



Emergency
Physicians
OF TIDEWATER

US Guided PIV Placement

Advanced PA Procedure Series
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Reasons for Placement

- Difficult access is estimated in about 10% of patients who present to the ED. ¹
- IV placement is a common pathway in almost all ED workups and can be a significant **rate limiting step!**
- Factors that contribute to difficult access include...
 - IV Drug Use
 - Chemo therapy/ Repeat IV sticks
 - Limb Restrictions (Fistula, lymph node resections)
 - Obesity
 - Contractures
 - Elderly
 - Dehydration

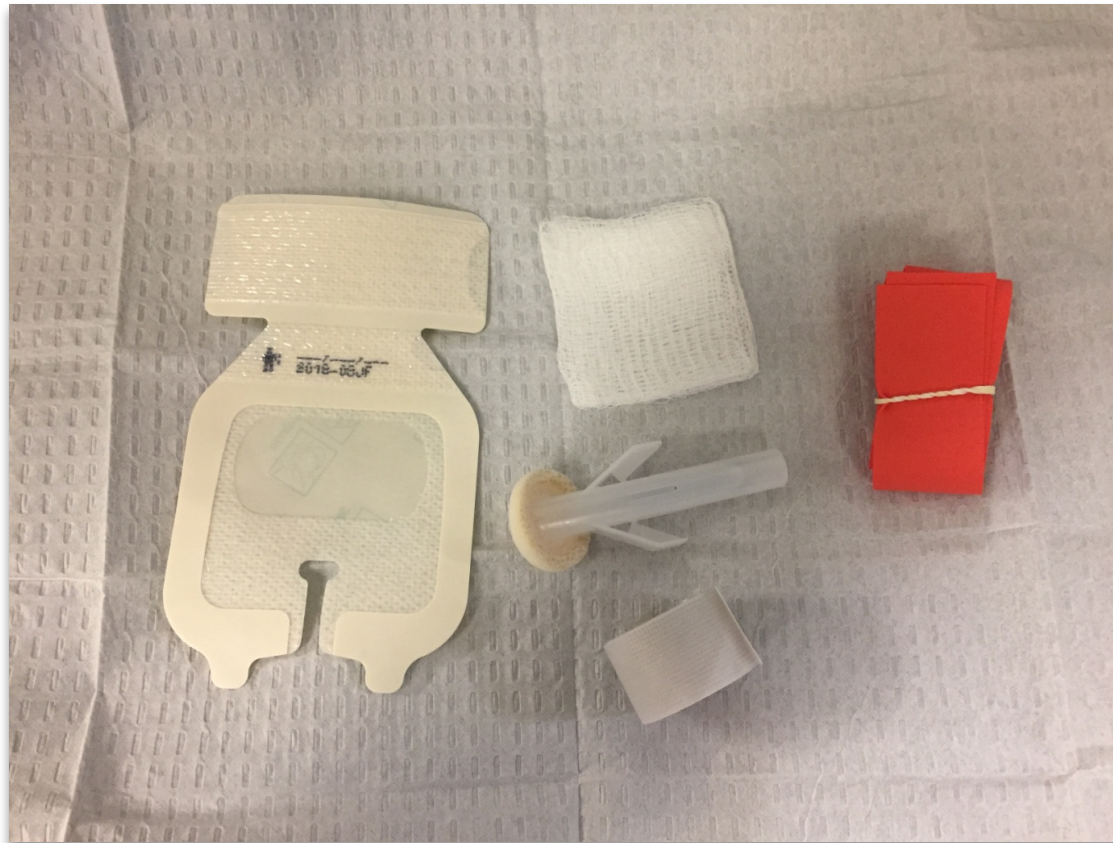
Utility

- “Ultrasonography Guided Peripheral Intravenous Access vs Traditional Approaches in Patients with Difficult Intravenous Access”
 - Patients enrolled after 3 or more missed attempts by Nursing
 - US guided success was 97% vs 33% with further blind attempts
 - US Guided lines took approx 13 minutes, 17 minutes less than subsequent blind attempts
 - On average US Guided lines required 1.7 punctures vs 3.7 in the non US group
 - Patient satisfaction was 8.7 with US vs 5.7 without US. ¹
- US Guided PIVs vs External Jugular Veins shows benefit to US Guided PIVs with a success rate of 89% vs 55% for EJ. ¹
- Infection rates are the same when comparing US guided IVs vs Peripheral IVs without Ultrasound. ³

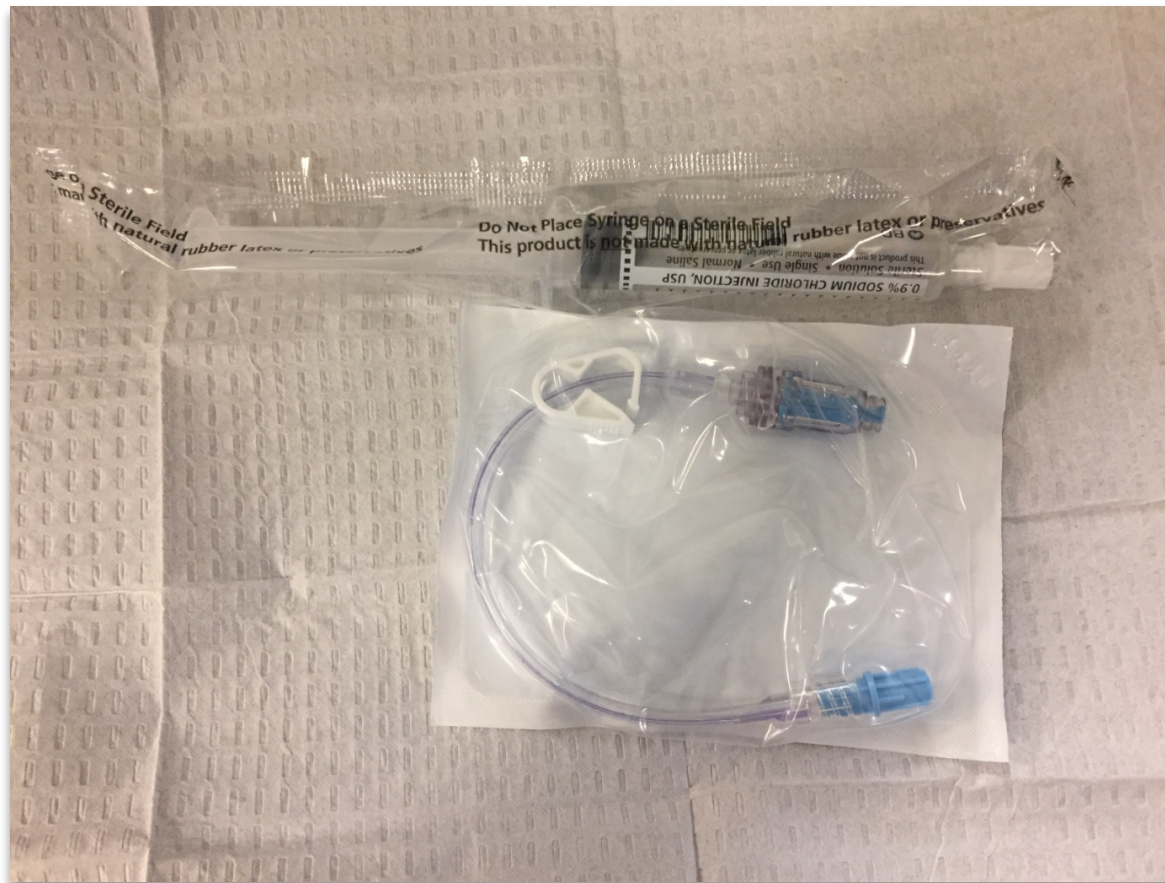
Equipment

- IV Start Kit
 - Tourniquet
 - 2X2
 - Chloroprep
 - Tegaderm Dressing
- 4 X4 Gauze Pack
- Connection Tubing
- 1.88 in Angiocath or Standard
- 10 cc NS Flush

IV Start Kit



Flush and Extension Tubing



Angiocath Components

- Cover
- Catheter
- Needle
- Retraction Device

Angiocatheter



Ultrasound Operation Overview

- Turn On Device
- Confirm Linear Probe is Connected
- Touch “Scan”
- Touch “Transducers and Exams”
- Touch the Linear Probe Icon
- Scroll down and Select “Venous”
- Adjust Depth to 2.0 CM
- Adjust Gain as needed



SCAN

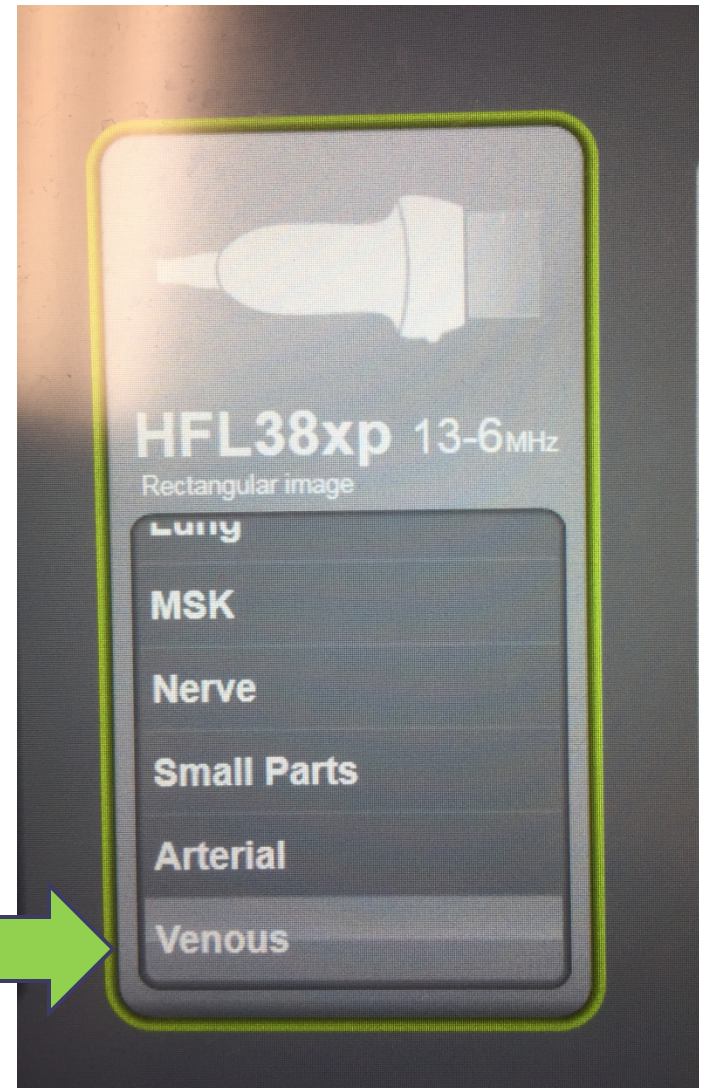
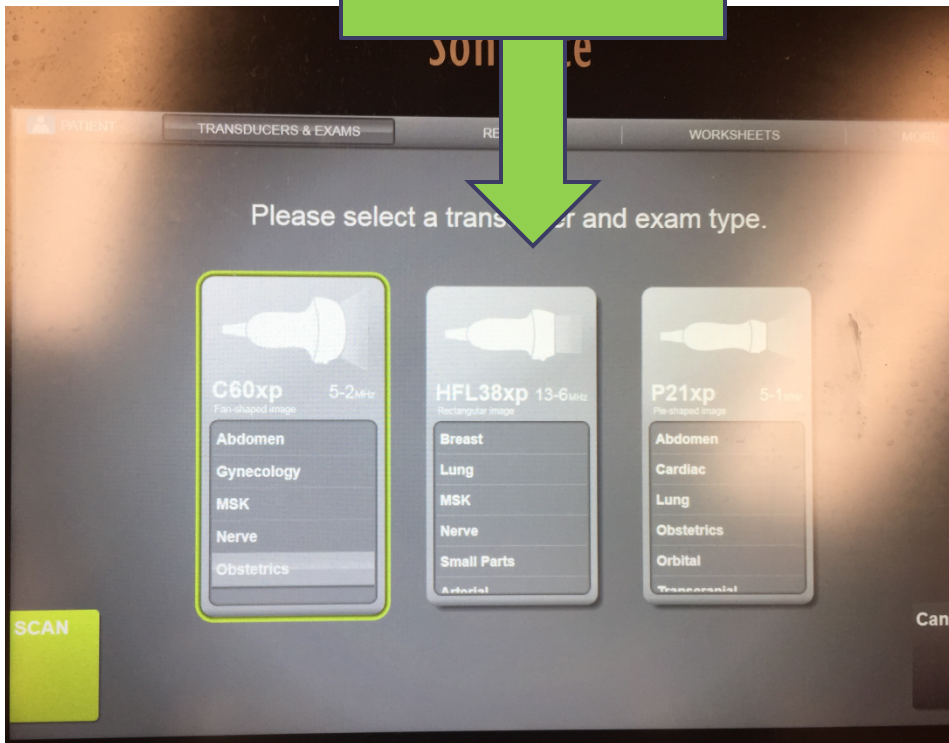
The image shows a Sonosite ultrasound machine with a large monitor displaying a B-mode scan of a vessel. A green box with the word 'SCAN' and a green arrow points to the control panel below the monitor. The control panel features four main buttons: 'SCAN' (green), 'EDIT' (blue), 'PAUSE' (grey), and 'LEARN' (purple).



Transducers and Exams

The image shows a Sonosite ultrasound machine with a large monitor displaying a menu. A green box with the text 'Transducers and Exams' and a green arrow points to the monitor. The monitor displays a menu with various options, including 'D', 'C', and '20'. The control panel below the monitor has a 'FREEZE' button and other controls.

Linear Probe





DEPTH

GAIN

Linear Probe



Probe Marker

Procedure Preparation

- Explain procedure to patient
- Place ultrasound on the cranial side of patients arm while you stand on the caudal side
- An alternative is to place the US at a diagonal position on the opposite side of the patient
- Ensure that no cords will be in your work space
- Place sheet from IV Start Kit on patients bed or on a table next to you, use this to arrange supplies

Patient Positioning

- Raise bed up to your waist level or a position that is comfortable
- Take towels and place under patients arm to keep patient comfortable in full elbow extension
- Attempt to keep arm parallel with the body and not extended down towards the floor
 - I typically have the patient partially rest his or her arm on the Ultrasound Machine itself
- For some patients it is easier to lie head of bed flat rather than sitting up at 90 degrees

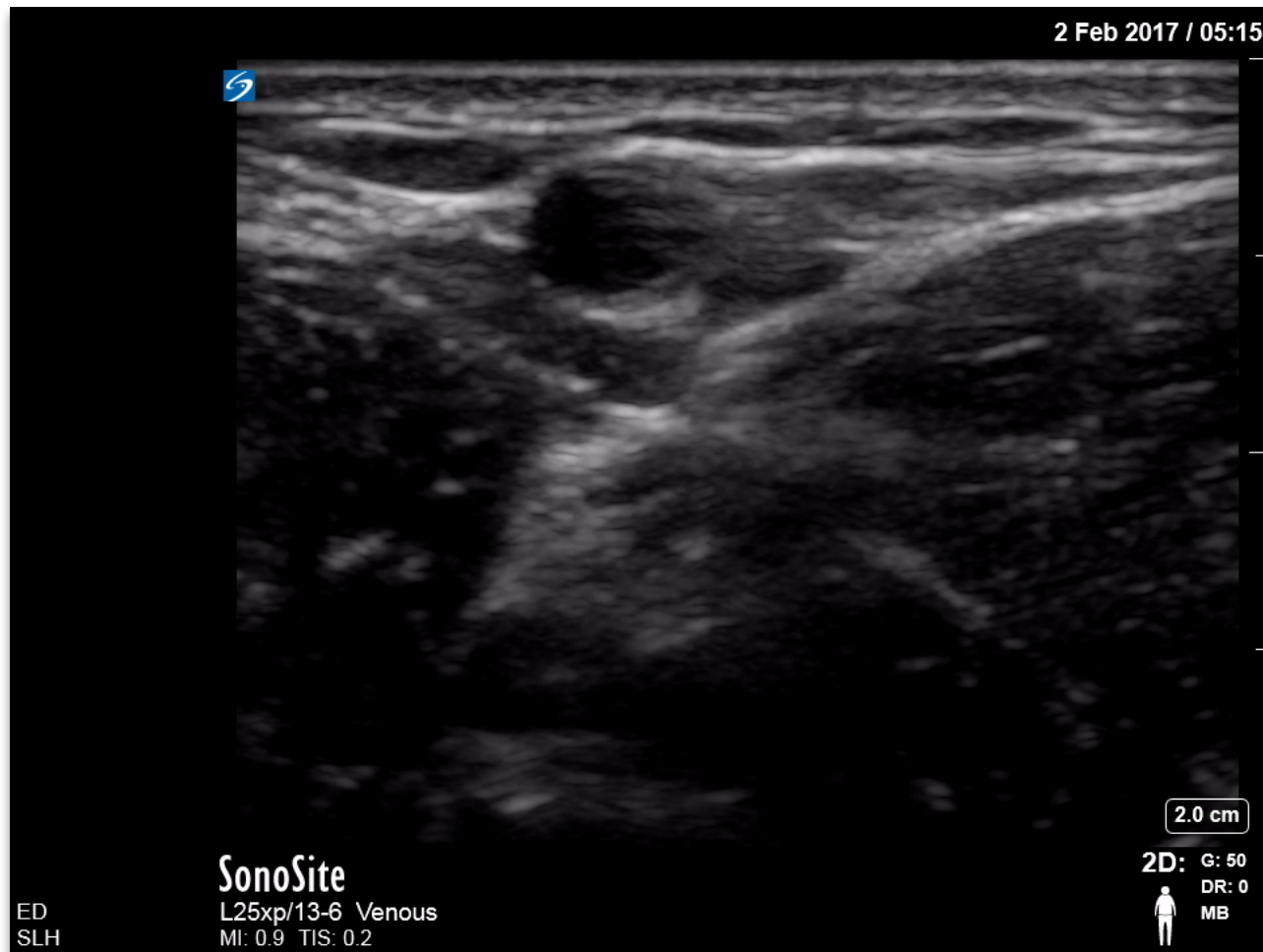
Pre Scanning

- Place the ultrasound on both arms and scan through the antecubital and brachial region
- Look for veins that are large and superficial
- Trace the vein proximally and distally looking for segments that are straight
- Select the arm with the best access
 - Large straight superficial veins
- I typically prescan without a tourniquet placed and only place a tourniquet prior to the procedure or if no “good” veins are apparent on the initial scan

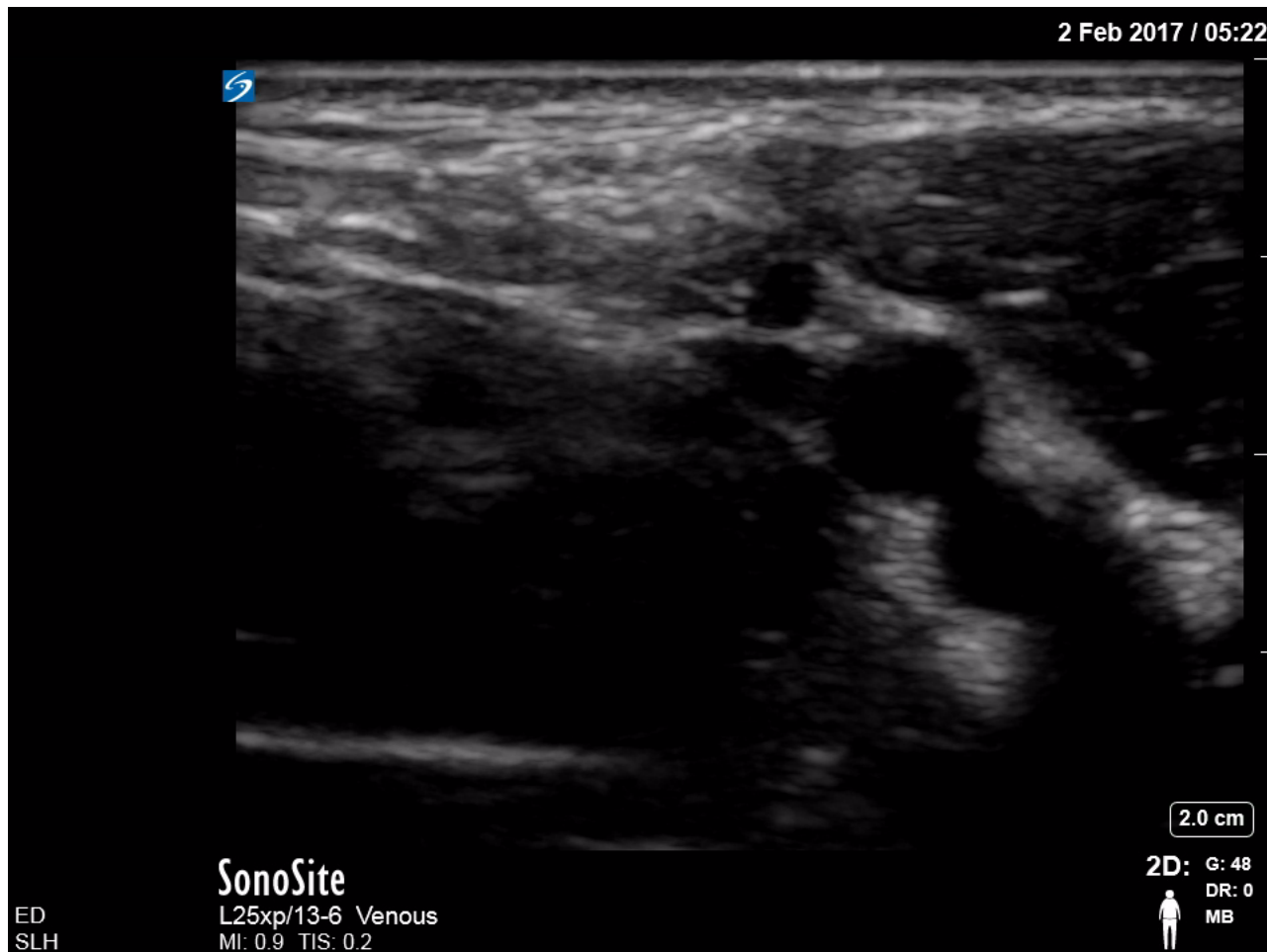
Identifying Key Structures on Ultrasound

- Identify Veins as compressible circular structures without biphasic flow
- Identify Arteries as non compressible pulsatile circular structures with biphasic flow
- Nerves are small structures typically sitting close to arteries that resemble a “cluster of grapes”
- Muscles are large striated appearing structures
- Bone is dense and bright white when seen on ultrasound

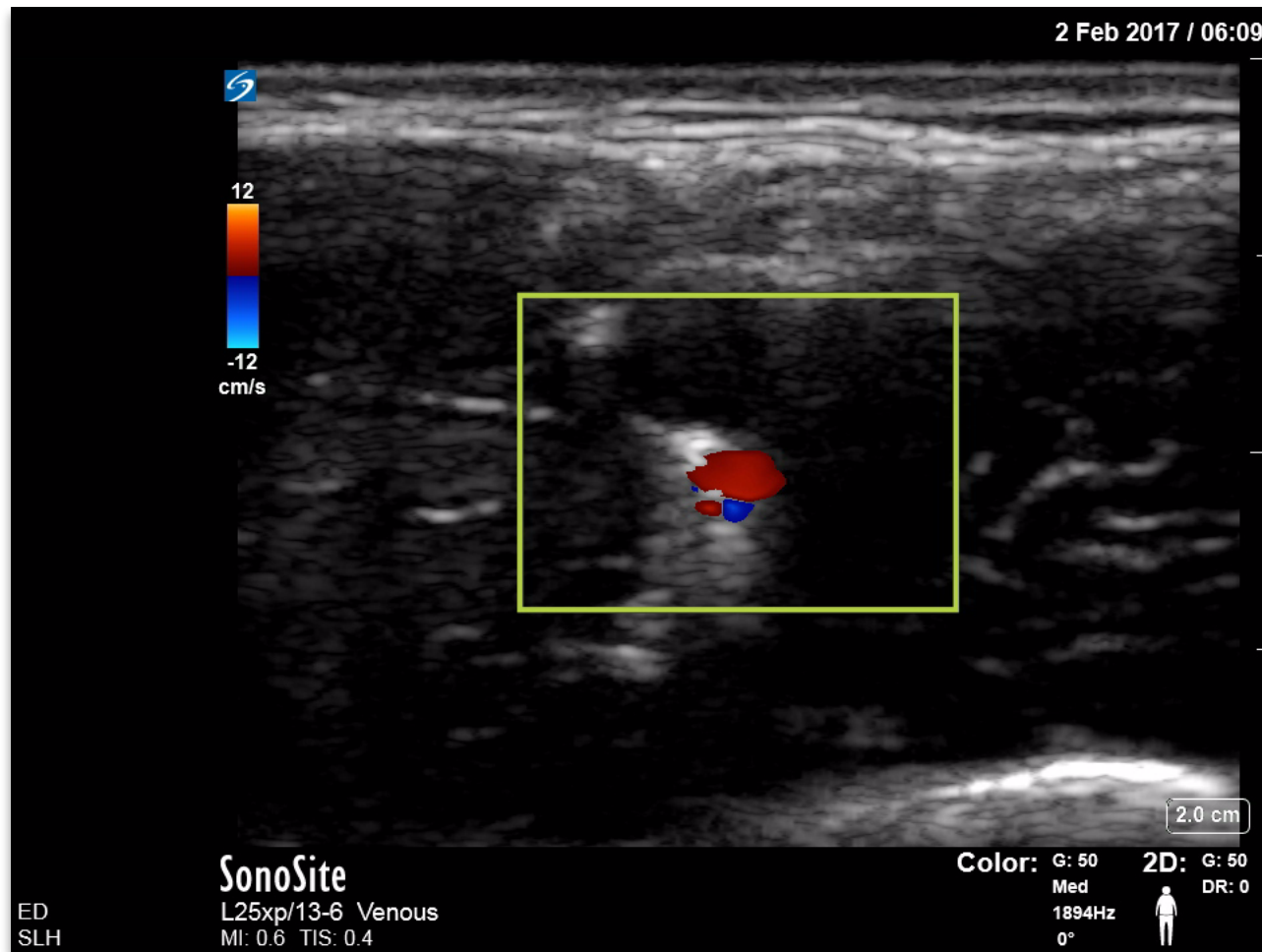
Median Antecubital Vein



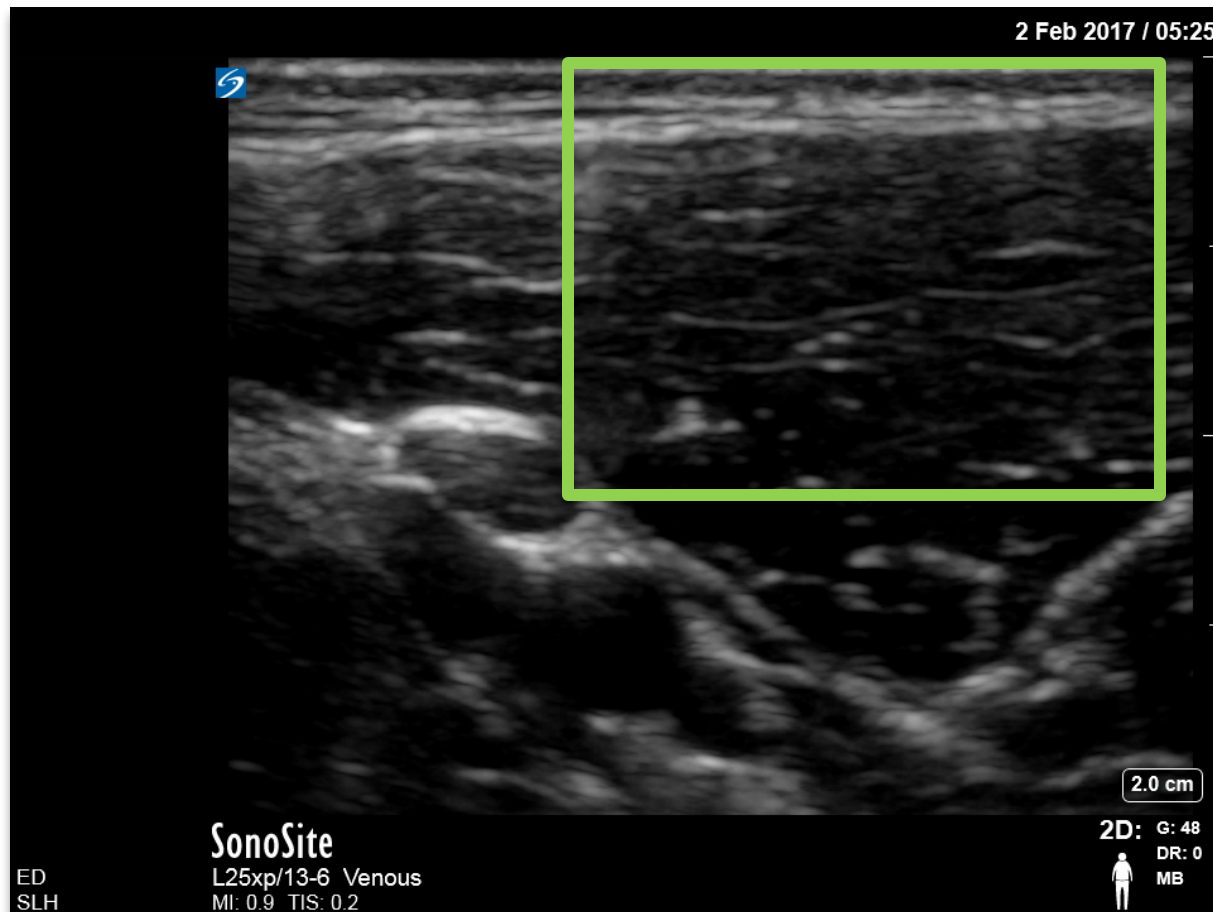
Brachial Artery



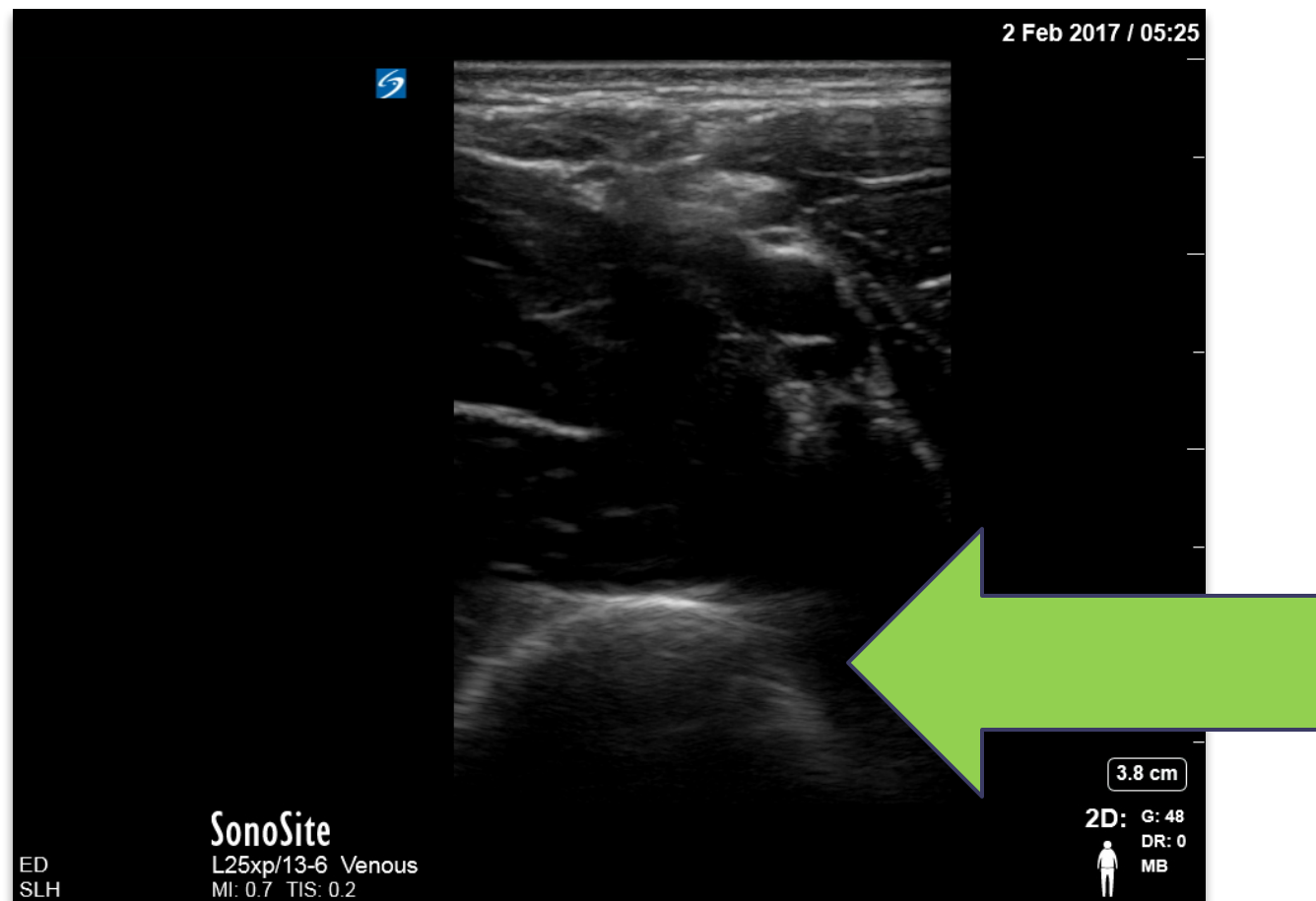
Artery Color Flow



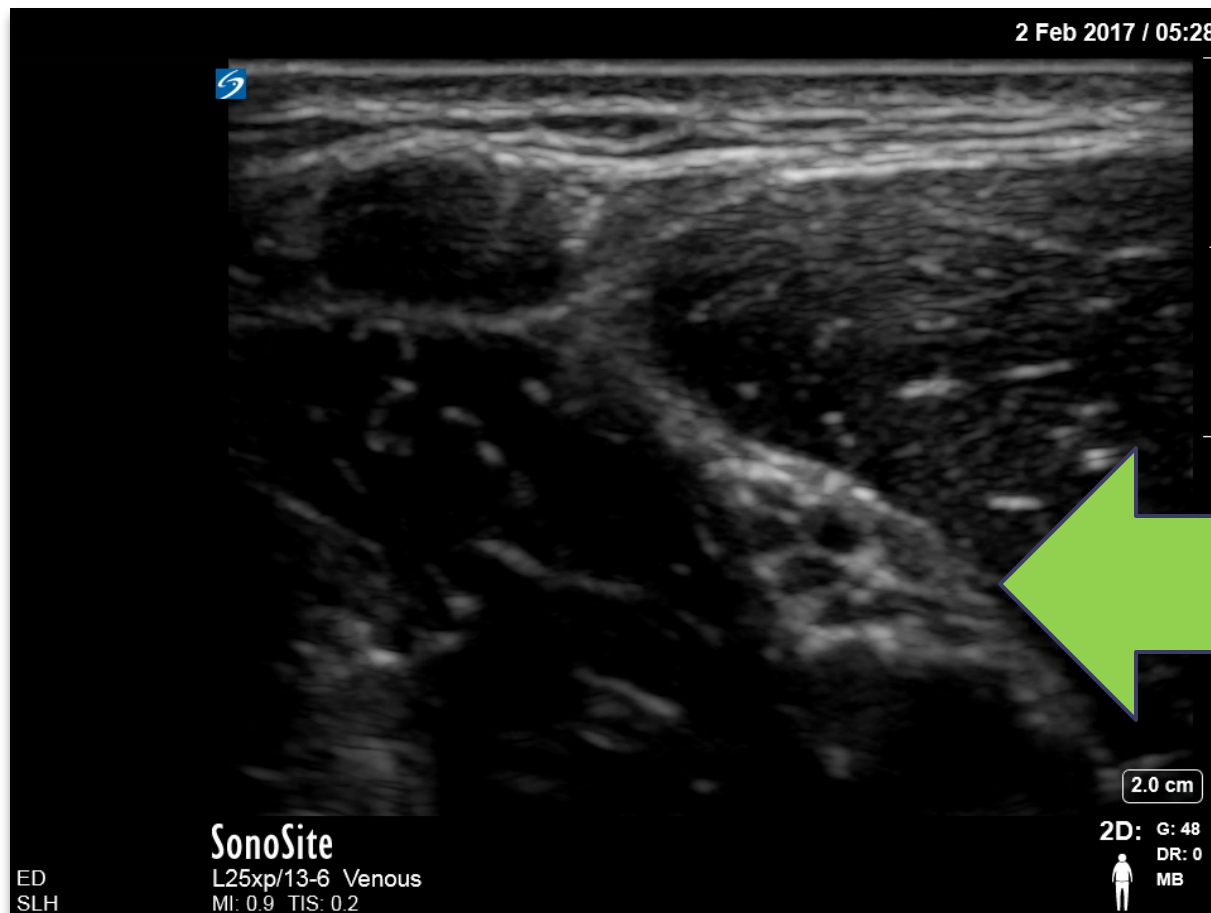
Muscle



Bone



Nerve



Patient Characteristics That Dictate Site Selection

- **Obese patients** are very difficult to cannulate in the brachial region, typically the AC or medial aspect of the elbow are good sites for finding a vein in these patients
- **IVDU** are frequently lean however have “scarred up” many of the veins surrounding the AC region. The best approach is to look for a basilic or brachial vein as these veins are rarely used by IVDU
- **Dialysis patients** are limb restricted, the brachial and basilic veins are typically used for AV fistulas, if possible avoid these veins to preserve them for future use

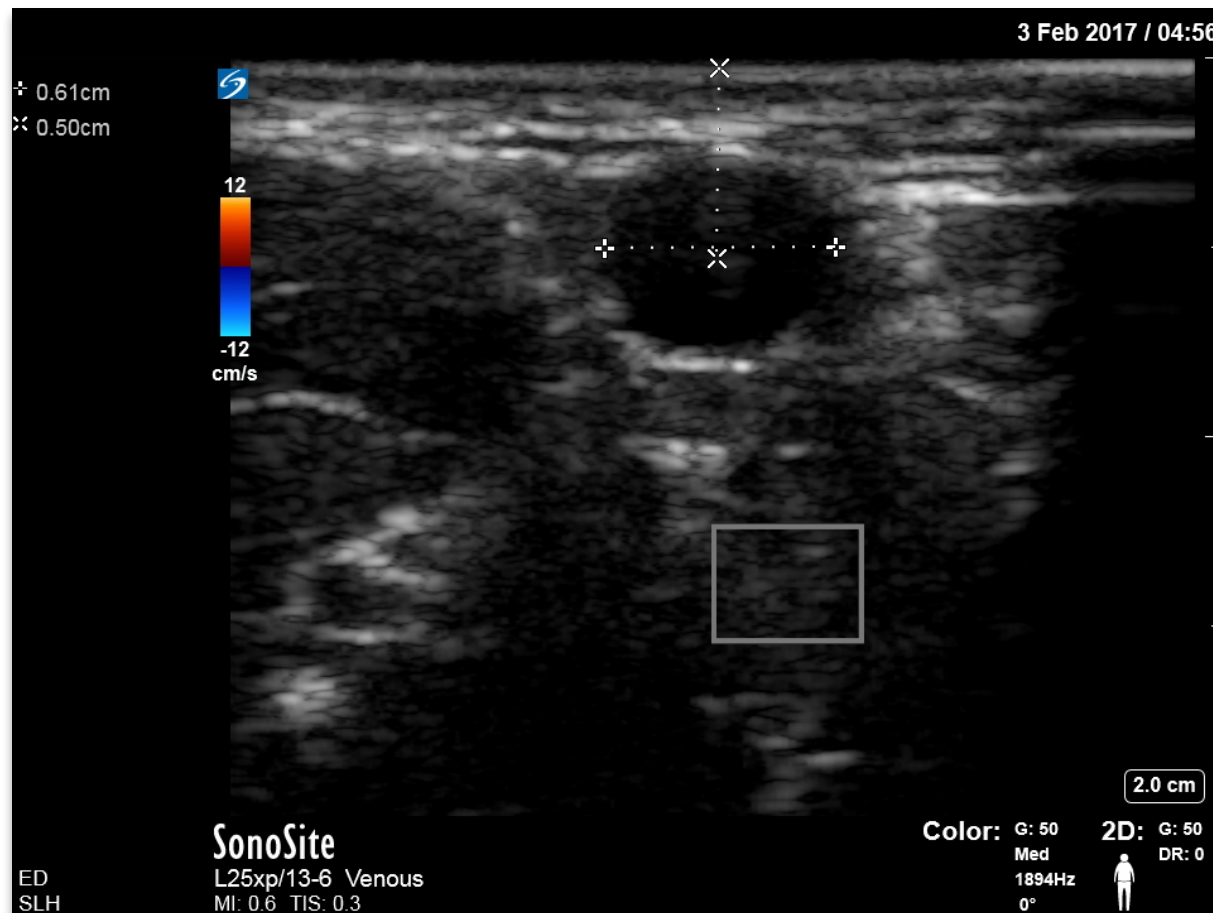
Goals of Care That Dictate Site Selection

- Remember patients requiring a **CTA** will need an IV at the AC or higher. CT Techs typically do not like to use basilic veins for CTAs as they tend to infiltrate more frequently
- Basilic and Brachial veins are great in the **septic or dehydrated patient**. Most distal veins are small and collapsed but mid line veins are usually easily accessible and are ideal for volume resuscitation.
- There is increasing research to support **peripheral vasopressor** use. Most guidelines include a large vein at the AC or higher. The greatest risk is infiltration.
 - Select the largest most superficial vein, the key is to use a long angiocatheter to maximize the amount of catheter in the vein
 - Repeat US every 30 minutes to confirm catheter is in vein while vasopressors are infusing

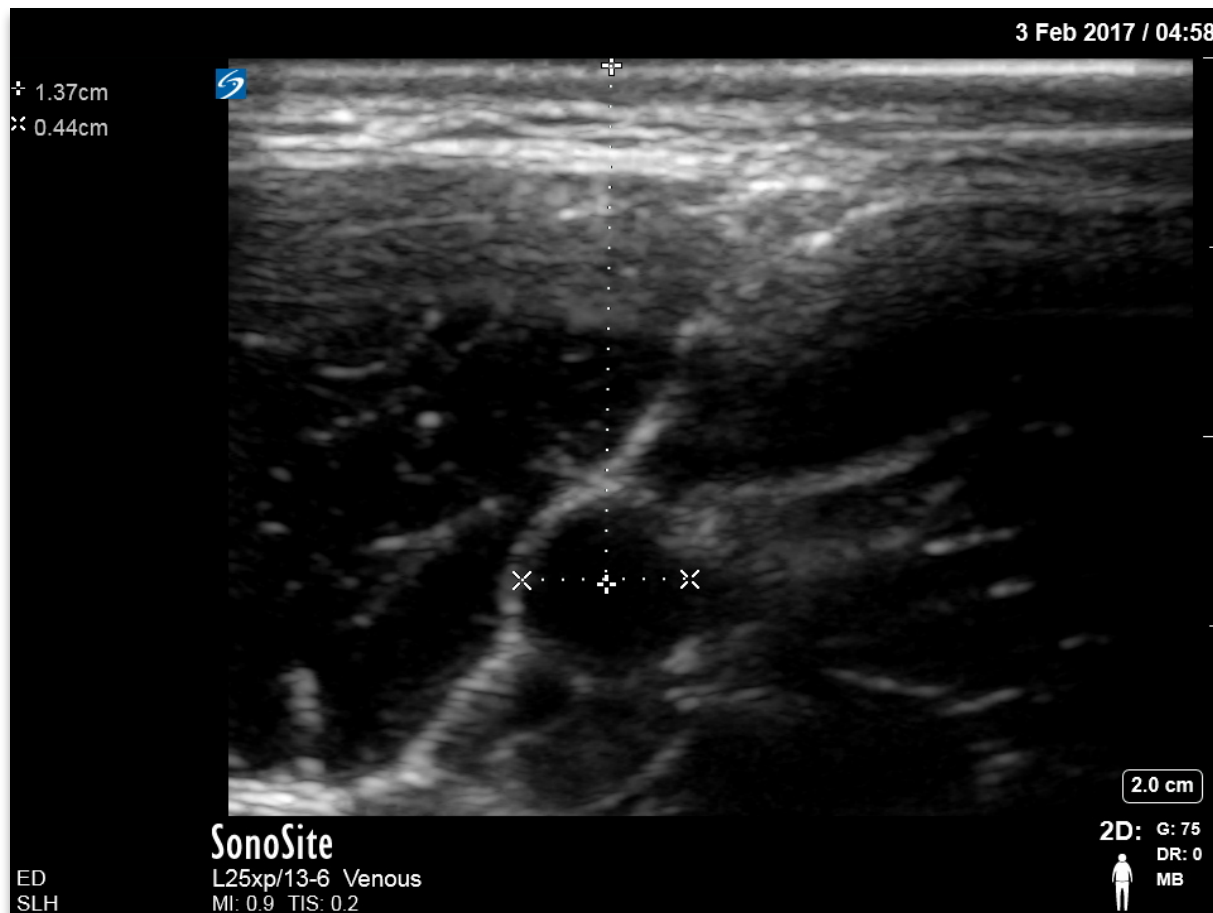
Selecting a “Good” Vein

- In a study of 169 patients there was a **0% success rate** on veins **deeper than 1.6 cm**
 - **Careful about applying too much pressure with the US probe as compression of soft tissue will give you an inaccurate depth**
- There is no real correlation between success rates < 1.6cm but in this study ranged from 60-80%
- Vein diameters of < 0.3 cm have a success rate was 56%
- Vein diameters of **>0.6 cm** have a much higher success rate at **92%**.⁵
- After 48 hours 32% of US Guided veins failed prematurely
- Survival probability was perfect for veins < 0.4 cm , intermediate for vessels 0.4 to 1.19 cm and poor for deep vessels > 1.2 cm
- IV survival was higher when placed in the antecubital or forearm vs lower brachial region.
- Vessel diameter did not effect longevity.⁷

Superficial



Deep



Veins to Avoid

- Avoid veins that are too deep or too small as discussed in the previous slide
- Avoid veins with a serpentine pattern or that take sharp angles
- Avoid veins with close proximity to arteries if patient is coagulopathy or if you are new to US Guided IVs
- Select an angle and approach that avoids penetrating muscle to cannulate the vein

3 Feb 2017 / 04:37



12
-12
cm/s



2.0 cm

SonoSite
L25xp/13-6 Venous
MI: 0.6 TIS: 0.3

Color: G: 50
Med
1894Hz
0°

2D: G: 50
DR: 0

ED
SLH



3 Feb 2017 / 04:38



12
-12
cm/s



2.0 cm

SonoSite
L25xp/13-6 Venous
MI: 0.6 TIS: 0.3

Color: G: 50 Med 1894Hz 0°
2D: G: 50 DR: 0

ED
SLH



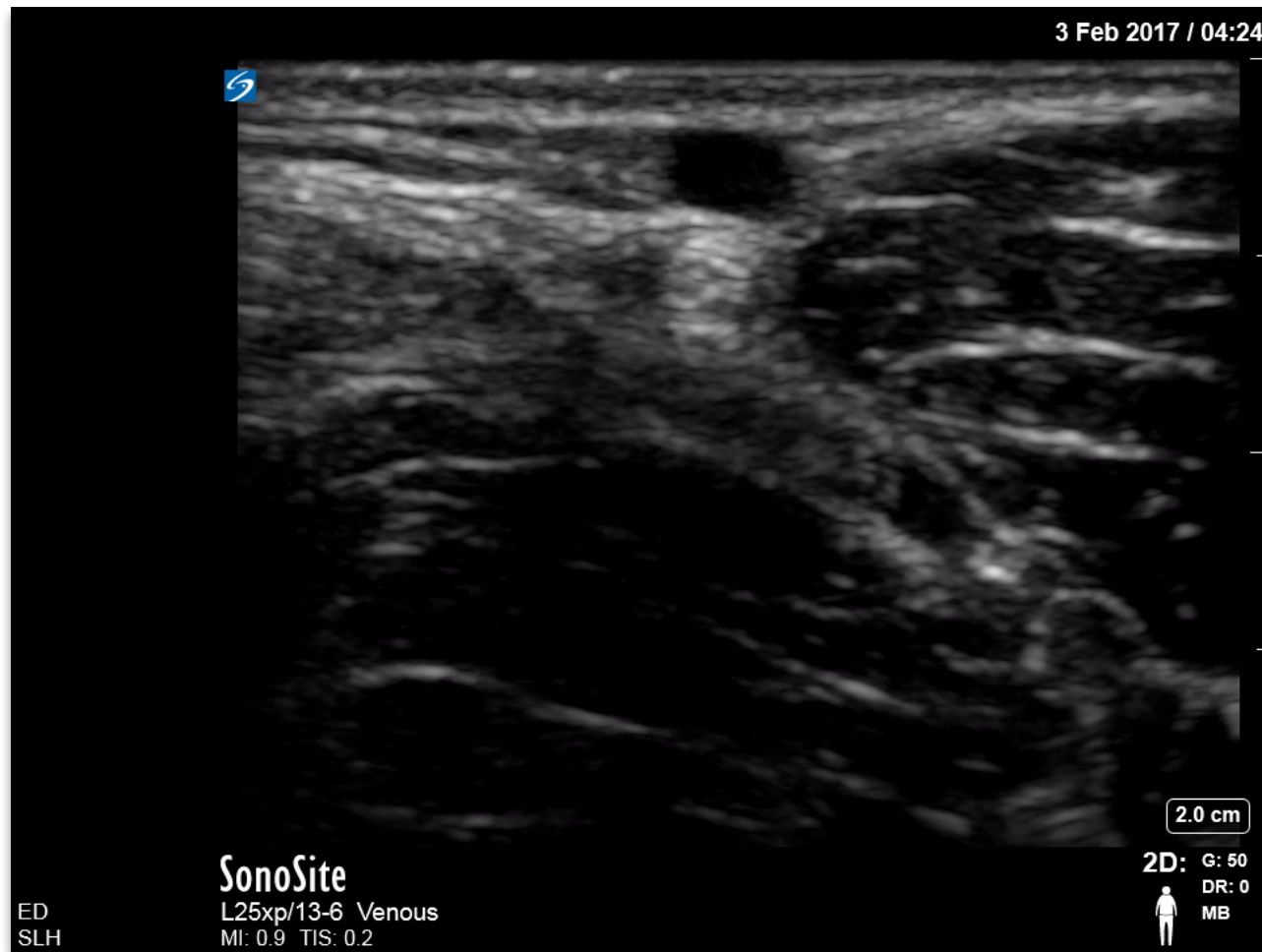
Selecting The Appropriate Angiocath

- Long Angiocaths are associated with a lower failure rate than short angiocaths, 45% vs. 14%. ²
- In some cases short angiocaths are beneficial in superficial veins or in veins that only have a short segment that runs in a straight path
- In general longer angiocaths are more stable because more catheter is able to enter the vein and the likelihood it will infiltrate is lower

General Approach

- Align the ultrasound probe over the vein, make note of the center mark on the probe
- The small round bump on the lateral aspect of the probe corresponds to the an indicator on the top left aspect of the screen
 - Keep the probe oriented correctly by confirming the probe marker always is facing left
- Compress the vein to make sure it fully collapses and is not pulsatile
 - In volume depleted patients arteries will collapse too BUT you will see the vessel pulse while collapsed
- If uncertain place “Color flow” on the vessel to assess velocity
- Once vein is aligned in the middle of the screen trace the vein proximally and distally, select the largest most superficial section

Trace Vein



Continued...

- Also confirm that the veins path is straight
- Be aware of the vein path, the needle will need to follow this path
- A general “rule of thumb” is to start your needle about as far away from your probe as your vessel is deep
- Follow the needle tip down with the ultrasound probe and watch it penetrate the vessel wall
- Look for “flash” in the angiocath

Sterilize

- Once you have identified the site at which you will start your IV hold the ultrasound probe still
- Use a chlorhexidine prep to clean the area distal to the ultrasound probe where your needle will enter the skin
- Alternatively you can do the whole procedure under sterile technique using a probe cover, sterile gloves, sterile ultrasound gel, and a chlorhexidine prep
 - If you need to obtain blood cultures this is how you will need to perform the procedure

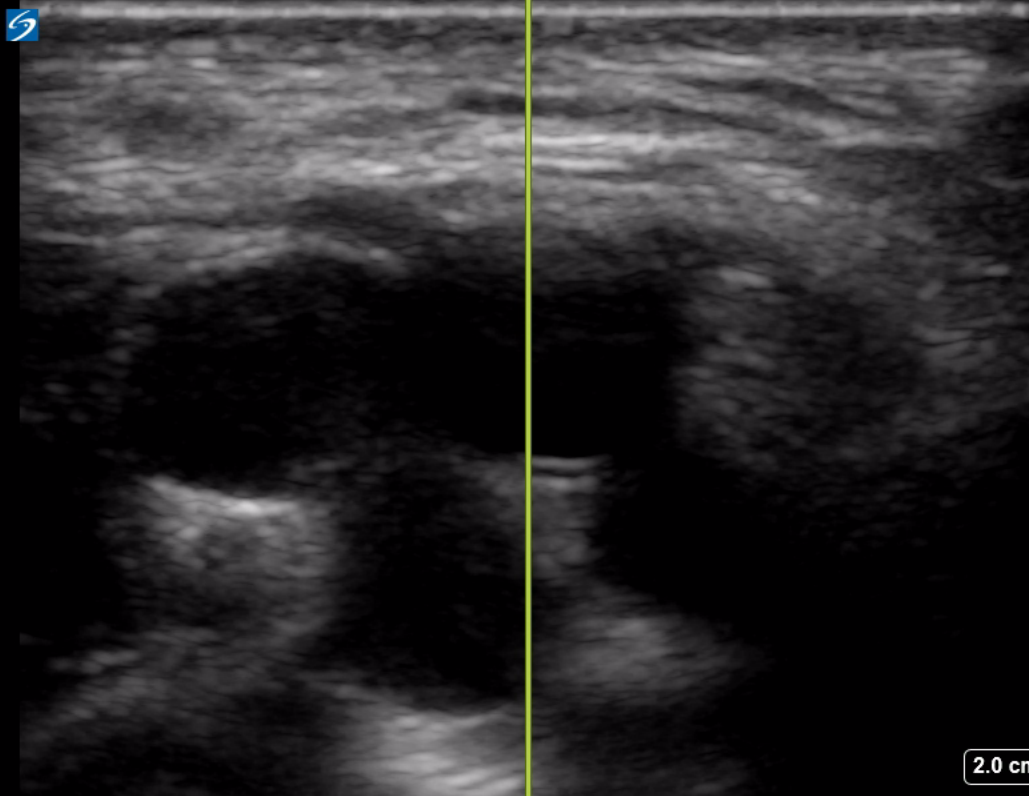
Approach for Antecubital and Superficial Veins

- The antecubital region is home to two veins and one artery
- The cephalic vein comes down the anterior part of the arm through the antecubital region
- The basilic vein originates in the medial brachial region and branches at the medial elbow into the median cubital vein which then runs anterior
- The brachial artery will be in the center of the antecubital fossa

Continued...

- The Cephalic vein is good for blood draws and small volume resuscitation but is prone to infiltration especially when contrast is introduced at high velocity
- The median cubital and basilic veins should be your targets in this region
- The median cubital tends to be superficial and therefore needle tip can be started fairly close to the ultrasound probe
- Your angle with the skin should be approx 20 degrees since your depth of penetration will not be over 1 cm in this region

13 Mar 2017 / 23:58



2.0 cm

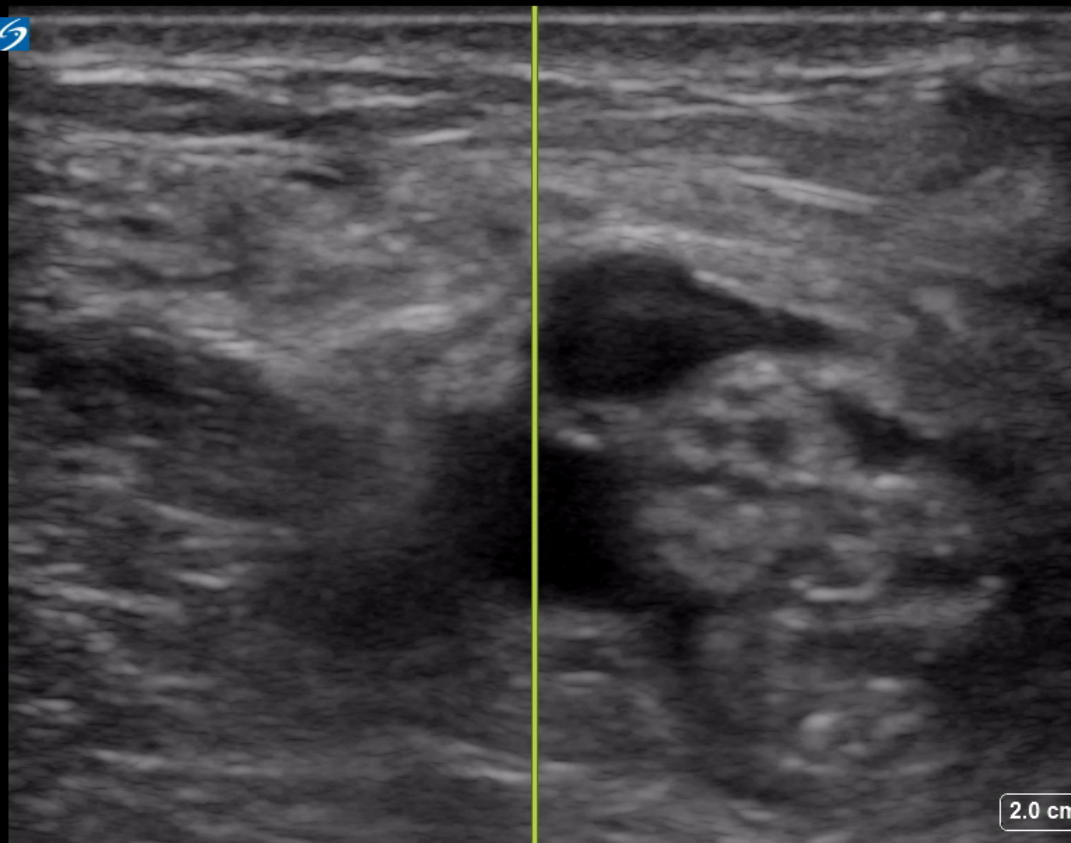
SonoSite

L25xp/13-6 Venous
MI: 0.9 TIS: 0.2

2D: G: 59
DR: 0
MB

ED
SLH

15 Mar 2017 / 22:17



2.0 cm

SonoSite

L25xp/13-6 Superficial
MI: 0.9 TIS: 0.2

ED
SLH

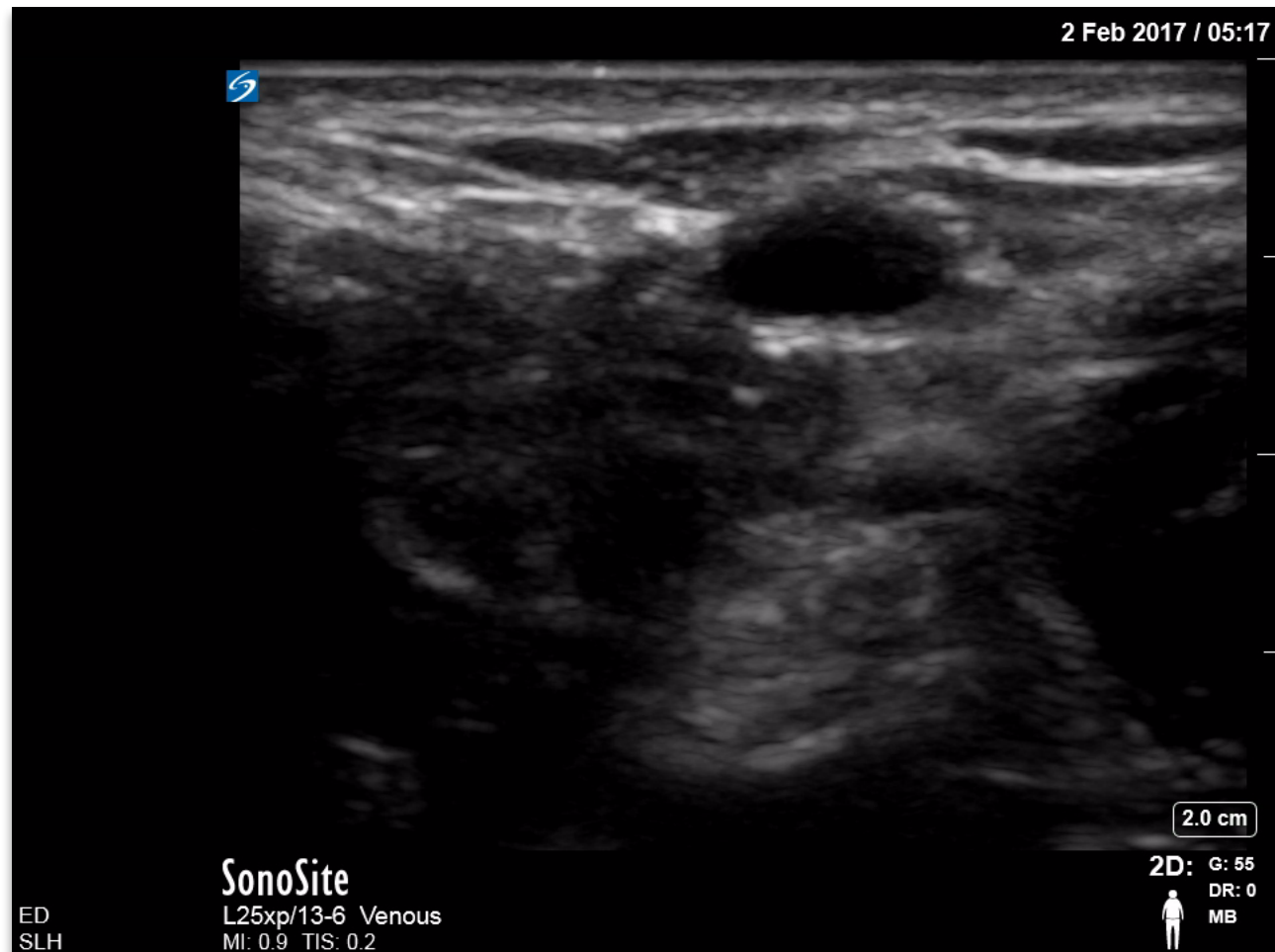
2D: G: 50
DR: 0
MB

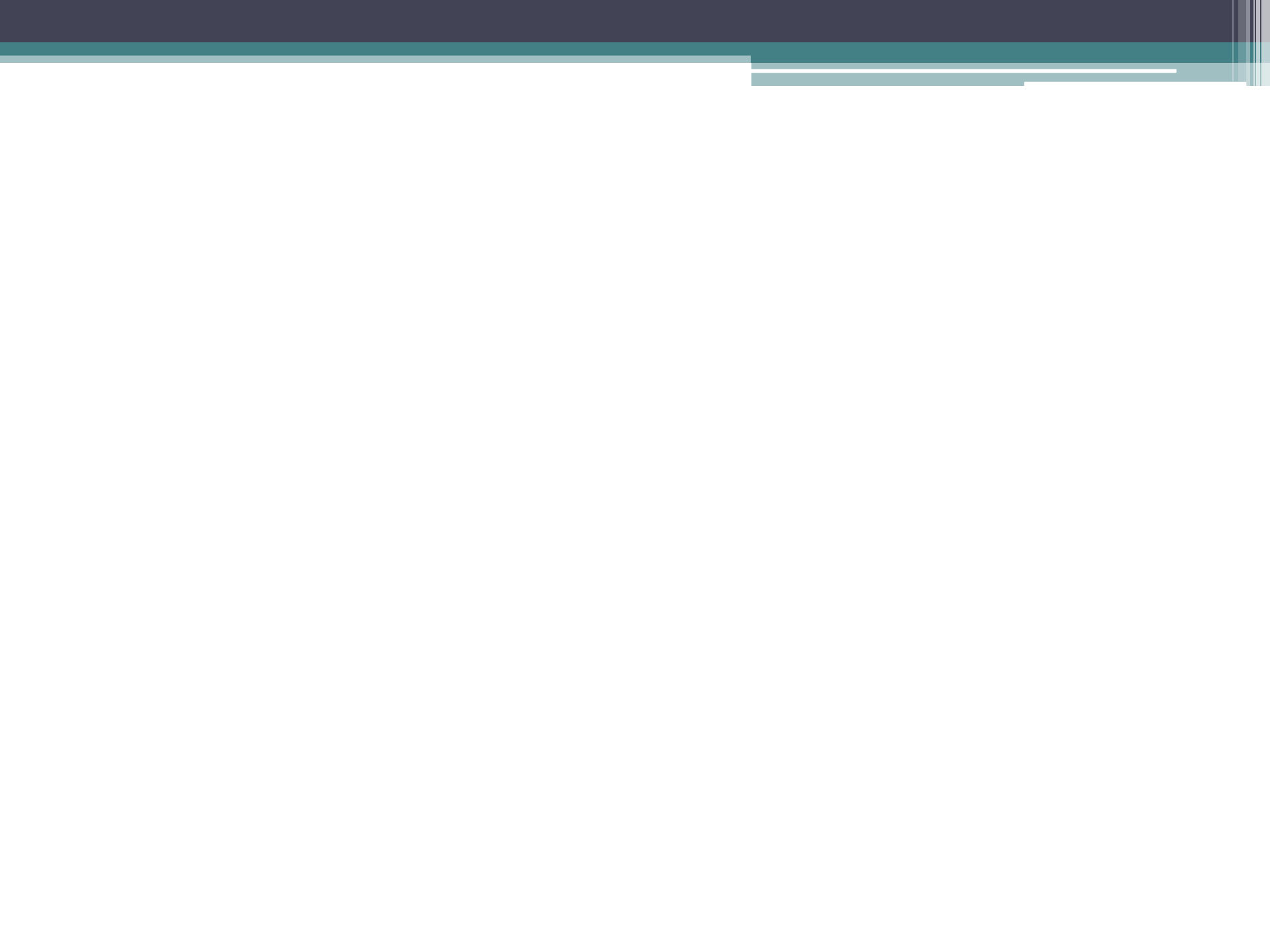


Tips

- Make sure to trace your veins proximally and distally in this region, there are numerous branch points and you do not want to attempt to thread a catheter in a vein that will take a sharp angle
- A good site in this region is the distal aspect of the basilic vein prior to branching into the median cubital vein
 - This vein tends to run fairly superficial and tends to be of good size
- IV lines in the antecubital region are bothersome to patients because it effects their ability to flex the arm. If possible place the line just distal or just proximal to the flexor crease of the elbow to allow for increased patient comfort.

Distal Basilic Vein



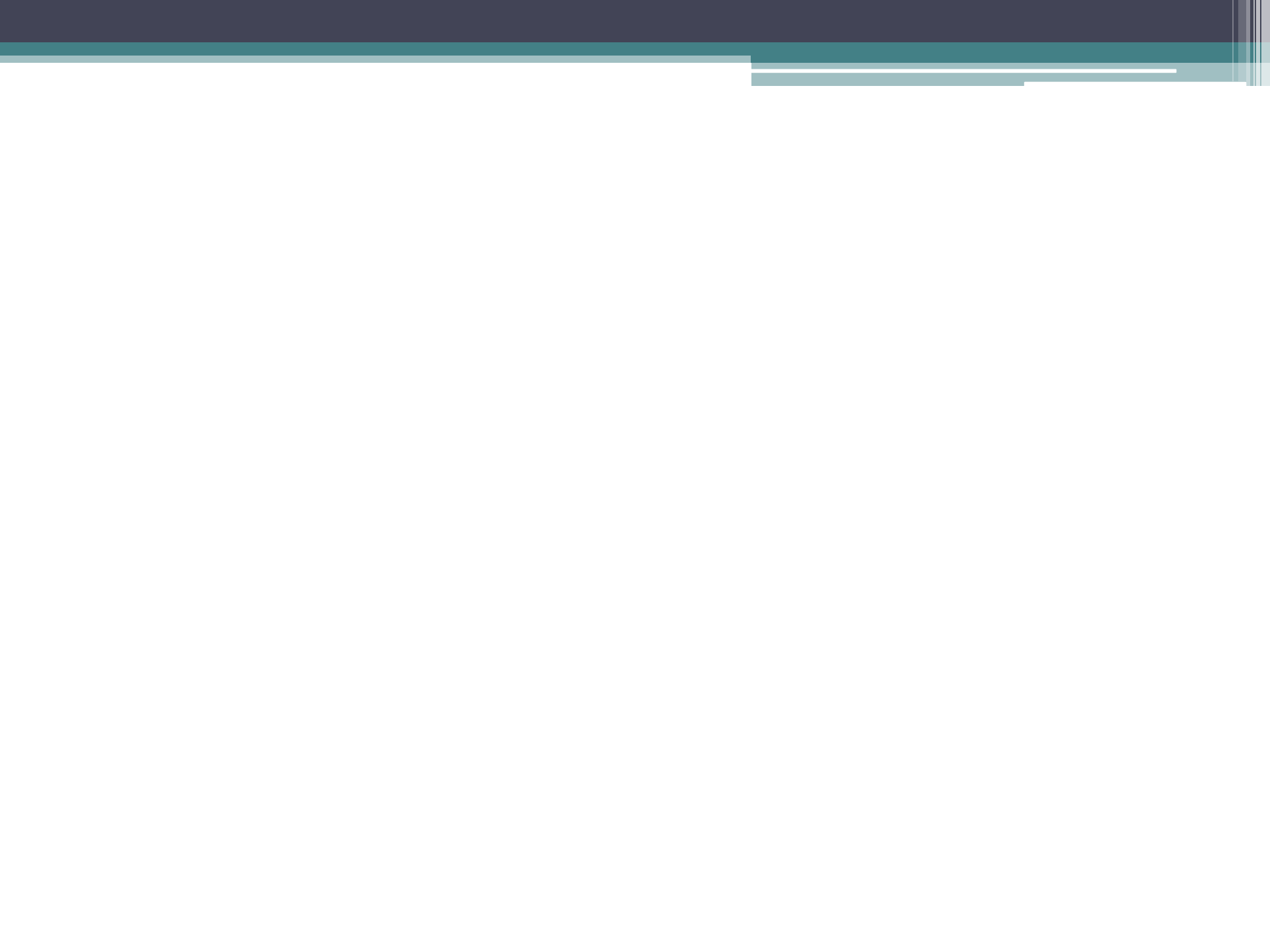


Approach for Basilic and Brachial Veins

- Success rates in this region are 91%, 73 % on first attempt in a study on 100 patients
- The line infiltrated within 1 hour in 8% of patients
- 2% of patients had a brachial artery puncture. ⁶

Continued...

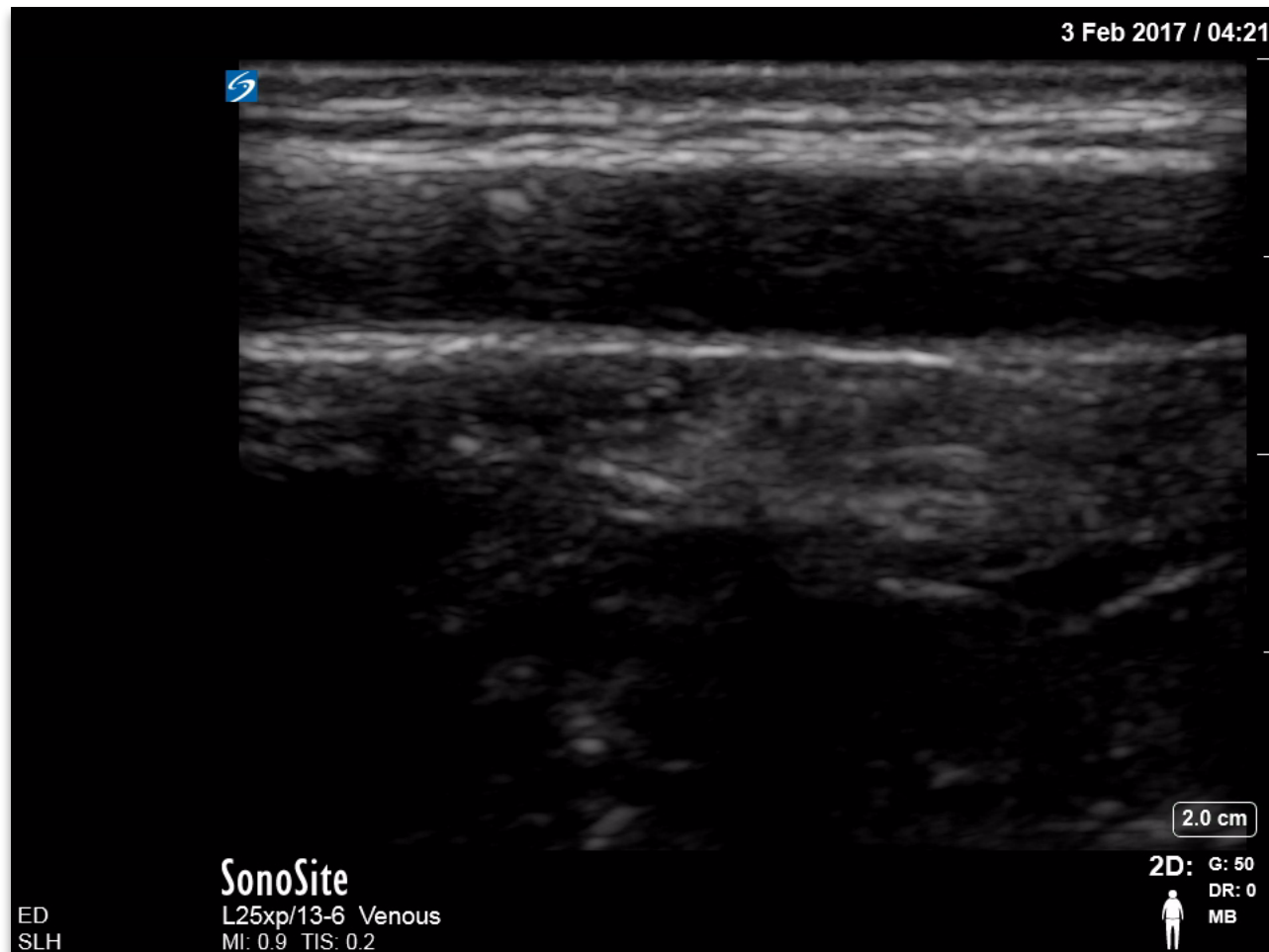
- Basilic and Brachial veins are commonly deeper however on lean patients they can be surprisingly superficial and very easy to access
- Be aware that the brachial artery lies close to these veins and at times can twist over them leading you to believe you are cannulating a vein when in fact it is now the artery
- Remember deep veins require the needle enter the skin further from the vessel target
- Be aware of the depth, anything deeper than 1.6 cm has a low chance of success
- Unless you are able to find a superficial lying basilic veins these veins are not ideal for high velocity contrast used in a CTA
- Infiltration in this region is more dangerous as it is typically deeper and closer to a larger artery
- However these lines are more comfortable for the patient once placed and great for volume resuscitation



Short vs Long Access Views

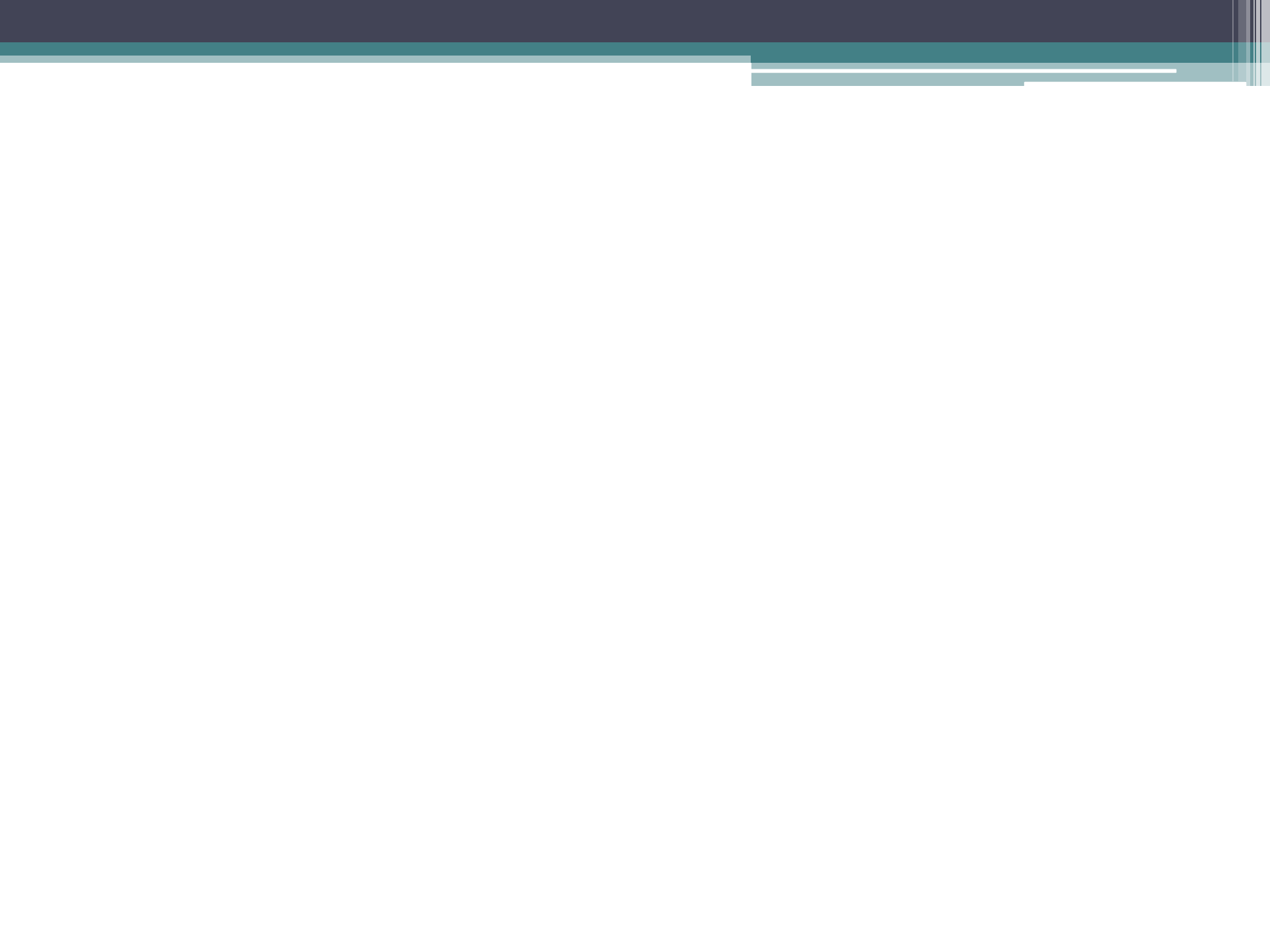
- In a study looking at 40 patients short axis showed a success rate of 95% compared to 85% in the long access approach
- All missed long access approaches were rescued by the short axis approach
- Average number of needle sticks was 1.5 ⁴
- Some providers will use short axis up until the point the needle penetrates the vessel then switch to long axis to confirm needle tip is in the center of the vessel walls

Long Access View



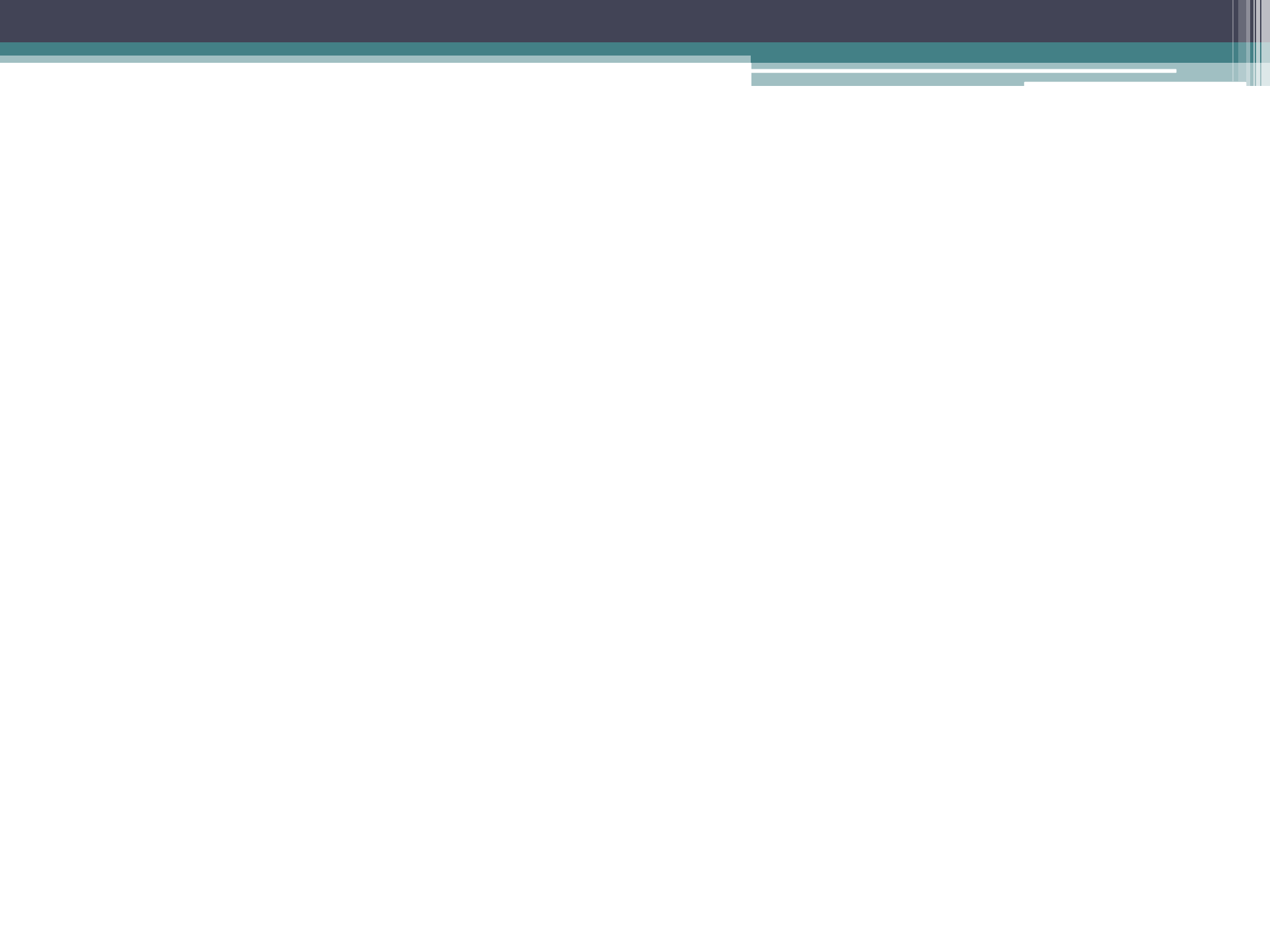
Confirmation

- It is important to confirm needle tip is within vein prior to advancing
- If you have “back walled” the vein or the needle is outside of the vein advancing the catheter will either not be possible or end up outside of the vessel walls
- Confirmation can be done by scanning proximally until you see the reverberation artifact of the needle tip and confirm its position



Cannulation

- Once confirmed hold needle still and advance catheter only
- It is important that the needle is directed in the same path as the vein, if not you may run into resistance as the catheter hits the vessel wall either puncturing it or kinking the catheter
- Once the catheter is in vein press the retraction button to withdraw needle
- Blood will start to come from catheter, connect extension tubing to the catheter
- Hold the line within vessel
- Clean US Jelly
- Apply Tegaderm



Pull THEN Flush Line

- It is important to first “pull” off blood by retracting the plunger on the syringe and then “flush” the saline into the line
 - Nursing will do the opposite when starting lines
- We want a line that both pulls and flushes
- If you flush saline into an infiltrated line your view on the US screen for subsequent attempts is ruined!
- If your line does not pull blood, remove it and try again, DO NOT attempt to flush it

Trouble Shooting

A series of horizontal lines in teal and light blue colors, some solid and some dashed, extending across the bottom of the slide.

Can't Find A Vein

- First see that your tourniquet is tight enough and in a good position
- Check and make sure the patients arm is parallel with the body and not pointed to the floor
- Find an artery, typically veins will run close to the arteries
- Make sure you are not applying too much pressure with the US probe as you are scanning, you can easily collapse superficial veins with slight pressure

Missing Vein With Needle

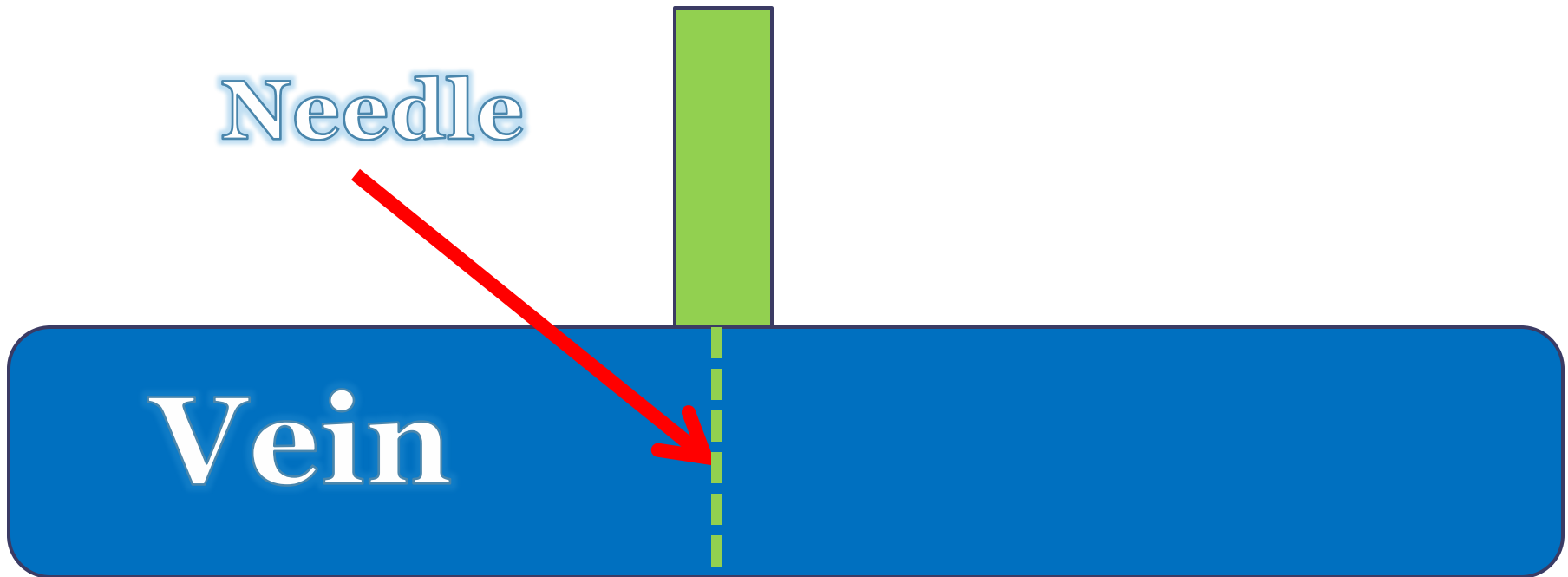
- This occurs commonly when first using US to establish an IV
- It is tricky but you have to follow the needle tip down into the vessel, lose the needle tip and you will miss the vein!
- Make small up and down micro-movements with the needle to get a better idea of its path and where it is located on the screen
- Check to make sure you are introducing your needle to the skin inline with the center mark on your probe and directing the needle in the path of the vein
- Make sure to keep the vein in the middle of your US screen, do not allow it to drift off to one side
- Lastly a final possibility is that you have chosen a vein that is too small or too deep! Accept defeat and find a better vein.

Ideal Position

Ultrasound Probe

Needle

Vein

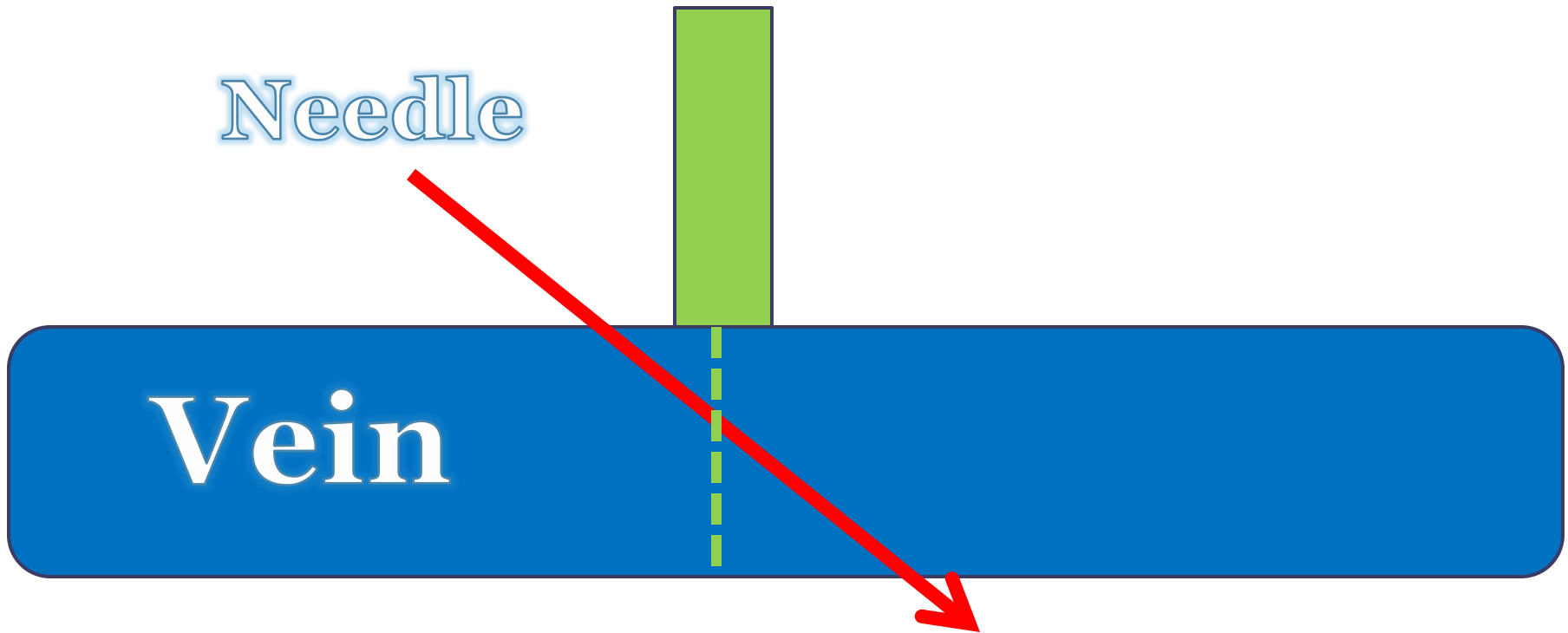


Missed IV

Ultrasound Probe

Needle

Vein

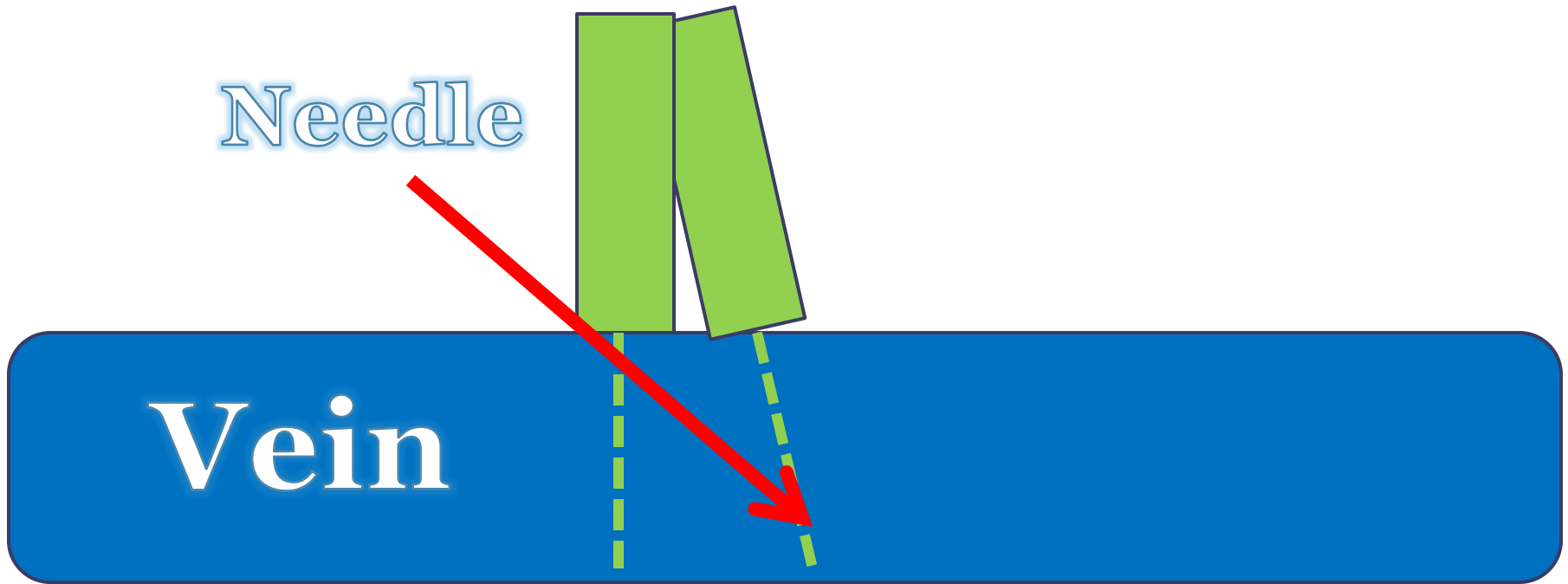


Correction

Ultrasound Probe

Needle

Vein



Cannula Will Not Advance

- This is a frustrating problem
- Commonly this is because the needle tip has pulled out of the vein or has penetrated through it
- Another possibility is that the catheter tip cannot pass around a sharp turn in the vein or that angle at which you approach the vein is too steep
 - Be sure to trace your veins!
 - Approach veins at a reasonable angle between 20-30 degrees

Flash Without Blood Return

- Obtaining a flash and then threading the catheter only to find out you are not in the vein is again very frustrating
- This is the purpose of confirming needle tip within vein prior to advancing
- Remember you will get a flash once you come into contact with the vein but your eyes may be on the US screen at this time and not notice the flash
- Use to the US to your benefit, do not rely on the “flash” to confirm you are in a vein

IV Infiltrated

- IVs will infiltrate for many reasons, some we cannot prevent
- Careful not to place a line through a muscle because once the patient moves that muscle it will pull out the line
- Be aware of how much catheter is actually in the vein, if only 10% of the catheter is in the vein any movement by the patient will pull that catheter out!
 - For this reason deep veins infiltrate more commonly
 - Your goal is for 40-50% of the catheter to be within the vein
- Contrast dye pushed at high velocity will frequently pull catheters out of veins or “blow” superficial veins
 - Place contrast IVs in large superficial veins that become rapidly larger as they move more proximal into systemic circulation
- Once a line has infiltrated you should avoid placing a subsequent line in that arm, if you have no option you must place a line proximal to where the IV infiltrated

Accidentally Cannulated an Artery

- Arterial sticks do happen, be sure to confirm vessel compresses, has no pulsatile action and has low velocity flow
 - Also know your anatomy! Know where to expect an artery to be located.
- If you notice a bright red flash you are likely in an artery, stop advancing, remove the needle and catheter and apply pressure
- If you have advanced the catheter already, stop, connect the extension tubing and have nursing draw blood work. Once blood has been drawn, pull the line and again hold pressure
- Know if a patient is coagulopathy prior to attempting an IV in close proximity to an artery
- Once you have applied pressure for ten minutes release and check back frequently for a hematoma formation
- Document good distal pulses
- Repeat attempts should be done away from the site of arterial puncture

Documenting in EPIC

A series of horizontal lines in teal and light blue colors, some solid and some dashed, extending across the width of the slide below the title.

VASCULAR ACCESS ULTRASOUND NOTE

INDICATION: PA expertise required for vascular access/blood draw, nursing unable to obtain access due to difficult anatomy complicating venous cannulation, access required for medication admin and lab work; all imperative in patient care during todays visit

EXAM TYPE: Peripheral IV Access with ultrasound guidance using linear high frequency probe

PROCEDURE: Vein identified using the high frequency linear probe, area marked with skin marker, area then sterilized using an chlorhexidine wipe, tourniquet placed, Ultrasound probe was reapplied to guide 20 gauge 1.88 in angiocatheter in the {Left/Right:26152} {IV; LOCATION:27975} vein using real time ultrasound guidance of needle and catheter.

Tip of catheter noted in *** on US confirmation

Sterile dressing applied

No complications were noted.

Line withdraws venous blood easily, flushes without resistance, no evidence of infiltration

Nursing notified line stable for use at this time

IMAGE DOCUMENTATION: Catheter placement confirmed at bedside with US after cannulation, no images saved

Time taken for procedure *** minutes

References

1. Costantino TG, Parikh AK, Satz WA, Fojtik JP. Ultrasonography-guided peripheral intravenous access versus traditional approaches in patients with difficult intravenous access. *Ann Emerg Med.* 2005;46(5):456-61.
2. Elia F, Ferrari G, Molino P, et al. Standard-length catheters vs long catheters in ultrasound-guided peripheral vein cannulation. *Am J Emerg Med.* 2012;30(5):712-6.
3. Liu YT, Alsaawi A, Bjornsson HM. Ultrasound-guided peripheral venous access: a systematic review of randomized-controlled trials. *Eur J Emerg Med.* 2014;21(1):18-23.
4. Mahler SA, Wang H, Lester C, Skinner J, Arnold TC, Conrad SA. Short- vs long-axis approach to ultrasound-guided peripheral intravenous access: a prospective randomized study. *Am J Emerg Med.* 2011;29(9):1194-7.
5. Panebianco NL, Fredette JM, Szyld D, Sagalyn EB, Pines JM, Dean AJ. What you see (sonographically) is what you get: vein and patient characteristics associated with successful ultrasound-guided peripheral intravenous placement in patients with difficult access. *Acad Emerg Med.* 2009;16(12):1298-303.
6. Wang R, Snoey E, Frazee B. Ultrasound-guided deep brachial and basilic vein cannulation in the emergency department. *Cal J Emerg Med.* 2005;6(2):38-40.
7. Witting MD, Schenkel SM, Lawner BJ, Euerle BD. Effects of vein width and depth on ultrasound-guided peripheral intravenous success rates. *J Emerg Med.* 2010;39(1):70-5.