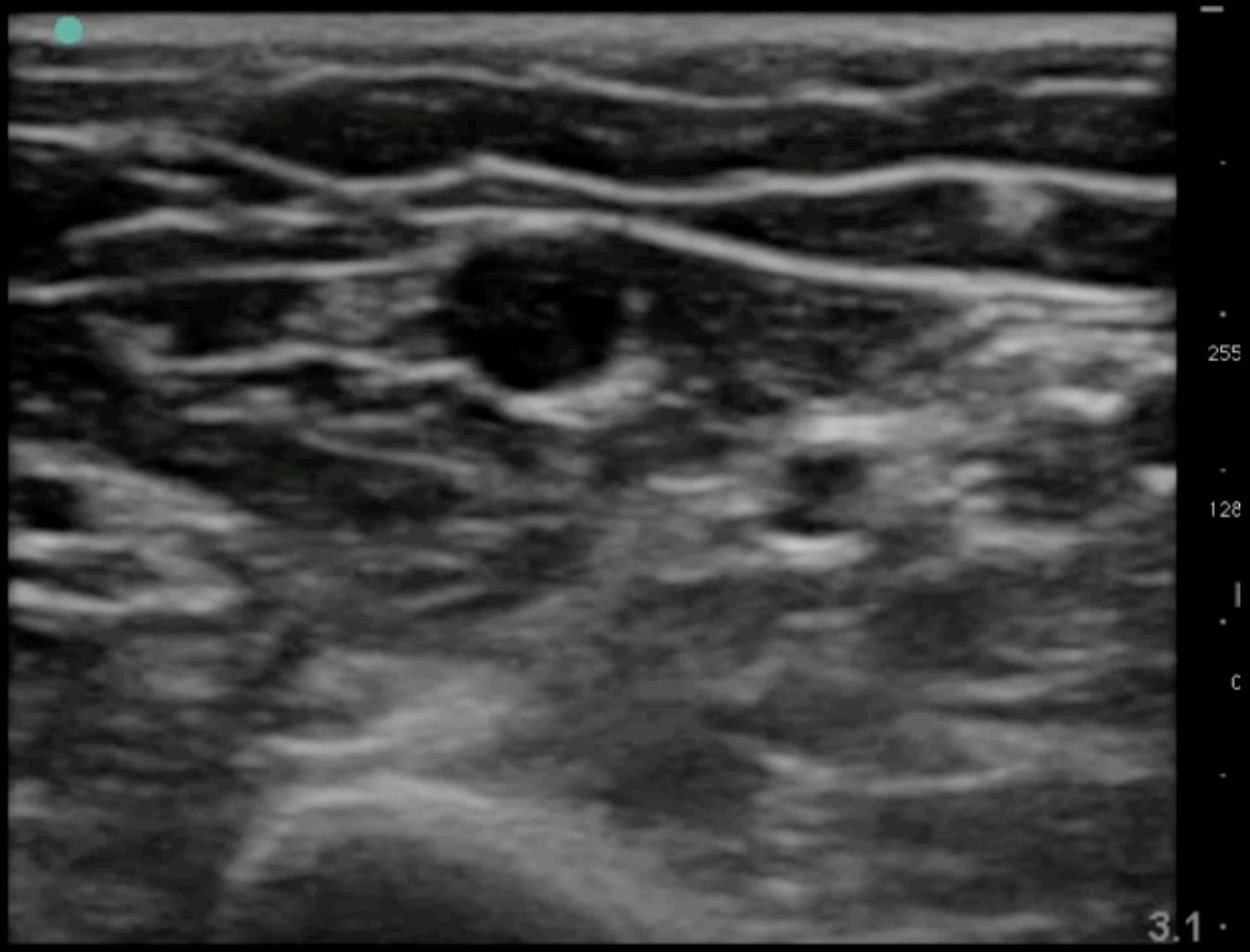
Vein Selection

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

Vein Selection

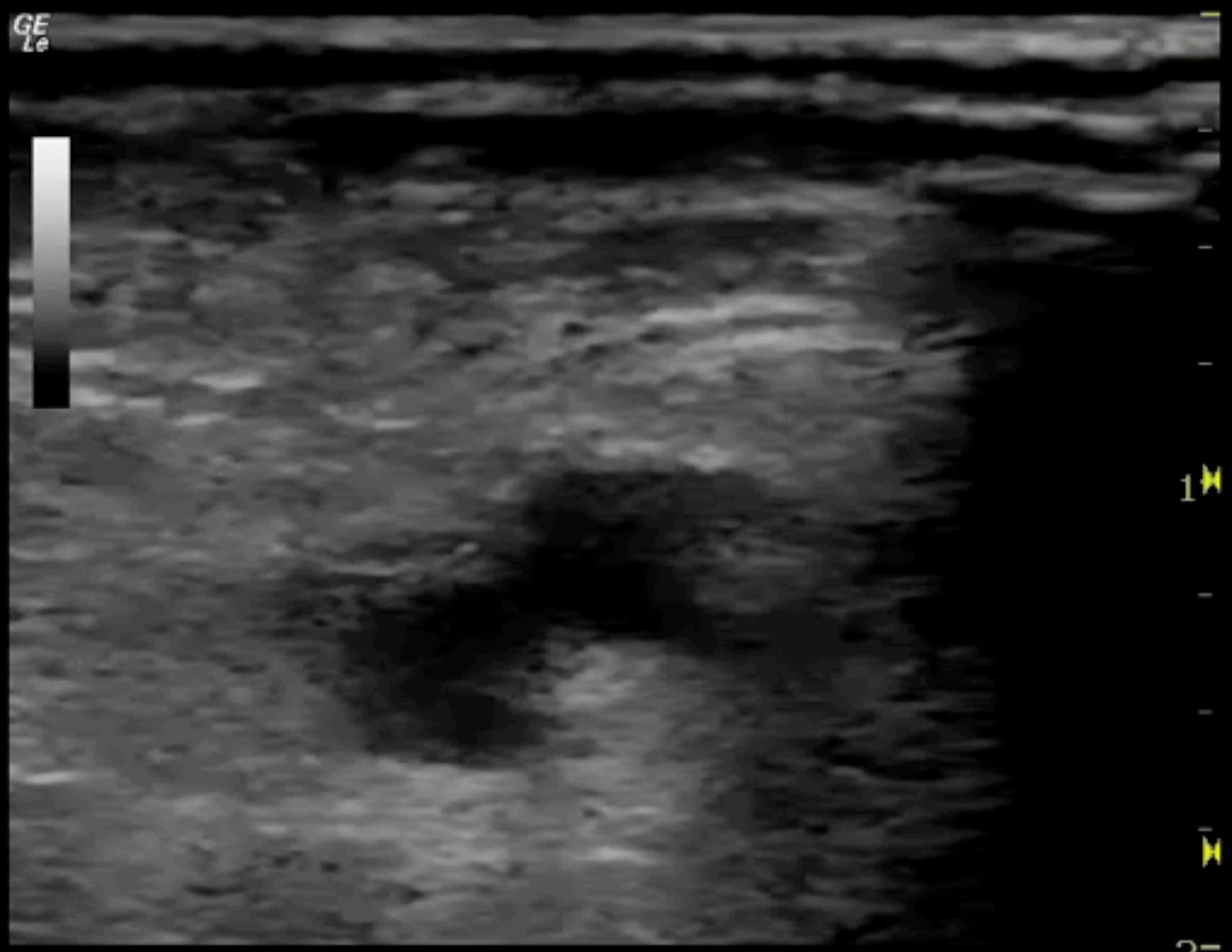
Optimal Vein

Vein Selection



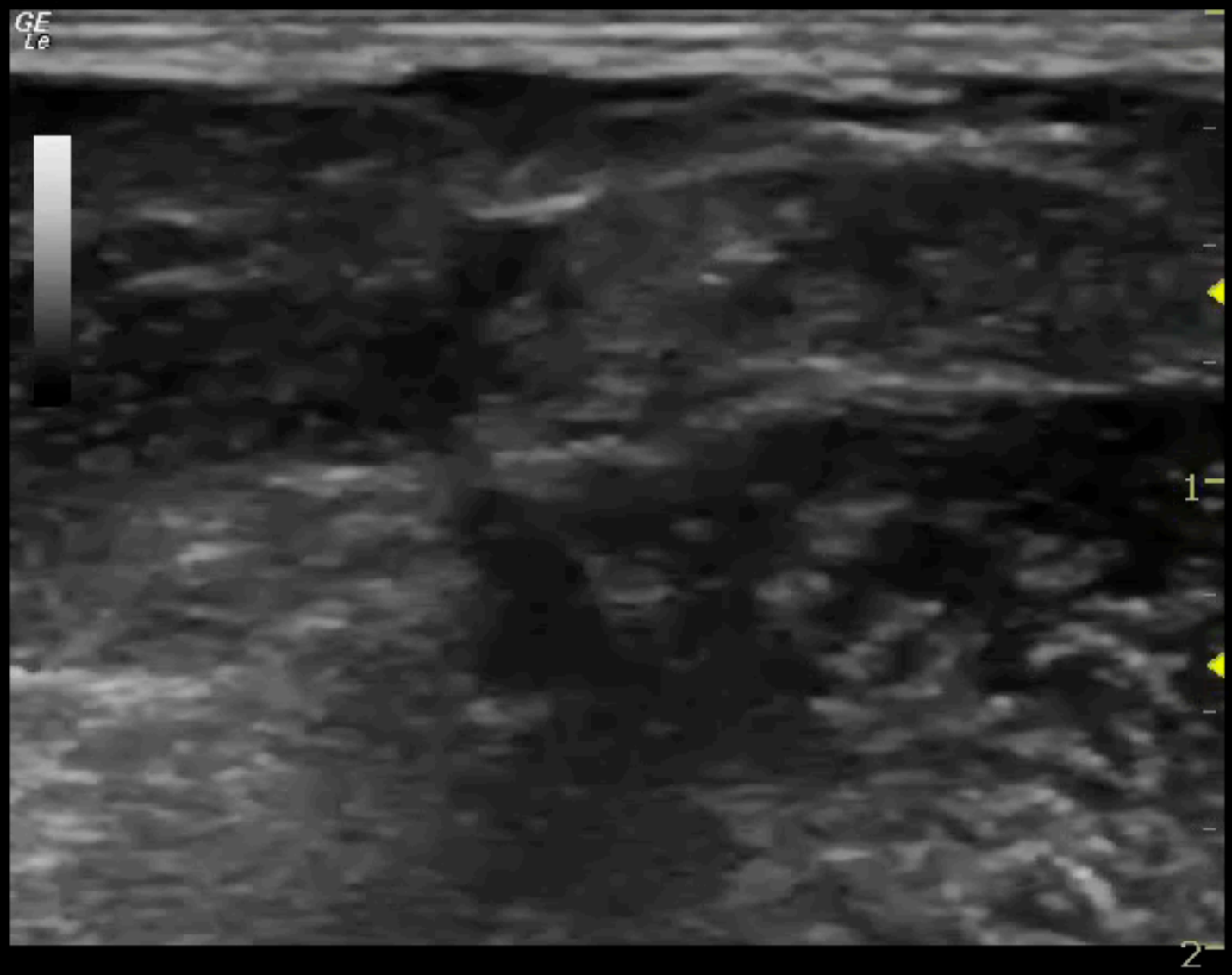
Vein should be relatively straight

Transverse Approach



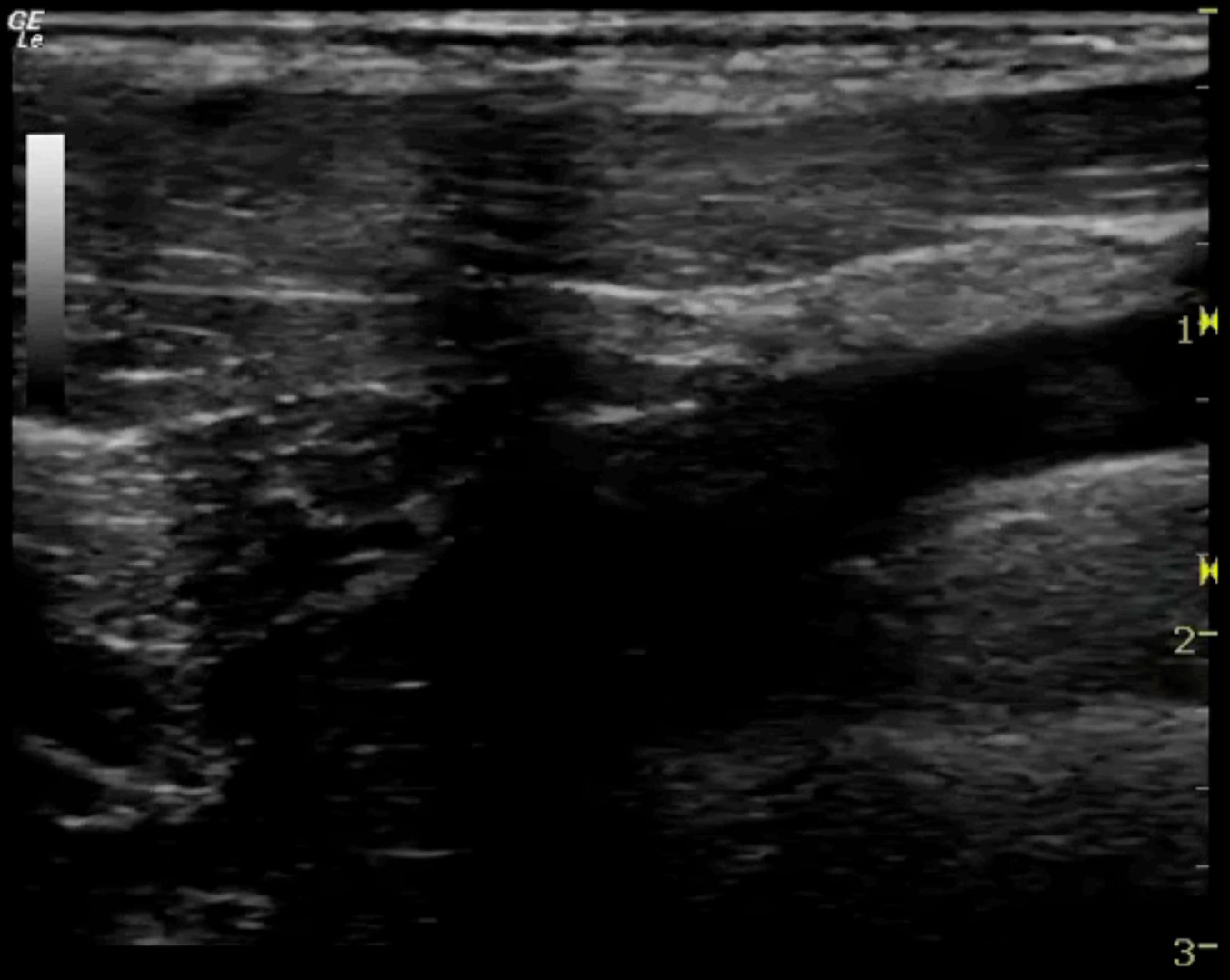
- Needle not usually seen directly
  - Location inferred by artifact and movement of surrounding tissues

Transverse Approach



"Bouncing" technique to localize needle

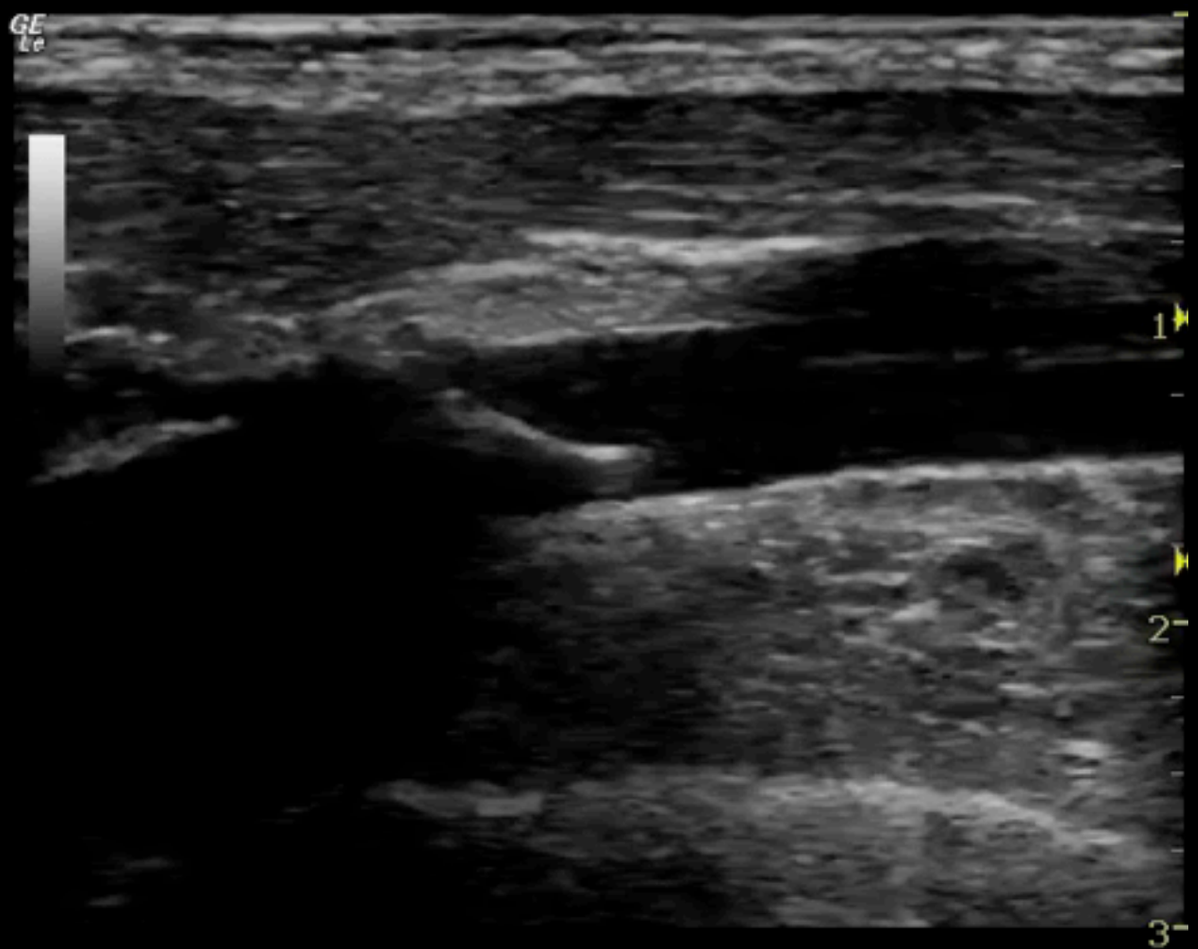
Longitudinal Approach

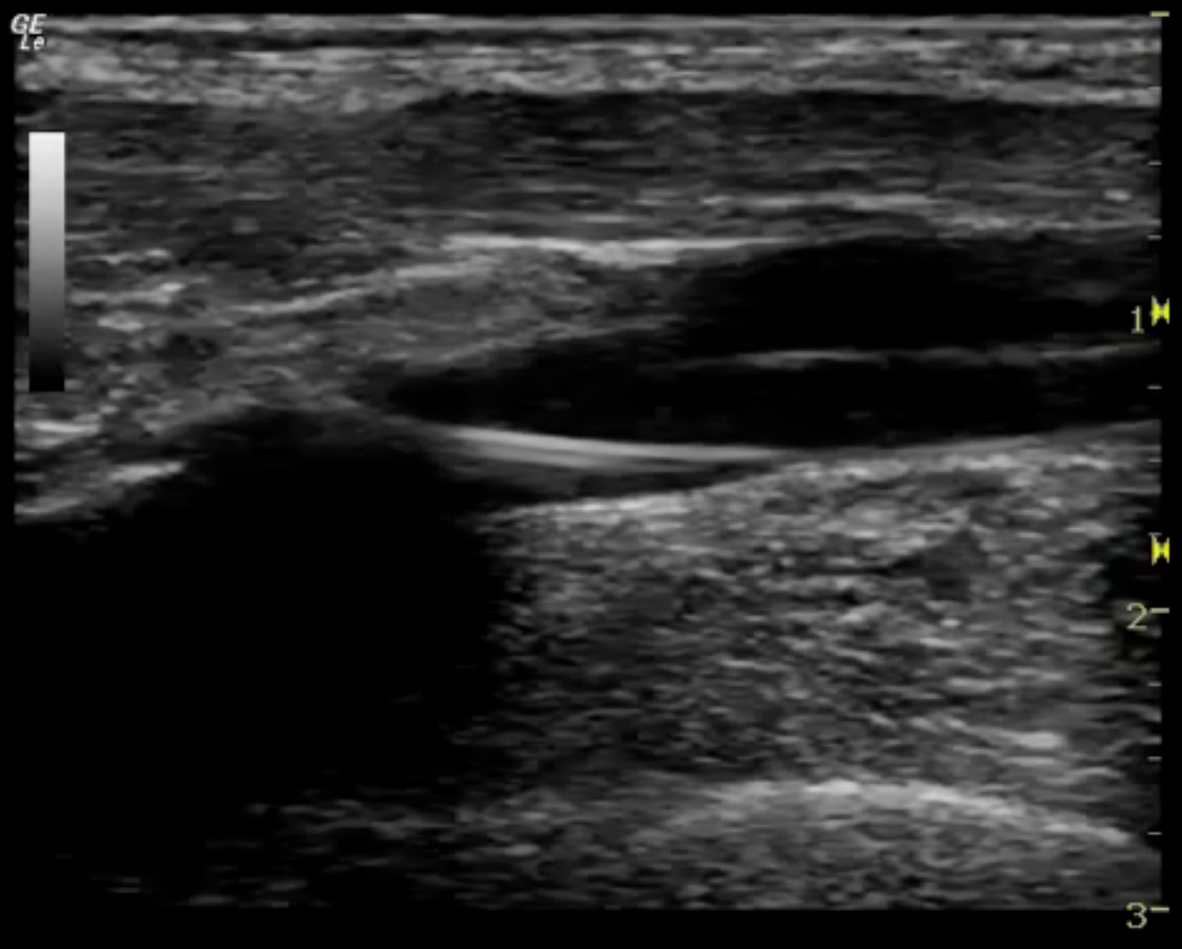


- Needle slope and tip may be seen
- More technically challenging

Peripheral Venous Access

Longitudinal Approach





Consider using Seldinger technique for deeper veins

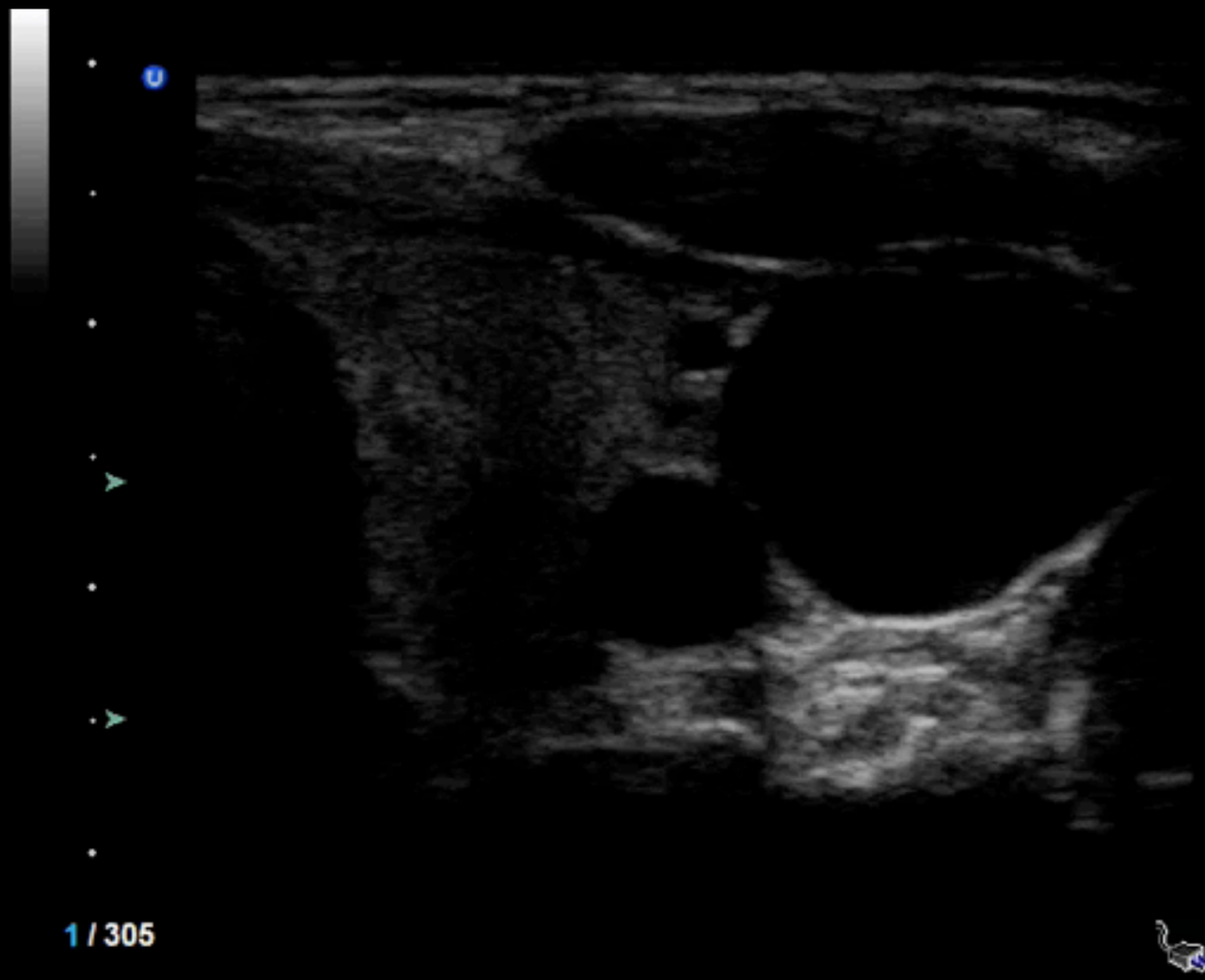
Pearls and Pitfalls

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

Pearls and Pitfalls

Compression



Compression is the most reliable way to differentiate arteries and veins

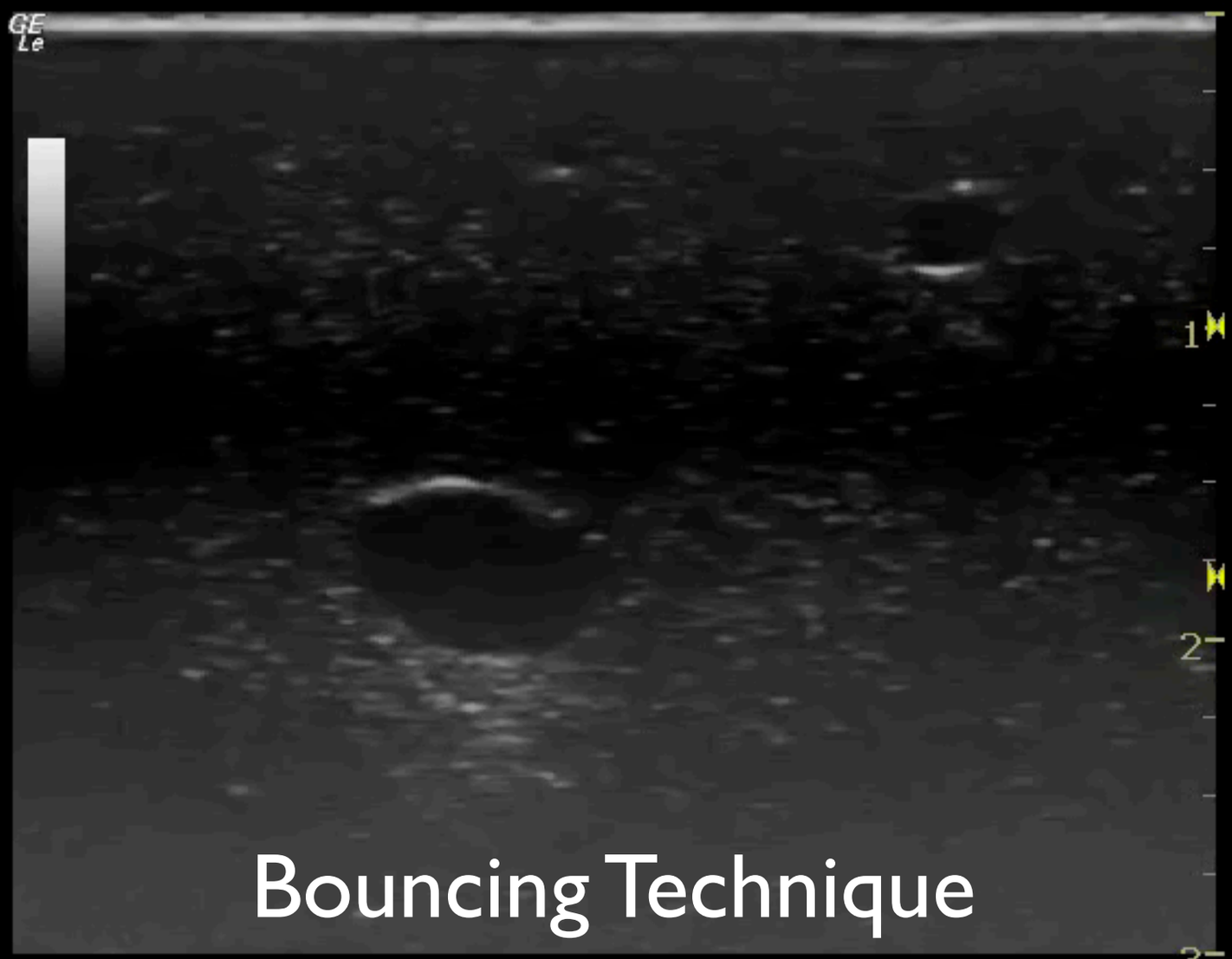
Pearls and Pitfalls

Valsalva & Trendelenberg

Both maneuvers will significantly increase the size of internal jugular vein

Pearls and Pitfalls

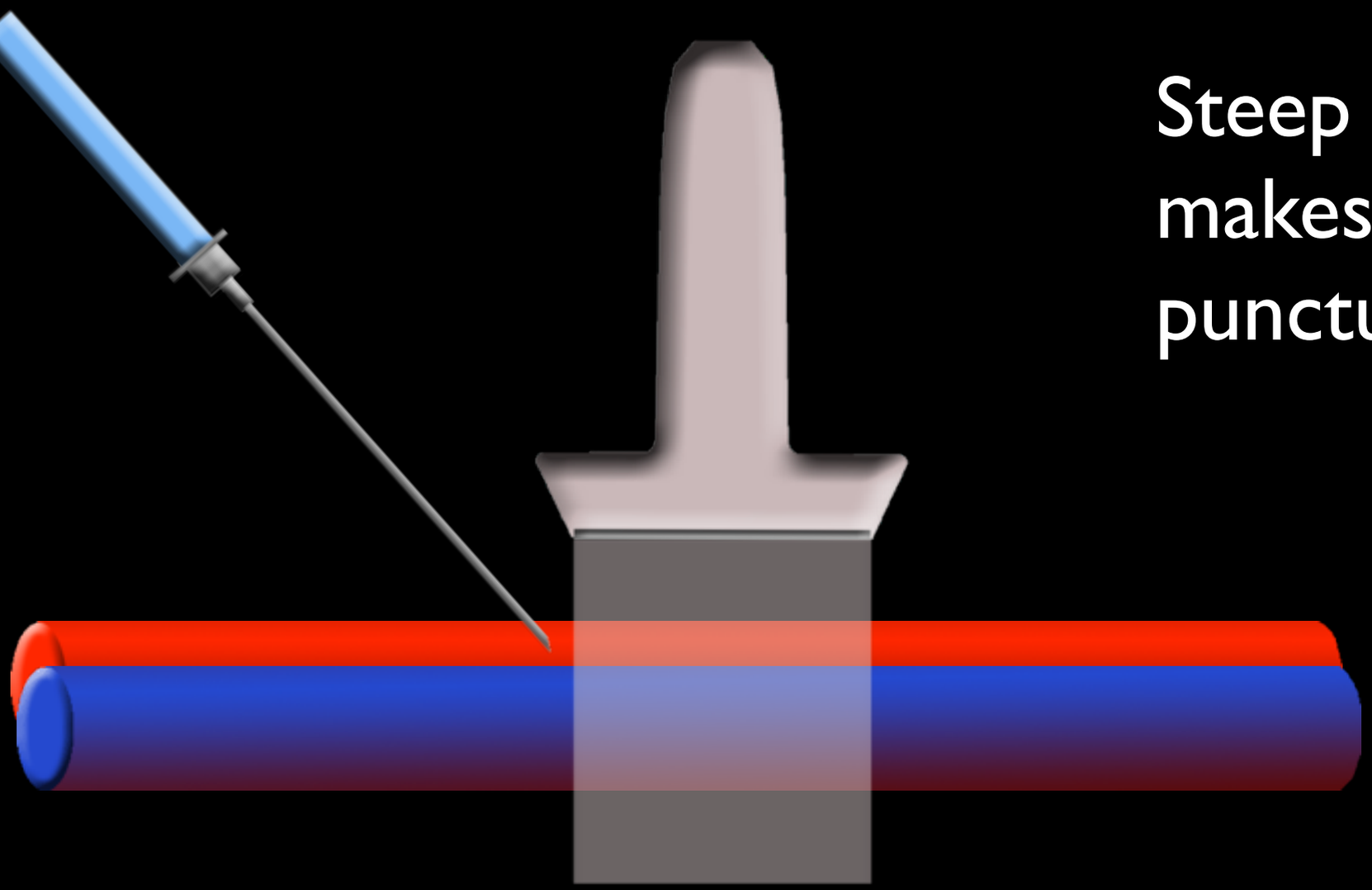
Locate the Needle



Bouncing Technique

Pearls and Pitfalls

Angle of Approach

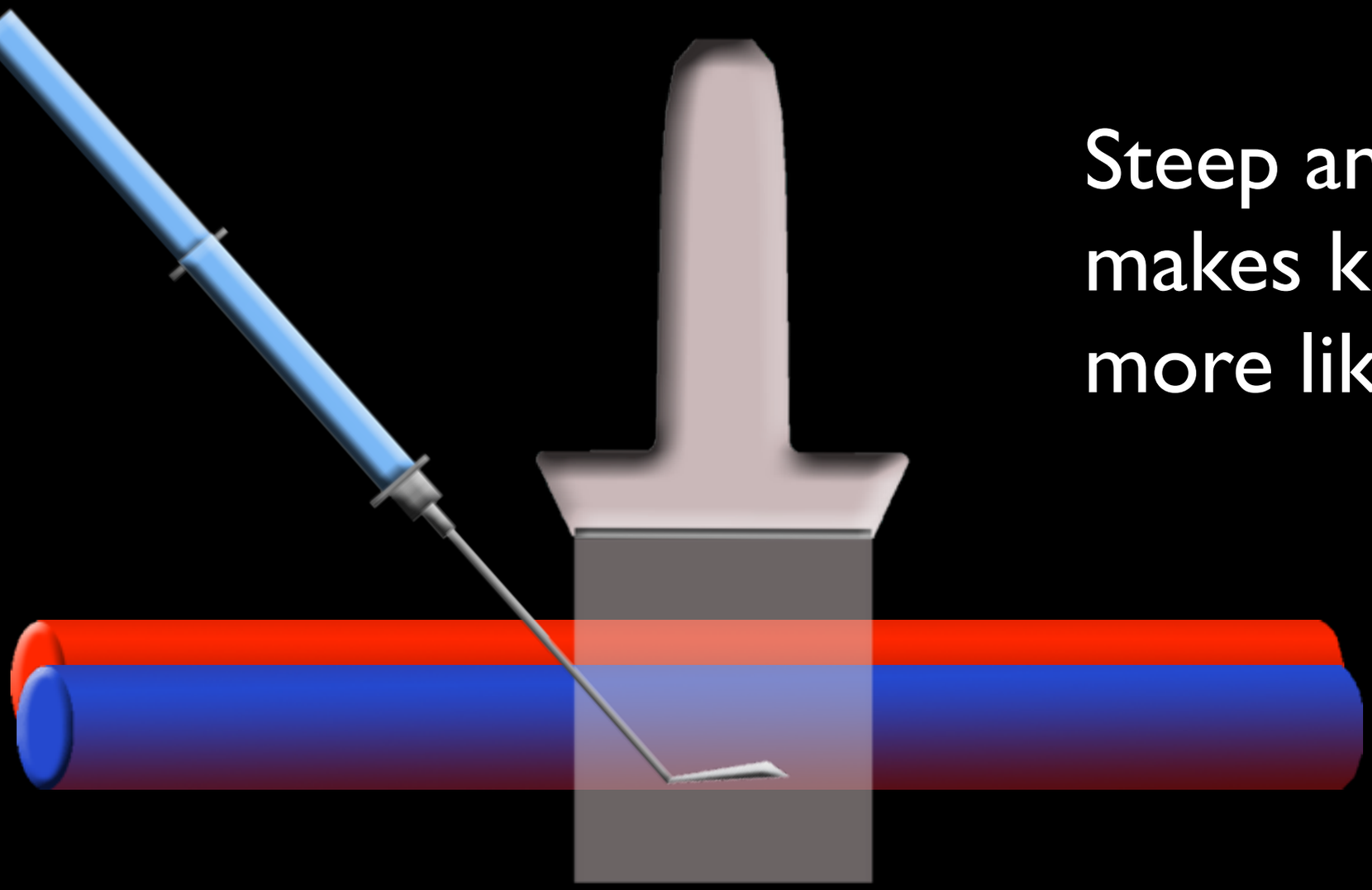


Steep angle of approach makes posterior wall puncture more likely

Posterior Wall Puncture

Pearls and Pitfalls

Angle of Approach

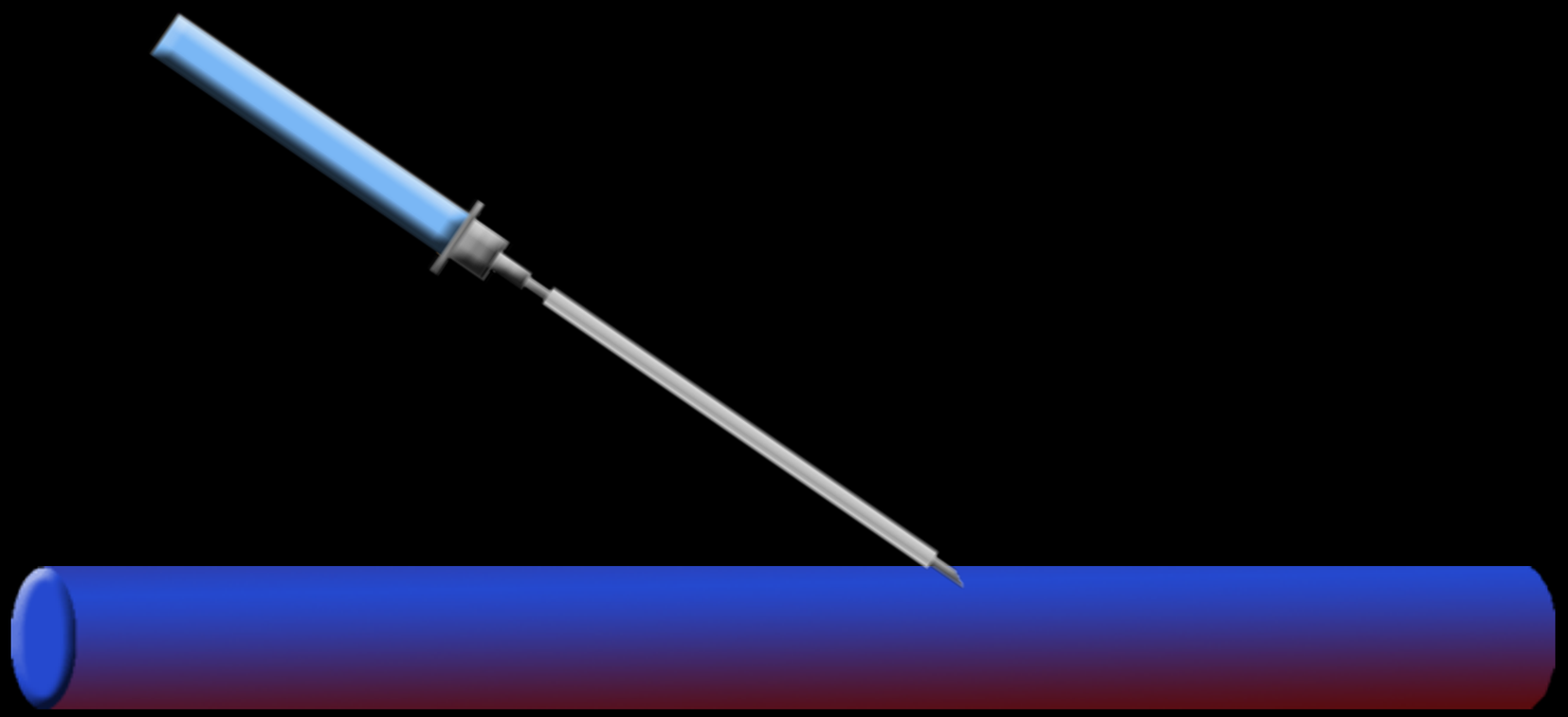


Steep angle of approach makes kinking of catheter more likely

Catheter kinks in vein

Pearls and Pitfalls

Thread the Catheter



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

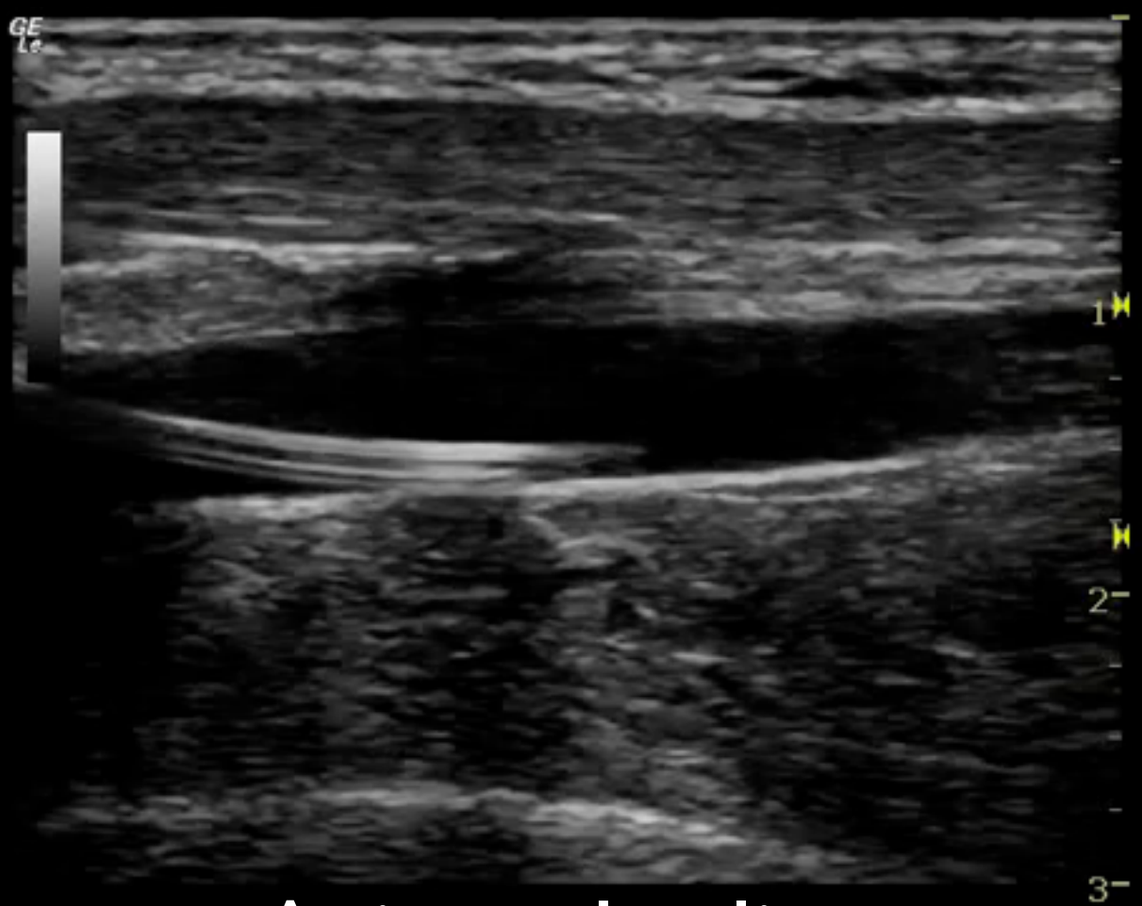
Pearls and Pitfalls

Thread the Catheter

Visually check that catheter is inside vein before advancing

Pearls and Pitfalls

Confirm Placement

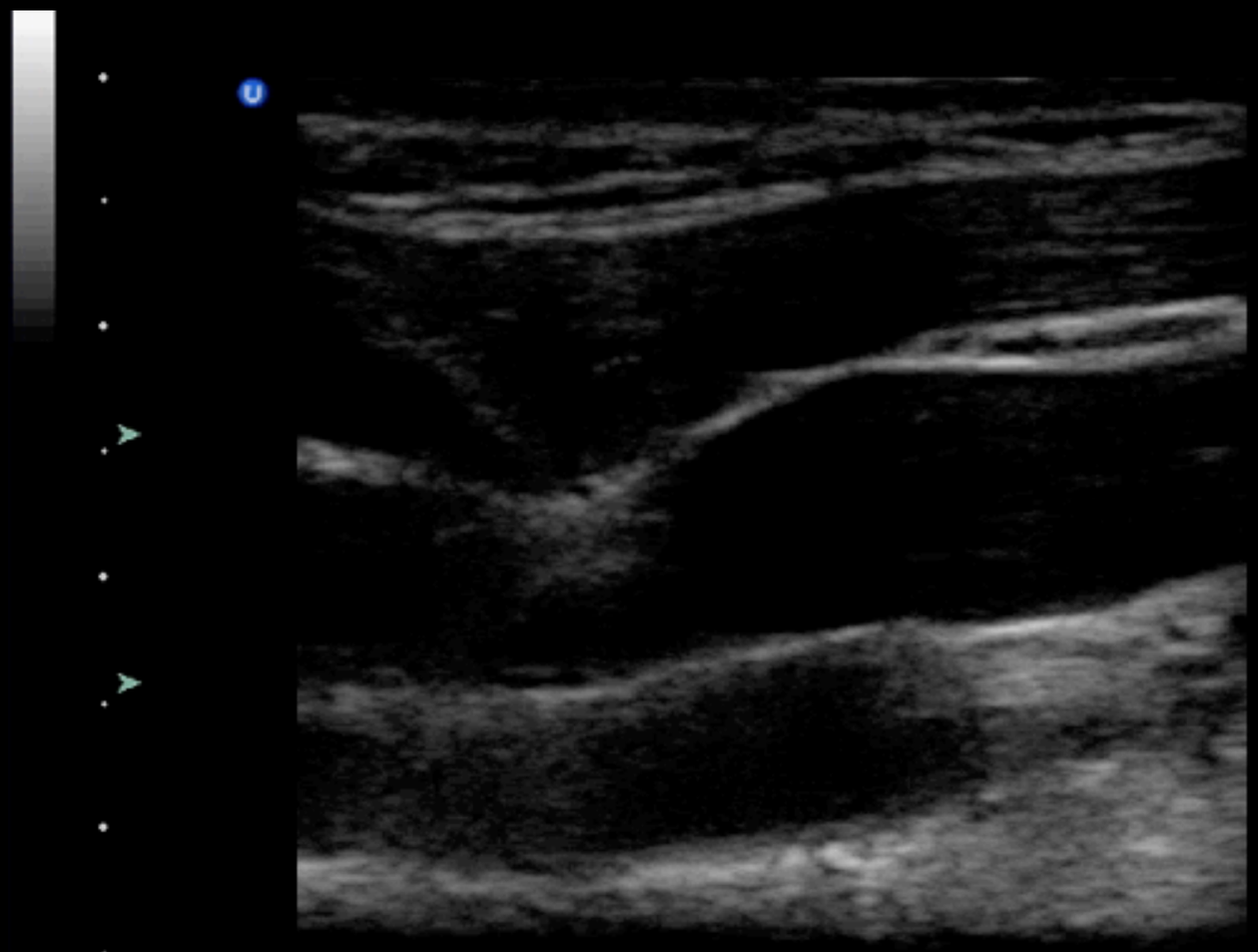


Agitated saline

“Bubble” Test

Pearls and Pitfalls

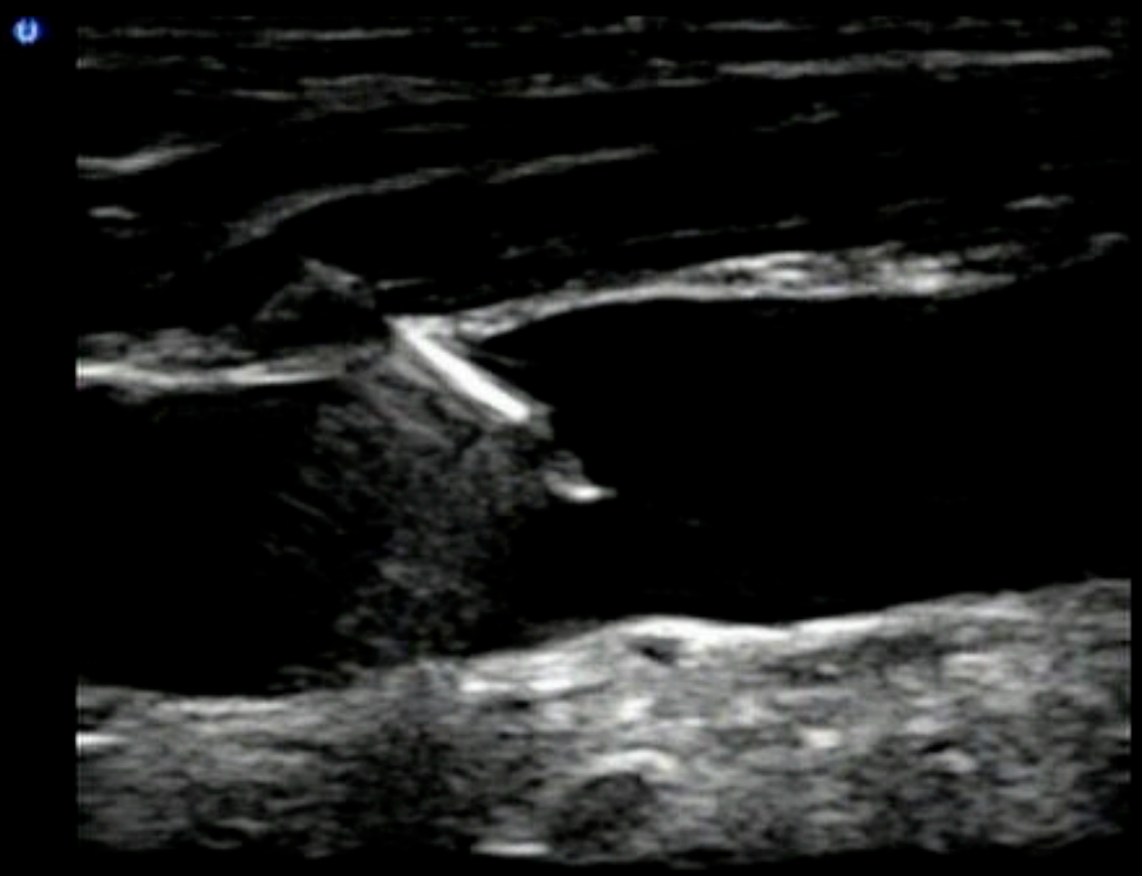
Quick Punch



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

Pearls and Pitfalls

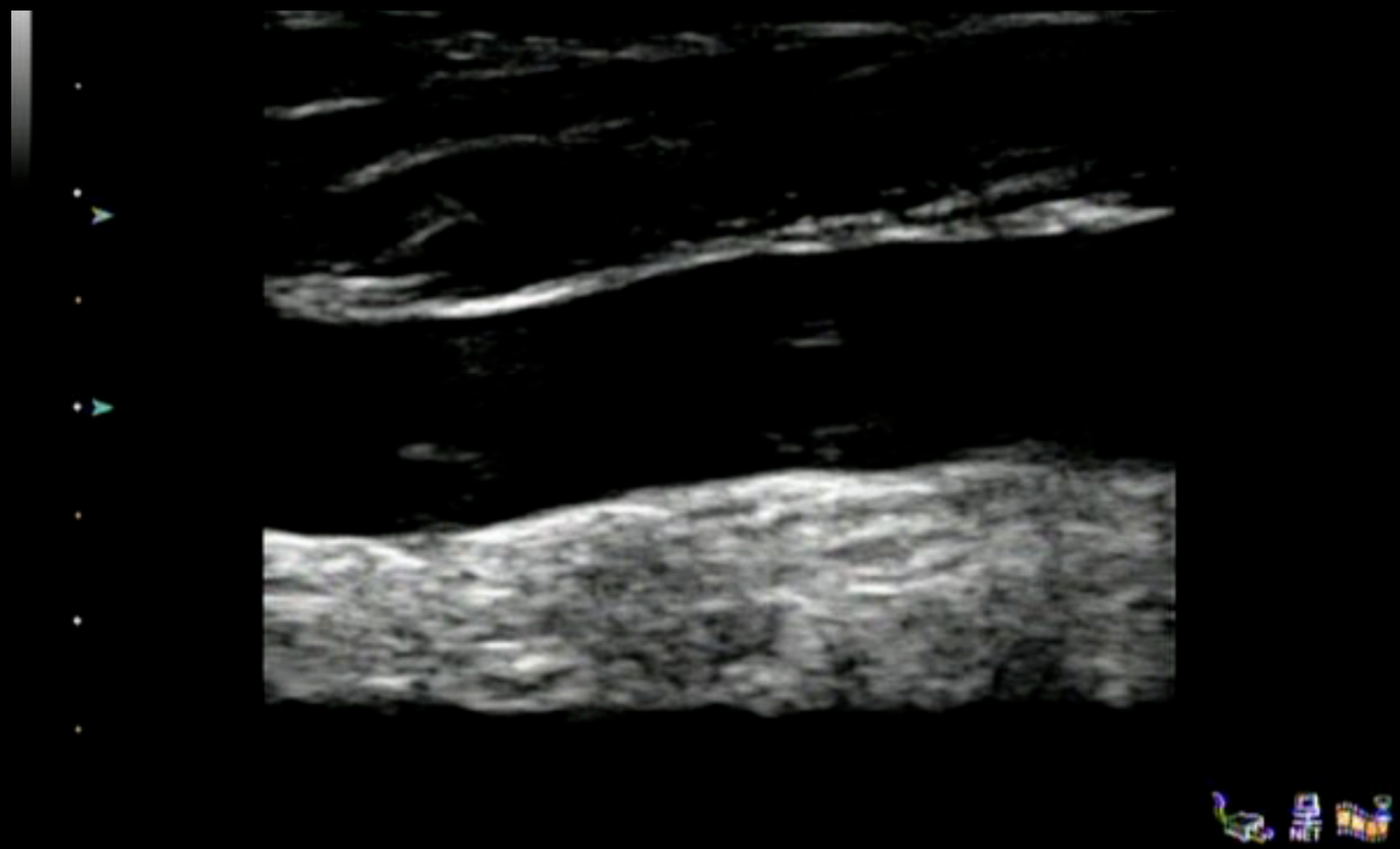
Echotip Needle



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

Pearls and Pitfalls

Troubleshooting



"Guidewire will not thread"

Needle no longer in vessel

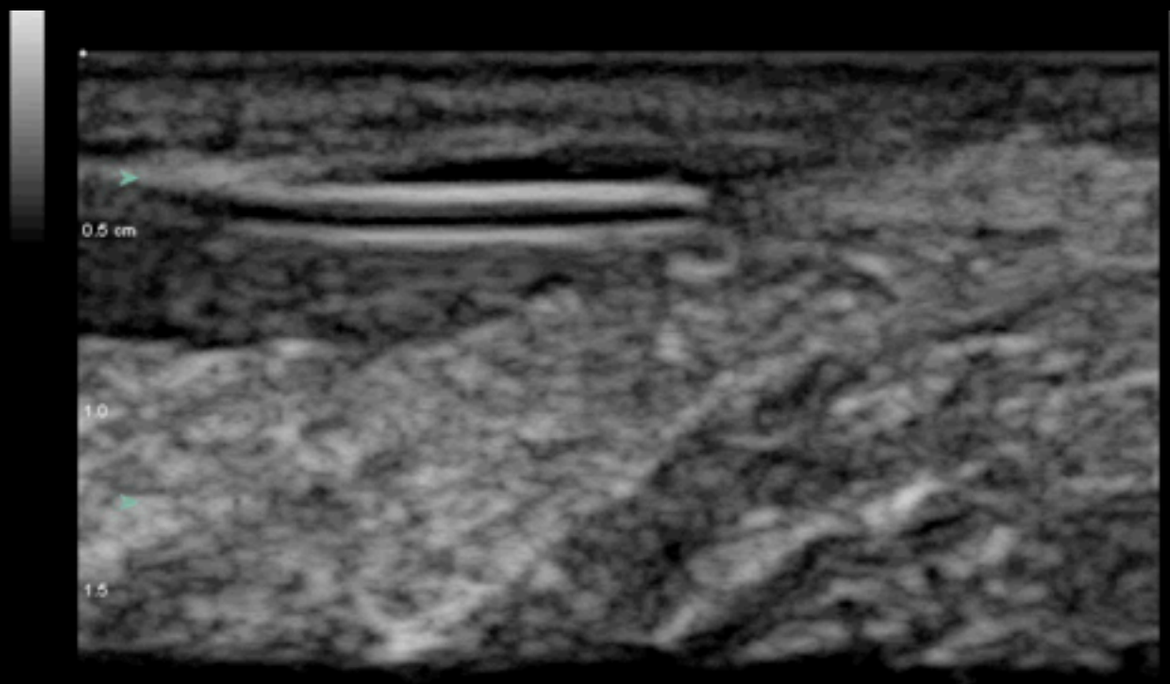
Trouble-shooting

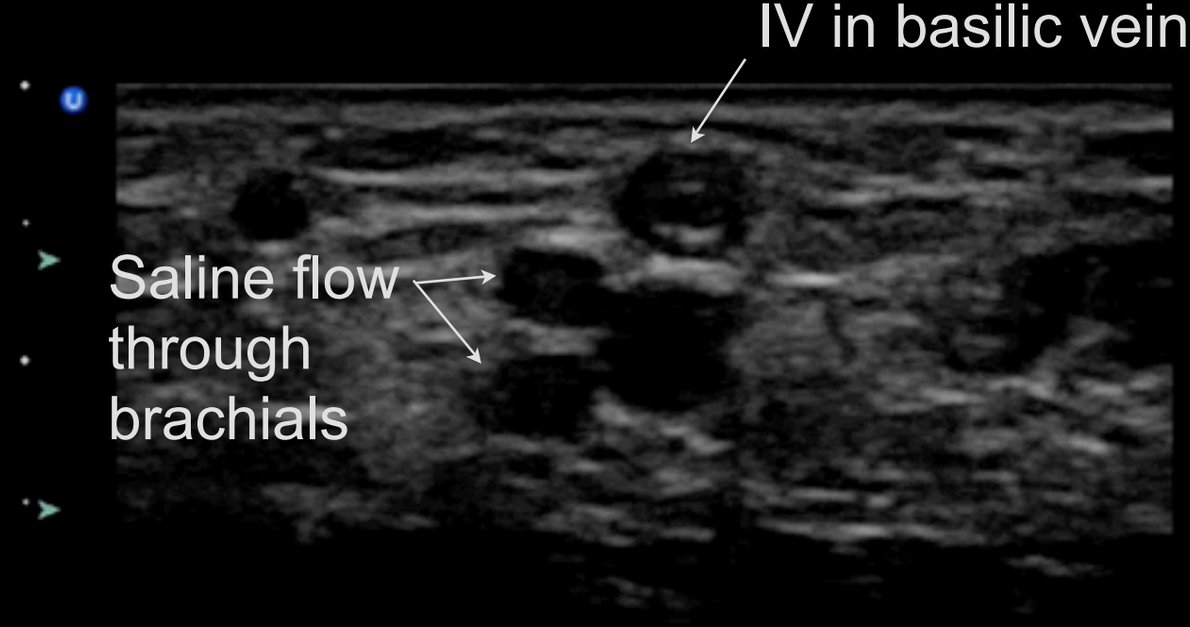
"IV has stopped working"

Clot has developed inside vein

Pearls and Pitfalls

Trouble-shooting





"IV has stopped working"

Clot has developed inside vein

Final Thoughts

- Ultrasound is safer, quicker
- Practice on stable patients
- Begin with transverse approach
- Peripheral lines are hard to master, but USEFUL!

Central and Peripheral Venous Access

Gavin Budhram, MD
Department of Emergency Medicine
Baystate Medical Center

Gavin Budhram, MD
Director of Emergency Ultrasound
Baystate Medical Center
Springfield, MA