

# Compression US for DVT

## **Anatomy**

Below the knee, the veins listed below are traditionally imaged to exclude DVT. This process is time consuming and requires expertise beyond the scope of this course.

Anterior tibial  
Posterior tibial  
Peroneal  
Gastrocnemial  
Soleal

The popliteal vein begins as the confluence of the calf veins behind the knee. It lies superficial to the popliteal artery in the popliteal fossa, and ascends to the adductor canal where it becomes the superficial femoral vein (SFV; known colloquially as the femoral vein, but named here as SFV to avoid confusion).

The SFV is found anteromedially in the thigh: initially deep to the superficial femoral artery, coming to lie more medially as it ascends. The profunda femoris vein joins the SFV approximately 4 cm below the inguinal ligament, becoming the common femoral vein (aka femoral vein).

The great saphenous vein (GSV, also known as the long saphenous vein) joins just proximal to the common femoral vein. The common femoral vein becomes the external iliac vein as it passes superiorly, under the inguinal ligament.

## **Probe and scanner settings**

- Standard B-mode soft tissue settings
- Ideally the linear high-frequency (5.0–7.5 MHz) transducer is used. However, even the curved (abdominal) probe will suffice if it is already in use.
- Depth & focus depth vary with patient size and anatomy.

## Anatomy

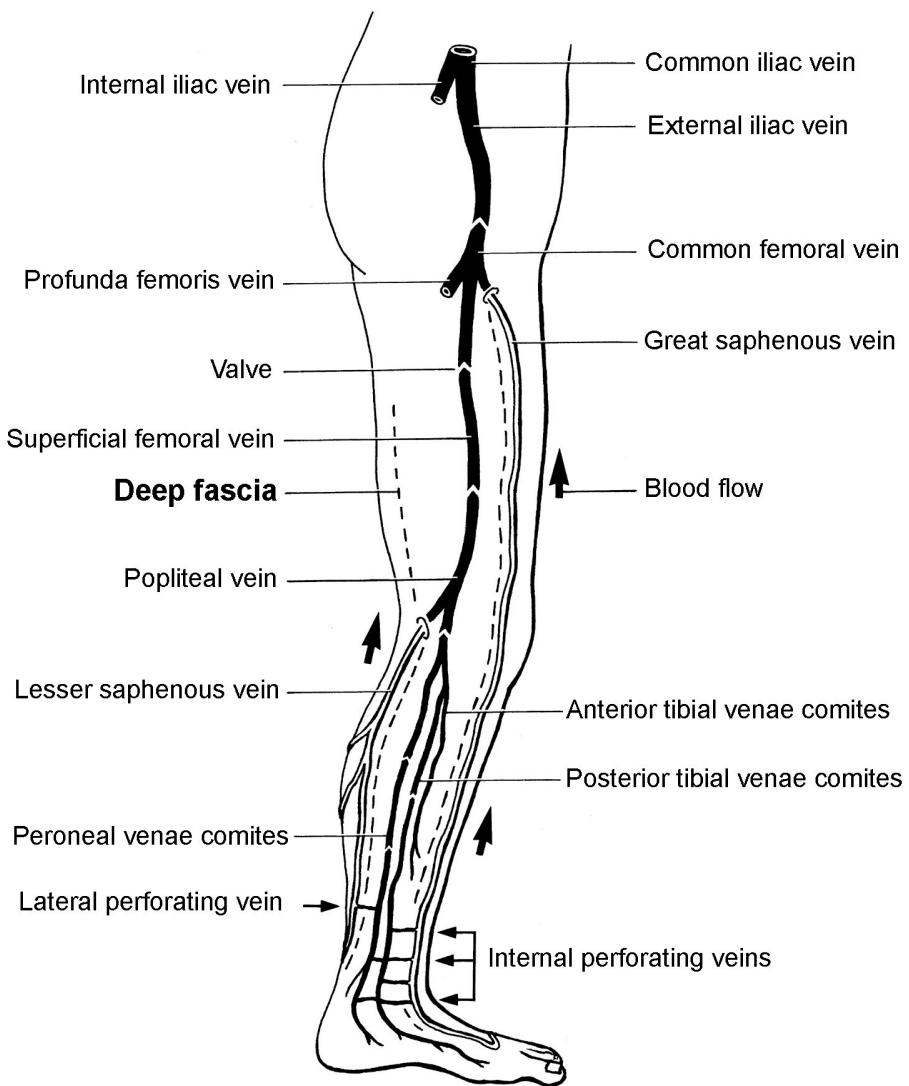


Diagram 2

### B-mode or Doppler?

**B-mode compression ultrasound** (compression US) has become the diagnostic modality of choice by radiologists for symptomatic DVT with both sensitivity and specificity of 98–100% reported for proximal DVT. In addition, compression US in the ED has been shown to reduce significantly the time to diagnosis for this group of patients.

Pulse wave (PW) Doppler and Colour Flow (CF) Doppler increase the accuracy of US interrogation of the limb veins, esp when used in combination with techniques such as flow augmentation and Valsalva manoeuvre. However, Doppler US of veins is outside the scope of today's course.

**Three-point compression US** is a simplification of standard compression US that is easily learned, rapid to perform, and has been shown to be highly accurate in the diagnosis of proximal DVT.

Using 3-point compression US, sensitivity of 93–100% and specificity of 97–100% for DVT is reported. Benefits include diagnosis at point of care, streamlined patient flow and decreased demand upon radiology departmental services.

A limitation of three-point compression US is that it is less sensitive in isolated below-knee DVT.

### **How to perform simple compression US for DVT**

- Hold the probe in transverse position initially, with the probe marker to the patient's right. (If trying to compress veins in the longitudinal position, the probe may 'slip off' and give a false impression of compression.)

### **5 sites to consider compressing**

Traditionally, 3-point compression US looks at:

- Upper femoral vein (at or around the femoral confluence in the groin)
- Lower femoral vein (just above and medial to the knee)
- Popliteal fossa (behind the knee)

However, Lichtenstein teaches below knee scanning as an alternative to popliteal fossa, more suitable in supine patients.

## 1. Groin to adductor canal

- Supine. Leg abducted to 10–15°, slight external rotation.
- Place probe in groin just below the midpoint of the inguinal ligament. Rest the probe lightly on the skin, identifying the ‘Mickey Mouse’ sign (Fig below)
- Femoral artery (thick-walled) seen pulsating lateral to femoral vein
- Saphenofemoral venous confluence: thinner-walled, transmitted pulsation only.
- Gentle compression with the probe will appose the anterior and posterior walls of normal veins; arteries are relatively incompressible. (Fig 5) **This is B-mode compression US.**

NB The key is to cease compressing when the artery's walls just begin to indent. If the vein is not compressed with this amount of pressure, it's abnormal.

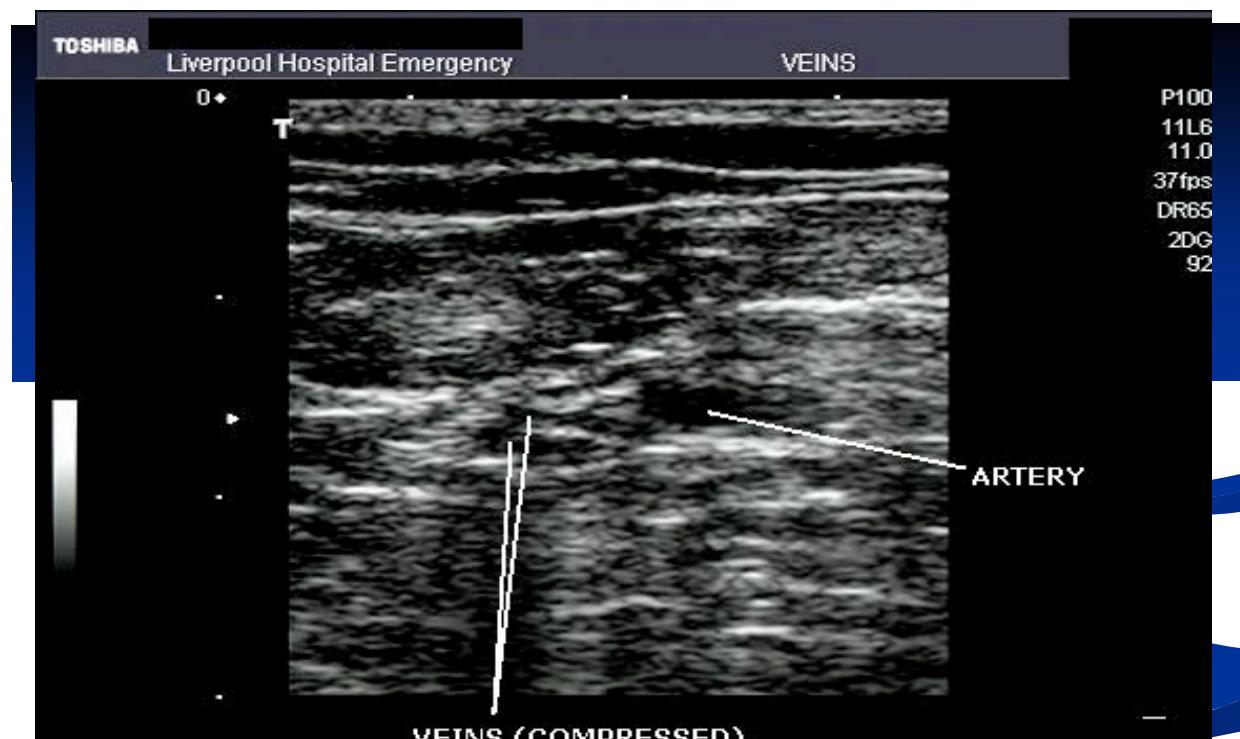
*Scanning the groin*



*Groin: 'Mickey Mouse' sign*



*Same site, with compression by probe. Normal veins.*



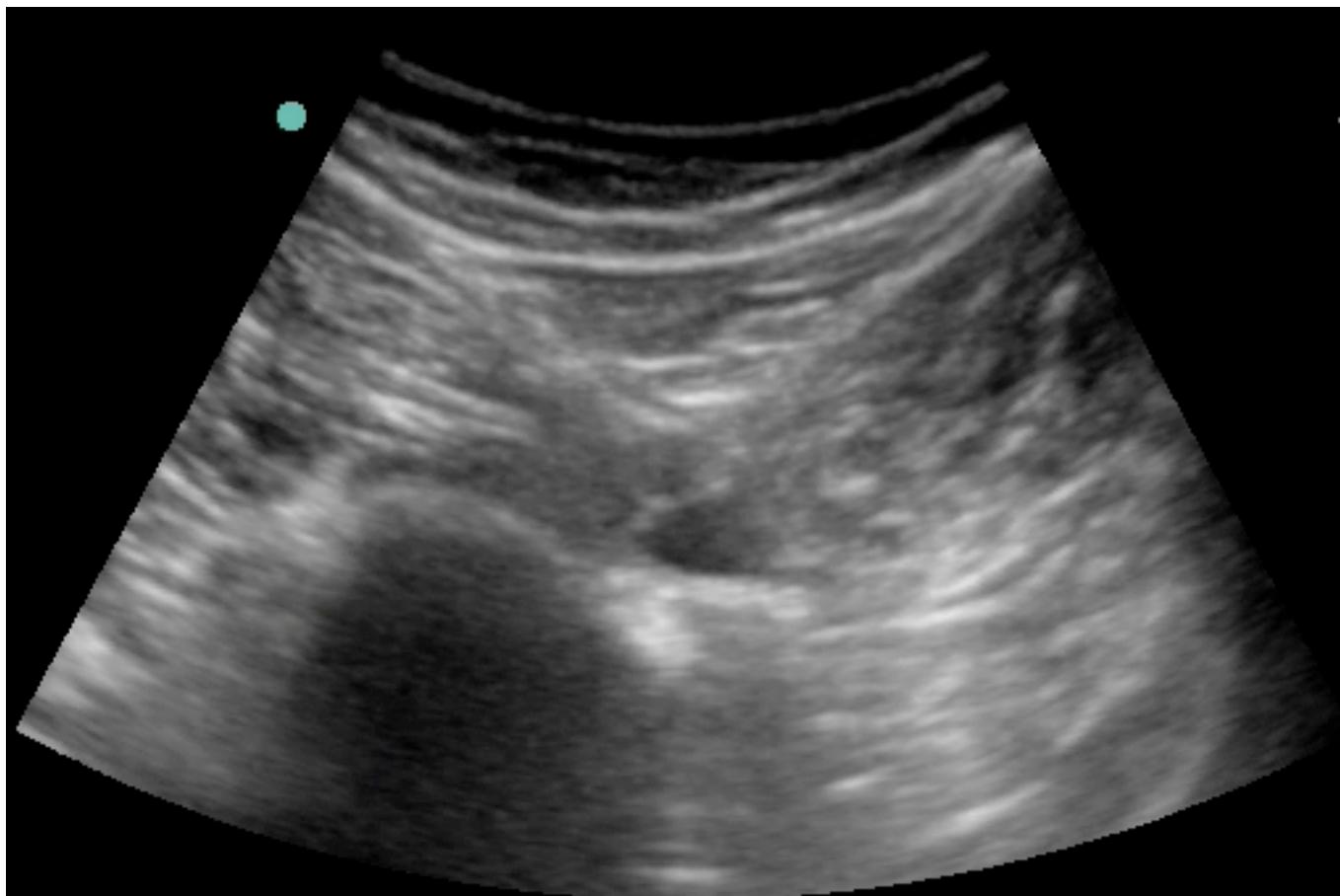
## 2. Lower femoral vein

- Supine
- Place probe medial to the lower femur
- Place your non-scanning hand behind the medial thigh and push up toward the vein, to compress it.

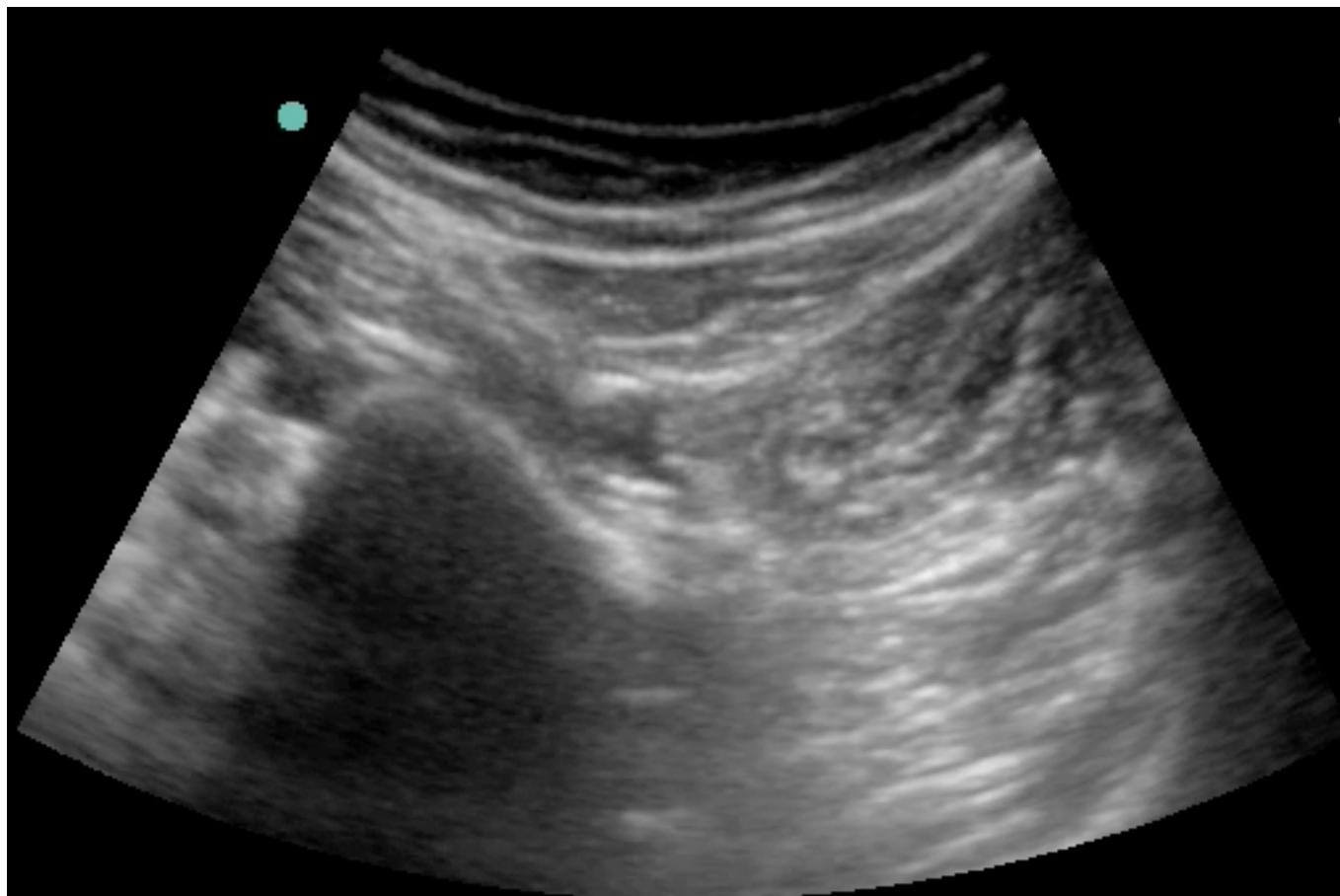
*Scanning the left lower thigh*



*Left lower thigh: femoral vein uncompressed*



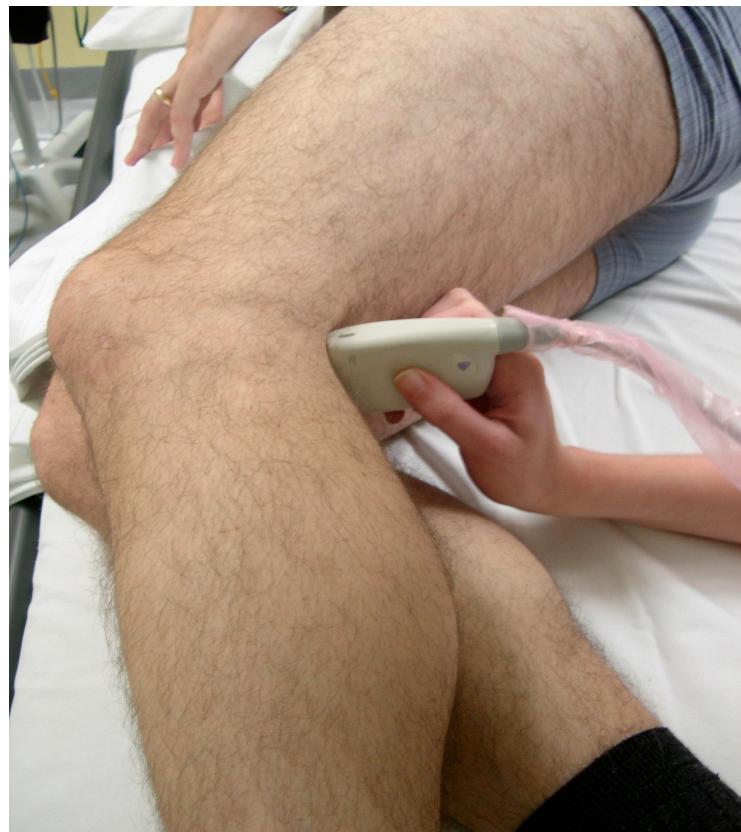
*Left lower thigh: femoral vein compressed. Artery still uncompressed.*



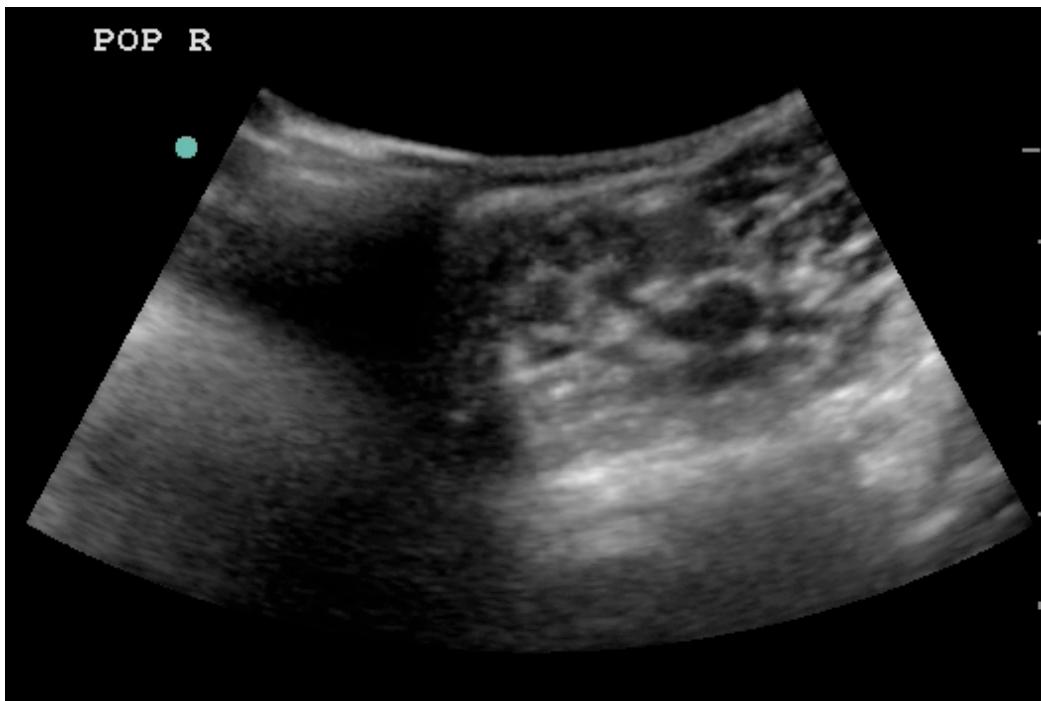
### 3. Popliteal segment

- Partial decubitus, affected leg uppermost
- Or seated with knee flexed and lower leg hanging over the side of the examination table
- Knee flexed to 25–30° (removes tension on popliteal fascia and vein).
- With the probe in the popliteal fossa, ID the popliteal vein lying superficial to the artery.
- Make sure you can visualise bone deep to the vessels, to ensure that you have adequately imaged the area. Otherwise, you'll miss duplication of the veins.

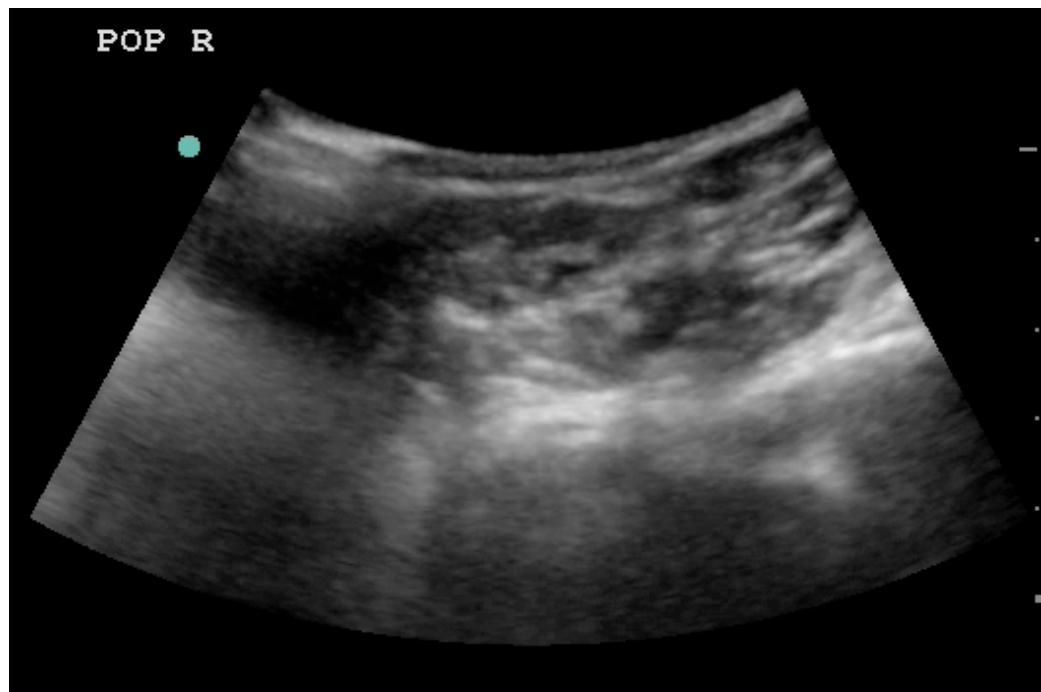
*Scanning the popliteal vein*



*Popliteal vein, uncompressed*



*Same site, compressed*



#### 4. Below the knee?

Yes, it's true: despite what they tell you, we can scan for below knee DVT. It's less accurate (the veins are smaller and it requires more practice) but sometimes it picks up a DVT.

The trick is to scan from the front, placing the probe on the (anterolateral) leg between the tibia and fibula. ID the 2 bones on US (using their shadows). Between them you should be able to ID the interosseous membrane. Just deep to this lie the vessels: 2 arteries and 4 veins, lying together in cross section.

*Scanning below the knee for DVT*



*Right below knee BVs uncompressed*



*Same patient, veins compressed, artery still visible.*



## **A 5<sup>th</sup> site: the upper limb veins**

Some operators (including Lichtenstein) routinely scan the upper limb deep veins (internal jugular and subclavian). They estimate that this increases the sensitivity of their algorithm by 4%. Most critical care doctors would not consider these standard sites in the undifferentiated ED patient with no recent upper limb cannulation.

## US appearance of normal veins versus DVT

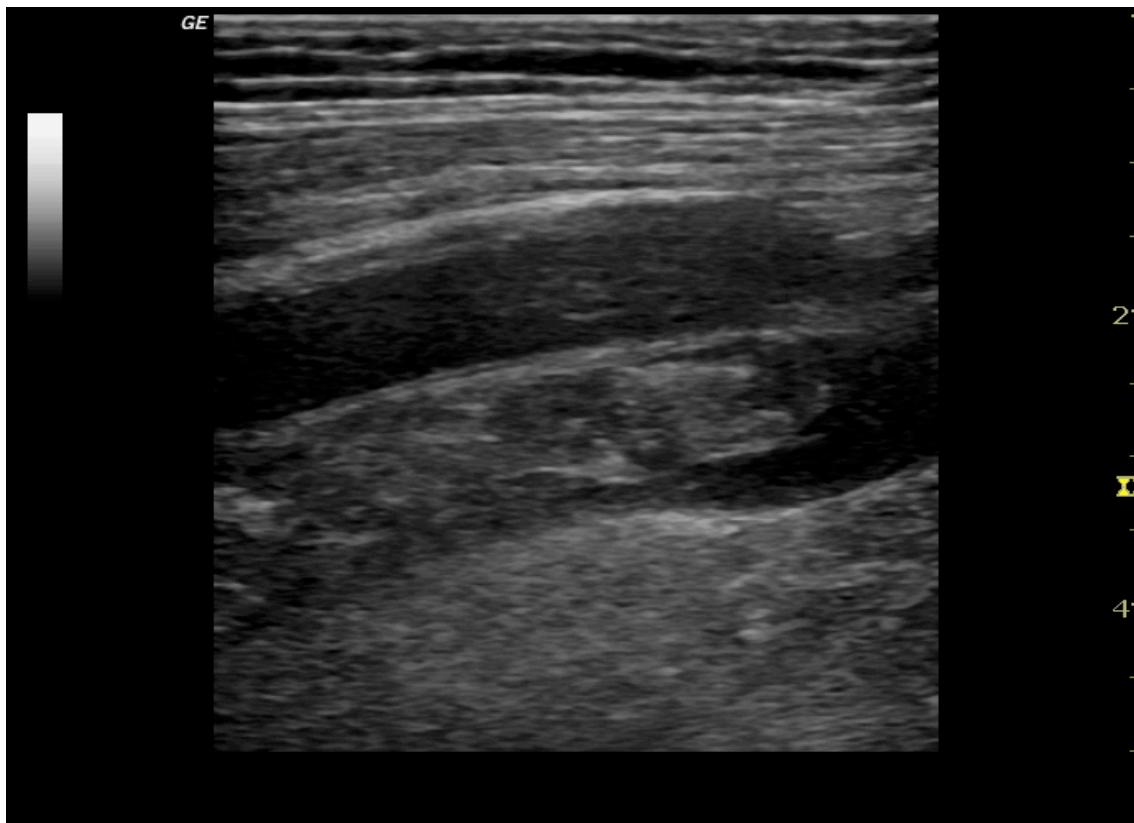
### Normal veins:

- completely compressible
- no echogenic material within lumen
- demonstrate flow augmentation with Valsalva manoeuvre and distal muscle compression

### DVT:

- *Cardinal sign = vein not completely compressible.* This is enough for the diagnosis of DVT.
- if echogenic material is seen within the lumen, this confirms the diagnosis. However, this is not essential for diagnosis as DVT isn't always visible on US! (Because of gain settings and presets)
- If there is DVT between the vein segment you're imaging and where you squeeze distally to augment flow, then there will be significant dampening of flow i.e. less or no augmentation. This sign can be subtle though.

*Echogenic material (DVT) in SFV, longitudinal scan. Artery can be seen lying superficial to the vein.*



## Tricks and traps

### General tips

- Press as lightly as possible for the 'uncompressed' view, to avoid obliterating the venous lumen (particularly in the popliteal fossa).
- A Valsalva manoeuvre may help to identify the femoral vein if there is any doubt.  
**(Tip: ask the patient to hum.)** The normal response is a 15% increase in venous diameter on straining. (This also assists in exclusion of occlusive thrombus in the iliac veins; however, the response will be less marked in a patient with congestive heart failure (CCF).)

### When progressing down the thigh:

- increase depth
- alter the focus arrow
- decrease the frequency
- increase the contrast (decrease dynamic range)

### In obese patients:

- ask the patient to stand if possible, to increase venous filling. Sitting with the legs dangling over the edge of the bed is another good way to improve your view of the popliteal segment.

### Pitfalls:

- Patients with previous venous disease including DVT may have incompressible veins, resulting in a false-positive result.
- Up to 35% of the population have duplex popliteal veins. Ensure that this segment particularly is well visualized, to avoid false-negative results.
- In very low flow states (eg severe CCF), Doppler may fail to show venous flow. In such patients, decrease the PRF and increase the gain, and try to ensure as low an angle of insonation as possible.
- Refer patients with a negative study but high likelihood for DVT for a formal study in the radiology dept.
- If any segment cannot be adequately visualized, then call the study inadequate and refer to the radiology department.