

Emergency Ultrasound Course

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**ED Course Manual 4:
Procedural guidance**

**Setup for procedures
Vascular access
Draining effusions**

Why use US at all?

- Safer than blind (landmark) technique
- Fewer attempts

SETTING UP FOR AN US-GUIDED PROCEDURE

Which probe?

Follow this simple rule:

- For procedures on small sites (eg vascular access, foreign body removal, nerve block) use the linear probe. But if the patient is very obese, consider a curved probe (it's not as hard as it sounds).
- For procedures on large sites (eg bladder tap, paracentesis) use the curved or sector probe

Probe sterilization

- You need an assistant for this
- One method (THE MESSY WAY) is to prepare the probe with standard gel, then insert the probe into a sterile US probe sheath or a sterile glove and apply sterile gel over the sheath.



PROBE STERILISATION:
THE MESSY WAY

An alternative method is 'THE NEAT WAY':

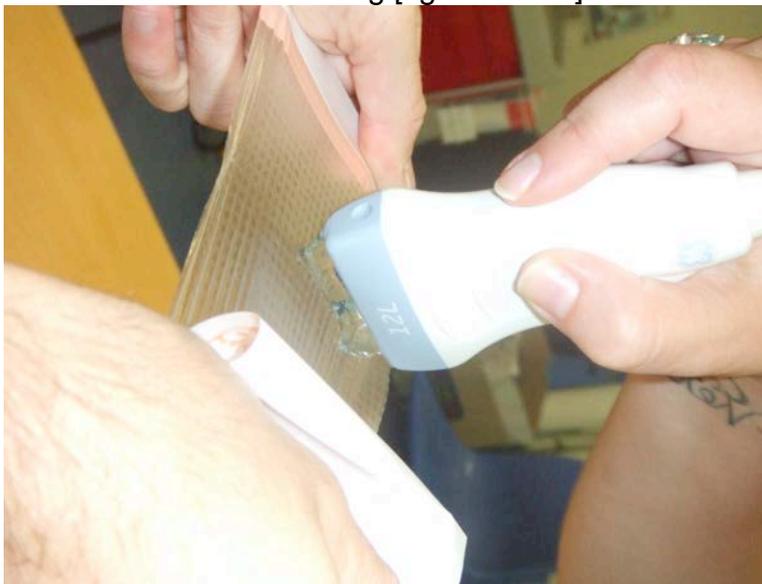
NB assume you're gloved up & sterile in these pictures!

- o Place a blob of US gel on the probe as usual, then hand the probe to your assistant



PLACING GEL ON THE PROBE

- o Get yourself sterilised as usual (hint: double glove for this, it's easy to get the outer gloves dirty while trying this the first few times)
- o Then your assistant holds the probe while you open up 2x sterile adherent dressing such as Opsite 3000 ®
- o Cover the probe with a sterile dressing [figure below].



PLACE THE ADHERENT DRESSING GENTLY OVER THE GEL



WRAP THE DRESSING AROUND THE PROBE.
BE CAREFUL NOT TO SQUEEZE THE GEL
DOWN THE SIDES OF THE PROBE.

- Ensure that no air bubbles are trapped between the probe and the dressing, or the resulting US image will be affected.
- Wrap a second dressing around the first.



WRAP A SECOND DRESSING AROUND THE FIRST.

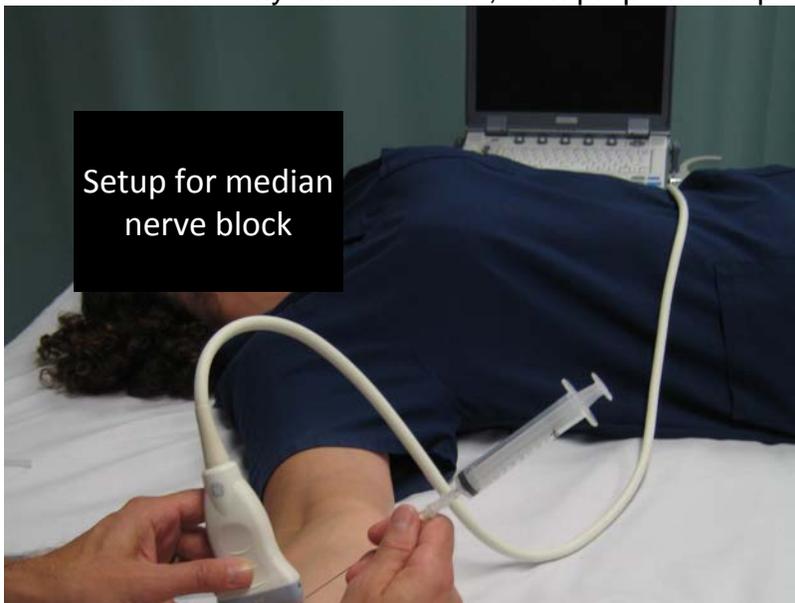
- Instead of using sterile gel over this, as a scanning medium simply use the antiseptic liquid used to sterilize your field (eg chlorhexidine)... or just sterile saline.
- **TIP: get your assistant to squirt more sterile saline onto the field if the image is poor**₄
quality.

- The resulting image will be adequate for most procedures, and the technique is much less messy.

Machine setup

Whatever the procedure you're attempting, do the following:

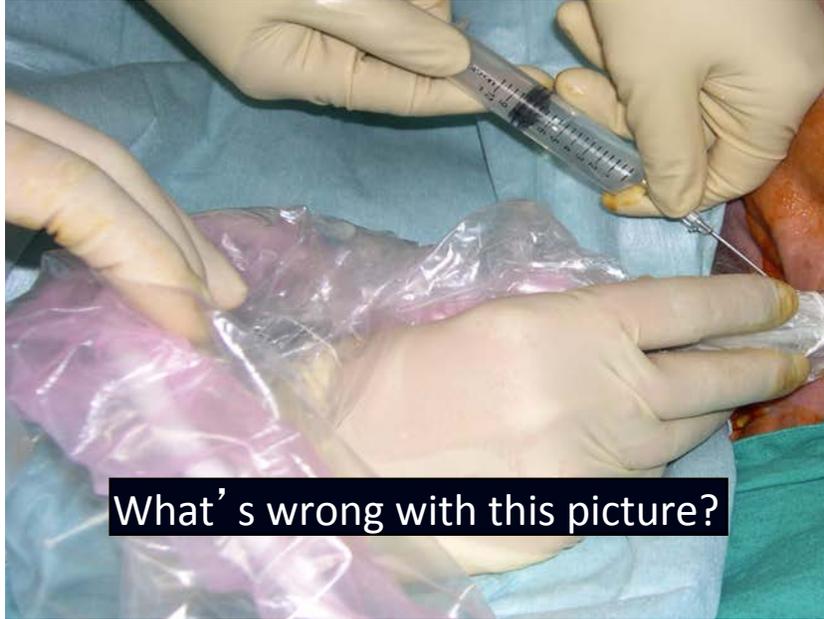
- Place the US monitor in your line of sight: don't try this trick looking over your shoulder! It makes it much easier when your eyes, hands, procedure site and machine's screen are all facing in the same direction.
- Choose site and confirm anatomy with static US, then prep and drape site.



SETUP (IN THIS CASE, FOR NERVE BLOCK):
PROCEDURAL SITE, PROBE & MACHINE
ARE ALL IN THE SAME LINE OF SIGHT

How many operators?

- One sterile operator: this is a single operator technique! No-one else should be scrubbed unless they are teaching the technique. That's because it's too confusing to ask the operator holding the probe to slide the probe left or right: your left? His left? The patient's left? Etc.
- An assistant is usually required to 'drive' the machine (change depth, save images for QA).



What's wrong with this picture?

TWO STERILE OPERATORS: **WRONG**

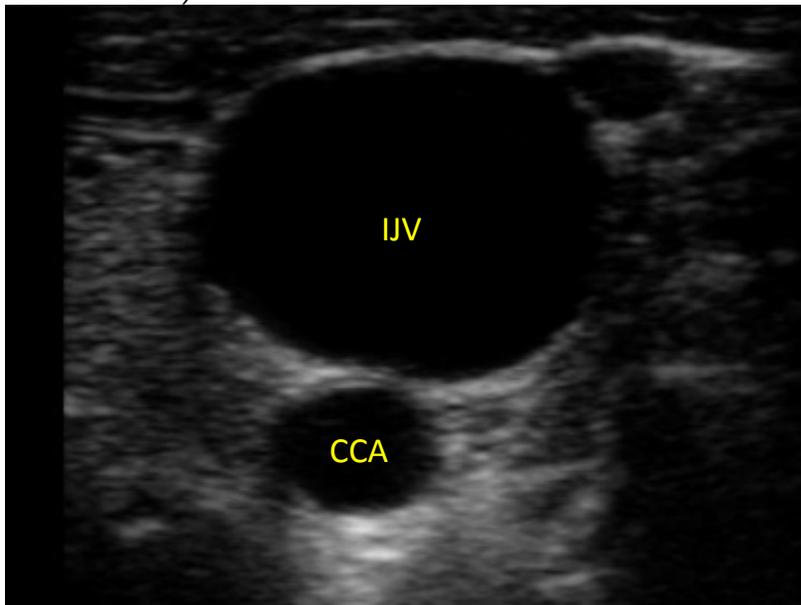
CENTRAL VENOUS CANNULATION

Which sites?

1. The internal jugular vein (IJV): compressible and easy to find
2. The femoral vein (FV, also known as Common Femoral Vein): has the same advantages and is far away from airway/CPR sites. Traditionally considered 'dirtier' than other sites. However, recent studies have questioned this.
3. Subclavian: not described here, but accessible with a curved or microconvex probe (counterintuitive!)

Vein or artery? How to tell on US

- Vein larger, oval cross section, thinner walled and enlarges with Valsalva
- Artery pulses (beware transmitted venous pulsation)
- Forget about Doppler! It's unnecessary and can be misleading. (See *DOPPLER* section in *Physics & Knobs*)



INTERNAL JUGULAR VEIN (IJV) AND COMMON CAROTID ARTERY (CCA)
DURING VALSALVA MANOEUVRE: TRANSVERSE VIEW

Which technique?

Three techniques are described. Pick the one you like, but I prefer to use a combination of all three:

1. Static technique before sterilising the probe
2. Real time out-of-plane to ID the vein
3. Real time in-plane to insert the needle

'Static' technique

Use US to identify the target vein and mark the optimum site of needle entry prior to sterile preparation of the field. This confirms venous depth, course and compressibility. It is easier than real time US guidance, but not as safe.

Real time in-plane and out-of-plane techniques

Described below, both techniques require a sterile technique. Both are trickier than the static technique and require an assistant to 'drive' the ultrasound machine.

CVC cannulation using real time US: Preparation

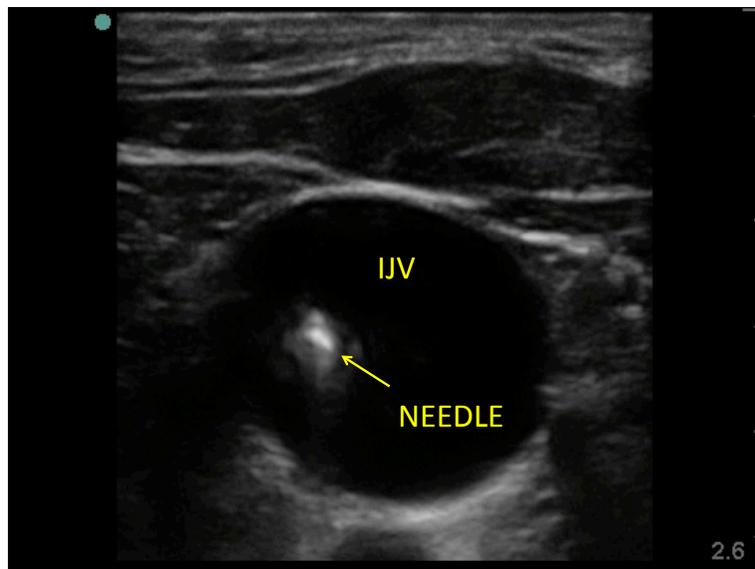
- US monitor in your line of sight: don't try this trick looking over your shoulder!
- Choose site and confirm anatomy with static US, then prep and drape site.

Probe and preset

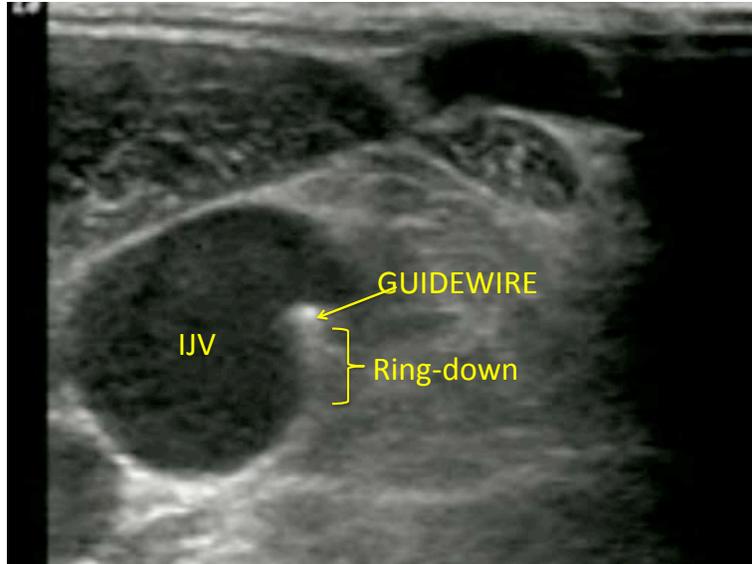
- High frequency linear probe
- Vascular preset: not essential, but it does give you better image quality

'Out-of-plane' or transverse technique

1. Place the probe transversely over the chosen site. Identify vein, artery and any nearby structures. (Try and avoid Doppler if possible.)
2. Move the probe and change the on-screen depth so that the vein appears in the centre of the screen. This is your landmark for inserting the needle.
3. Administer local anaesthetic (LA) at the probe's midway point.
4. Move the probe to your non-dominant hand.
5. With your dominant hand, insert introducer needle and syringe) at the site of LA. Fan the probe back and forth as you introduce the needle, to guide it into the vein.
6. Often you won't see the tip of the needle, but you can usually pick up the needle somewhere along its length.
7. The major risk of such a steep angle is inadvertent 'through and through' venous puncture. Avoid this by the following:
 - Introduce the needle more slowly than when performing blind CVC insertion.
 - Watch for 'tenting' of the vein's upper wall inwards as the needle approaches the vein... and watch for flashback of blood in the syringe.



NEEDLE IN IJV: OUT-OF-PLANE TECHNIQUE



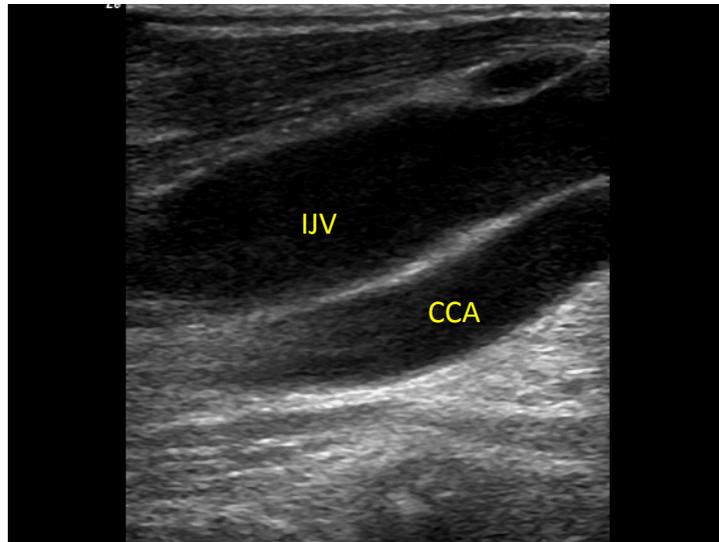
GUIDEWIRE IN IJV: OUT-OF-PLANE TECHNIQUE

When you introduce the guide wire, you should be able to see this in the lumen of the vein on US.

'In-plane' or longitudinal section (LS) technique:

This can be trickier to learn, but it is safer than the out-of-plane technique. The tricky part is keeping the axes of the needle and the probe exactly aligned, so that you can see the needle on screen at all times. BUT if you can get this part right, then there should be no danger of needle overshoot, or of puncturing the wrong structure. That's because you can see all of the needle, all of the time.

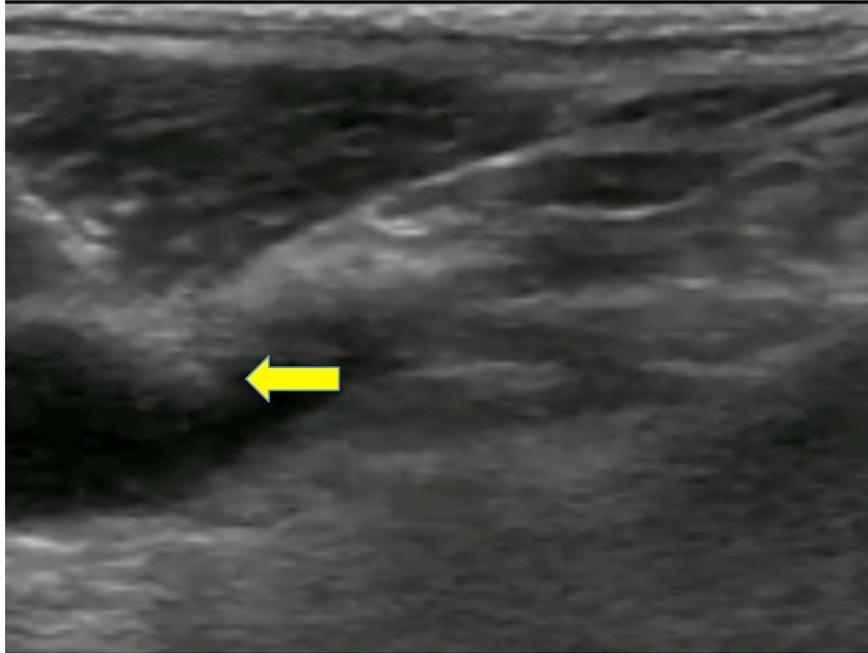
1. ID the vein as above, using transverse / out-of-plane technique. Then rotate the probe until the vein appears in its long axis.



IJV & CCA imaged in long axis

3. Administer LA etc.

4. Introduce introducer needle at a **shallow** angle as for traditional blind cannulation. The shallower the angle, the better that your US waves will pick up the needle.

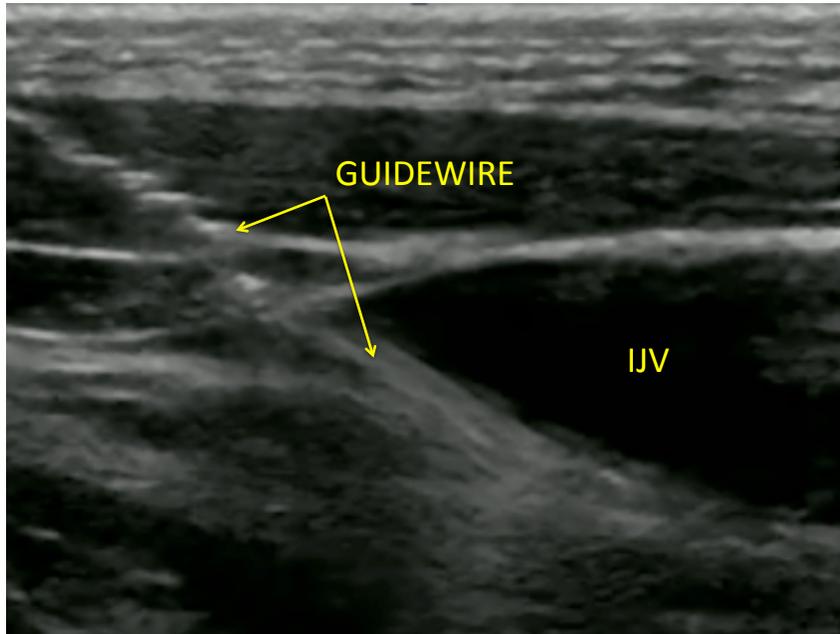


NEEDLE (TIP ARROWED) TENTING THE IJV
IN-PLANE TECHNIQUE



NEEDLE ENTERS IJV: IN-PLANE TECHNIQUE

- It's hard to keep the needle and probe lined up. But if you don't, you won't see the needle and then you won't know where it's going.
- Once the needle has entered the vein, complete the process as described above.

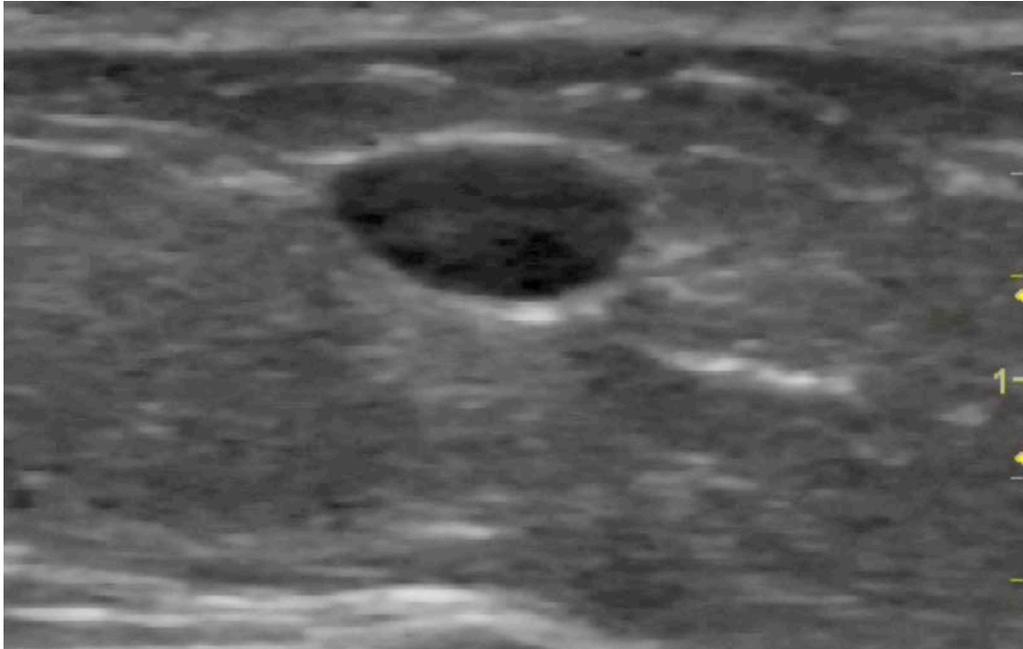


GUIDEWIRE IN IJV: IN-PLANE TECHNIQUE

PERIPHERAL VENOUS ACCESS

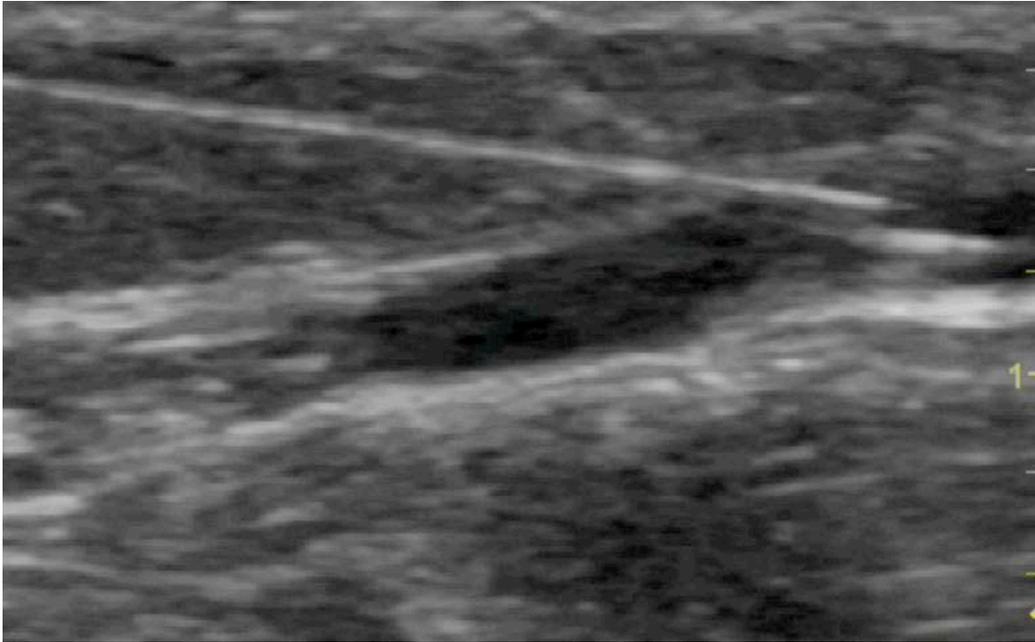
Surprisingly, peripheral cannulation can be harder than central, because everything involved is so much smaller and more fiddly. But the principles are the same, and there are some fantastic veins in most patients that simply can't be palpated.

1. With a tourniquet applied, ID the vein in the transverse plane. Trace its course up and down a few cm, to ensure your needle approaches from the correct angle.



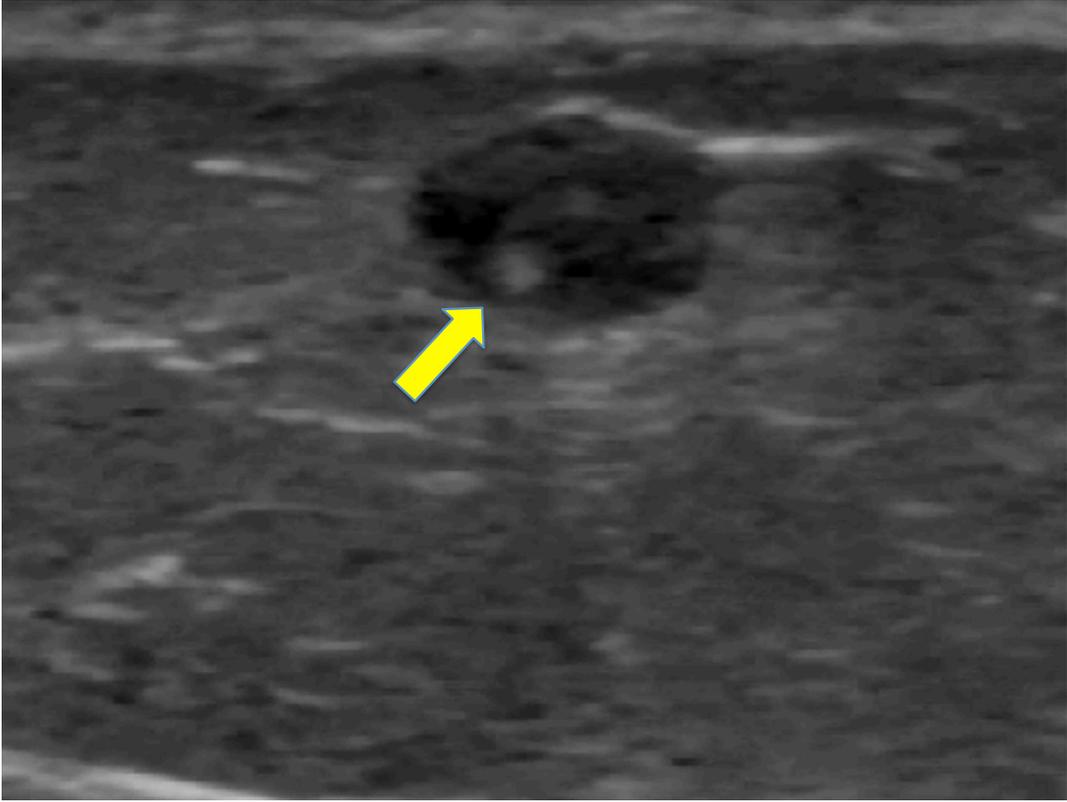
IDENTIFY THE VEIN IN TRANSVERSE PLANE

2. Explain to the patient what you are doing, then inject a tiny bleb of subcut lignocaine (you'll need to dig around a little with this technique, and the process can take a minute or two, so it can be more painful than standard venous cannulation).
3. Sterilise the probe as usual.
4. Ideally use the in-plane technique to insert the needle & cannula, BUT don't be too hard on yourself. If the vein is tiny, then the out-of-plane technique will have to do.



INSERTING THE NEEDLE INTO THE VEIN: IN-PLANE TECHNIQUE

5. Once you get a flashback, advance the needle another 1-2mm to be sure... or follow the course of the entire thing with US to make sure it's advanced far enough into the vein.
6. Then advance the cannula.
7. If there is no flashback, double check that the cannula is in the vein: with US and/or a saline flush.

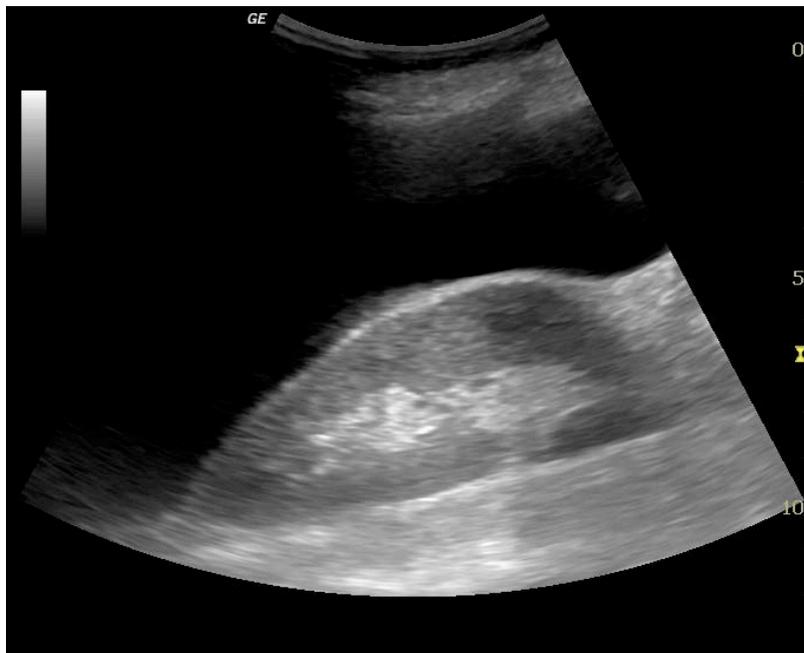


CANNULA IN VEIN (ARROWED): TRANSVERSE PLANE

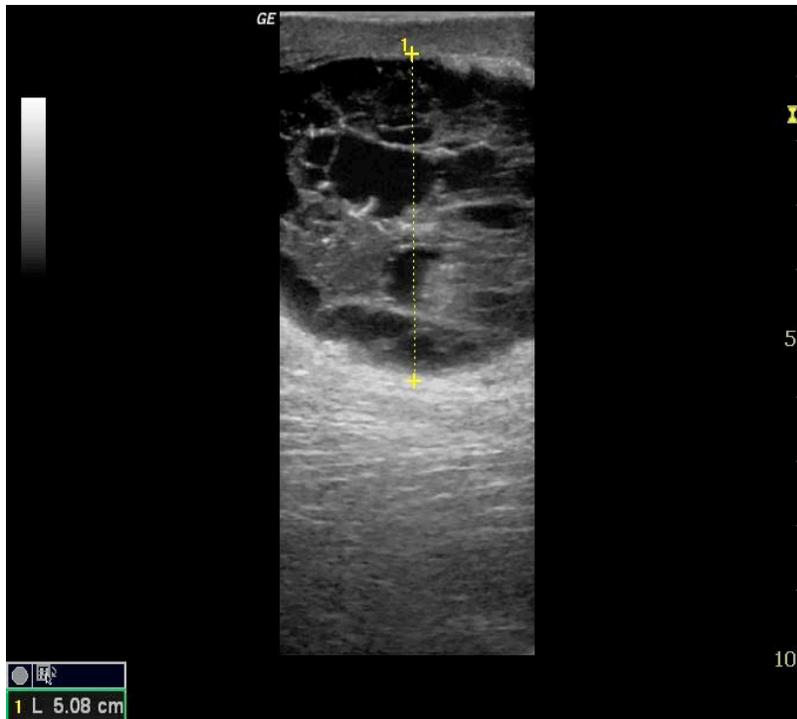
DRAINING BIG THINGS: Thoracentesis, pericardiocentesis and paracentesis

Anatomy

- Simple fluid collections (eg transudate, fresh blood) are hypoechoic (dark) on US and demonstrate posterior acoustic enhancement.
- Complex collections (eg pus, clotted blood) can appear complex and even iso- or hyperechoic. They may contain particles (debris) and even linear structures (eg fibrin strands, multi-loculated collections).
- Bowel air and normal lung tissue reflect sound poorly and produce scatter.



**SIMPLE FLUID: ASCITES
(KIDNEY SEEN AT BOTTOM OF IMAGE)**



COMPLEX FLUID: SUBCUTANEOUS ABSCESS

Preparation

- As for vascular access
- use a curved or sector probe to map out the fluid and nearby anatomical structures to avoid.
- then either:
 - (a) switch to linear probe: more accurate and lets you see the needle BUT you lose sight of the big picture (won't see organs, diaphragm etc)
 - (b) continue to use a curved / sector probe throughout: less likely to see the needle but it's still possible



ASCITIC TAP USING CURVED PROBE:
NEEDLE SEEN AT TOP OF SCREEN

(c) no real-time guidance: make sure your patient doesn't move in the interval between your scout scan and your needle insertion!

Needle placement

IN GENERAL: scan in 2 planes to avoid nasty surprises! Such as organs that are closer than you realised.

Thoracocentesis

- Make sure your chosen site is well above the diaphragm in full expiration.

Pericardiocentesis

- Subxiphoid approach is traditional BUT you will harpoon the liver!
- Parasternal or apical windows are fine (as long as you avoid the liver and make sure you insert the needle at the site of maximal fluid).



LARGE PERICARDIAL EFFUSION:
APICAL WINDOW

Paracentesis

- Watch out for:
 - (a) the inferior epigastric arteries
 - (b) the diaphragm!