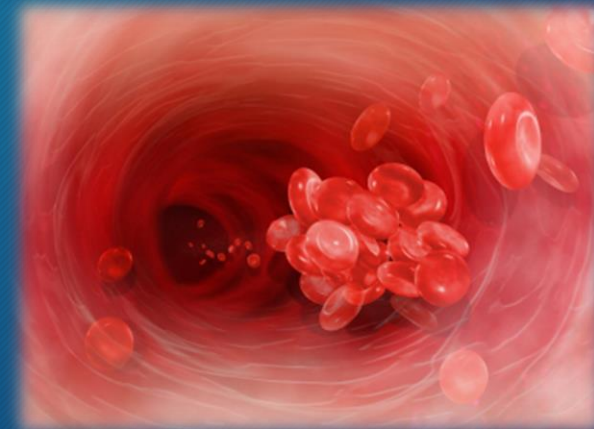
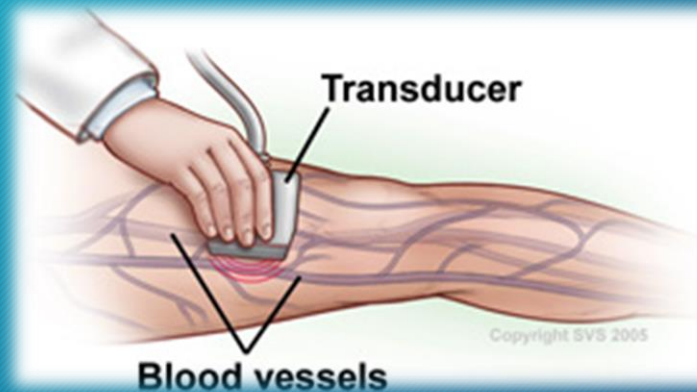
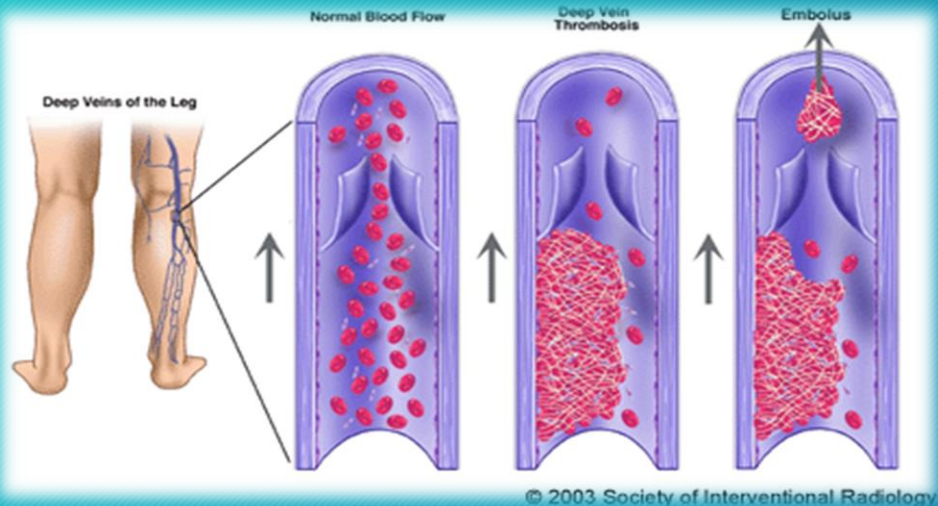
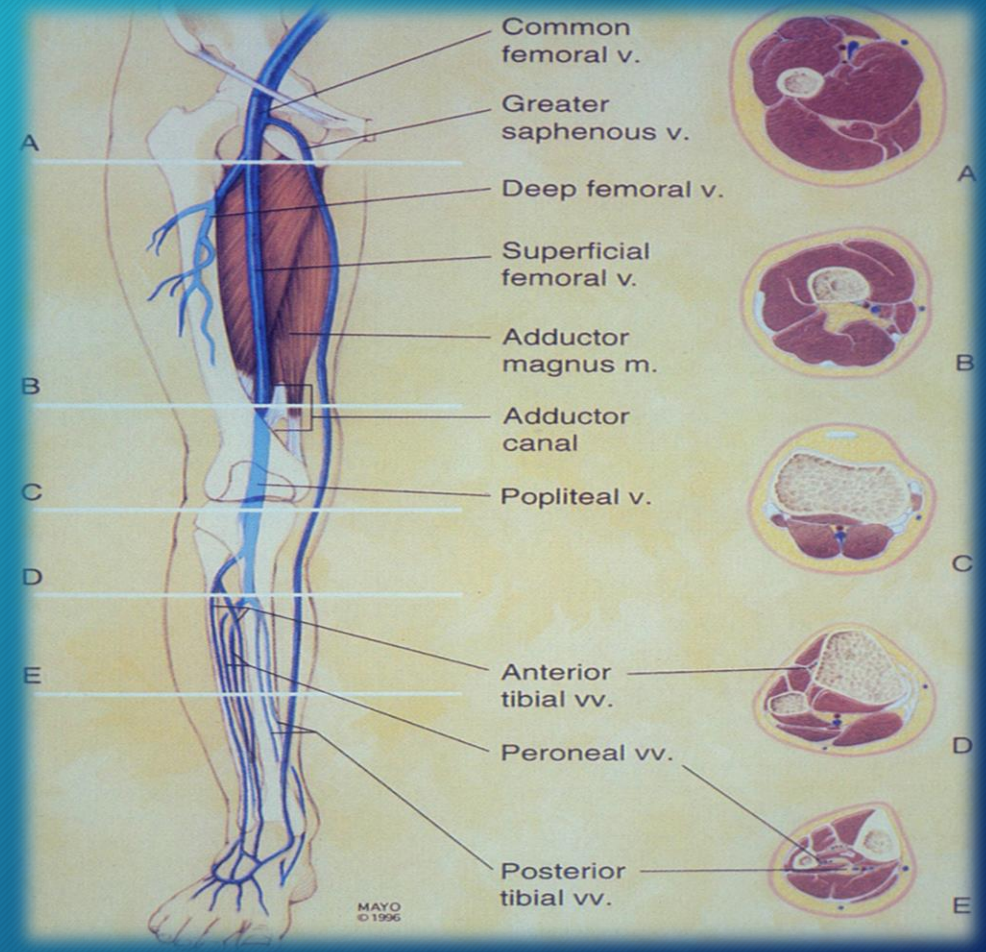
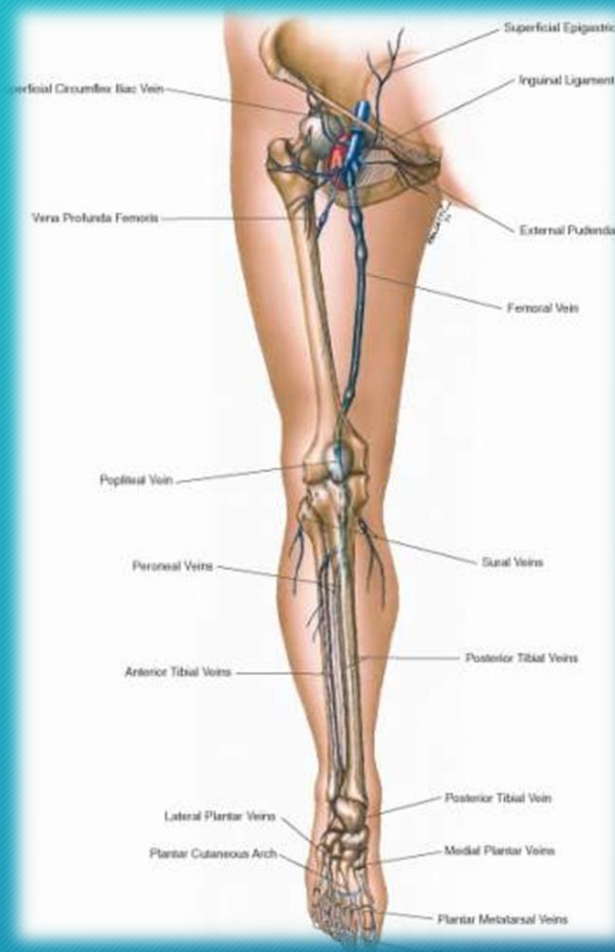
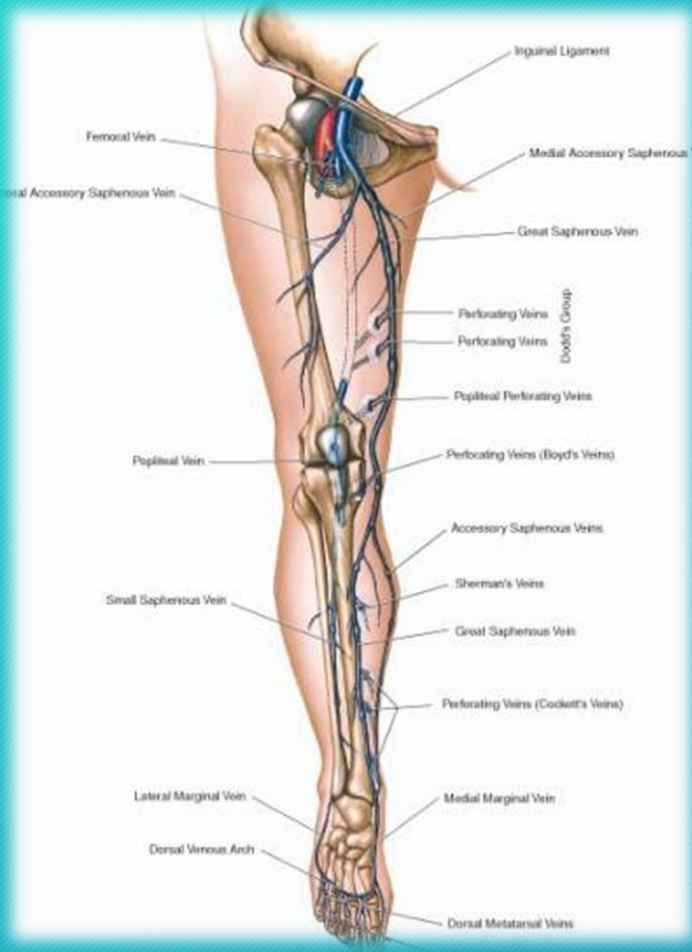


Lower Limb Venous Ultrasound

Colin P. Griffin
MSc, BSc (Hons)



Peripheral Vessels - Lower Limb



Peripheral Vessels - Lower Limb

- Venous

- Deep System

- Common Iliac
 - External/Internal Iliac
 - Common Femoral
 - Femoral
 - Profunda Femoris
 - Popliteal
 - Anterior Tibial
 - Posterior Tibial
 - Peroneal

- Superficial System

- Long (Great) Saphenous
 - Short (Small) Saphenous

 - Perforators
 - Giacomini

 - Gastrocnemius
 - Soleal

 - Pudendal

What is deep vein thrombosis?

- Formation of blood clot within a deep vein
- Form of thrombophlebitis
- Commonly affects the leg or pelvis and occasionally the arm
- Painful, swollen, red, warm
- DVT is a medical emergency

Mechanisms

- Virchow's Triad
 - Decreased blood flow
 - Damage to vessel wall
 - Physical trauma
 - Compression of vessel
 - Cancer
 - Infections
 - Stroke, heart failure, nephrotic syndrome
 - Hypercoagulability

Risk Factors

- Oestrogen containing oral contraception
- Recent long-haul travel
- Intravenous drug use
- History of miscarriage
- Smoker
- Obesity
- Family history (hereditary thrombophilia)
 - Factor V Lieden; Antithrombin; etc.



The Wells Score

- Clinical examination system
- Ranges from -2 to +9
- Active cancer - treatment within 6/12 or palliative (+1)
- Calf swelling >3cm (+1)
- Collateral superficial veins (+1)
- Pitting oedema (+1)
- Swelling to entire leg (+1)
- Localised pain along deep vein distribution (+1)
- Paralysis, paresis or recent cast (+1)
- Recently bedridden (+1)
- Previous DVT (+1)
- Alternative diagnosis at least as likely (-2)

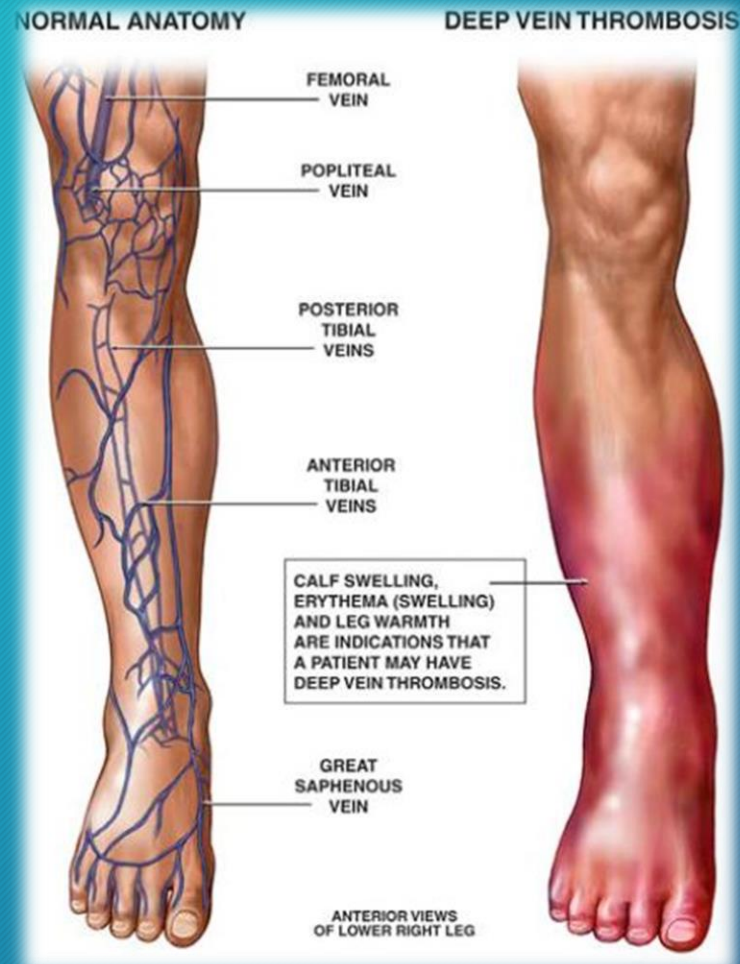
Diagnosis

- Physical examination
 - Homan's sign
 - Dorsiflexion of foot elicits pain in posterior calf
 - Pratt's sign
 - Squeezing of posterior calf elicits pain
- Wells Score
 - Score ranges from -2 to +9
 - Score ≥ 2 - DVT likely
 - Score ≤ 1 - DVT unlikely, consider D-dimer
- Blood Tests
 - D-dimer - fibrin degradation product
 - False +ve: liver disease; \uparrow rheumatoid factor; inflammation; malignancy; fracture; pregnancy; recent surgery; advanced age
 - CBC; Coagulation studies; LFTs; U&Es

Diagnosis...continued

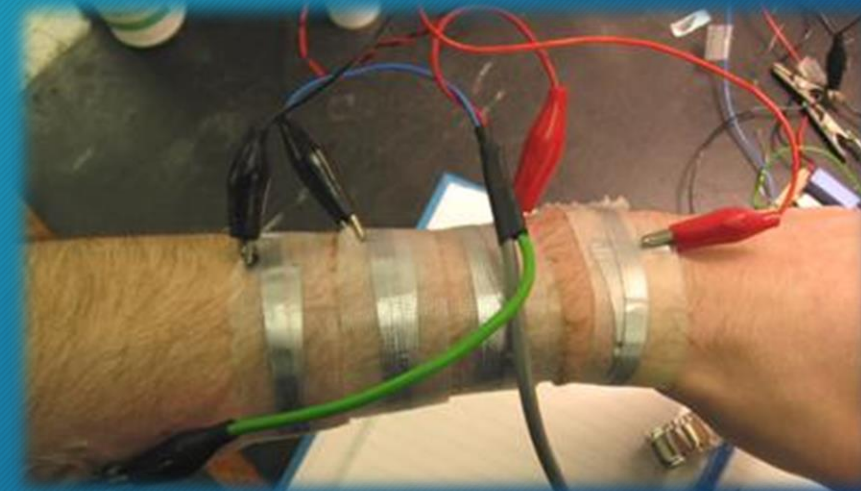
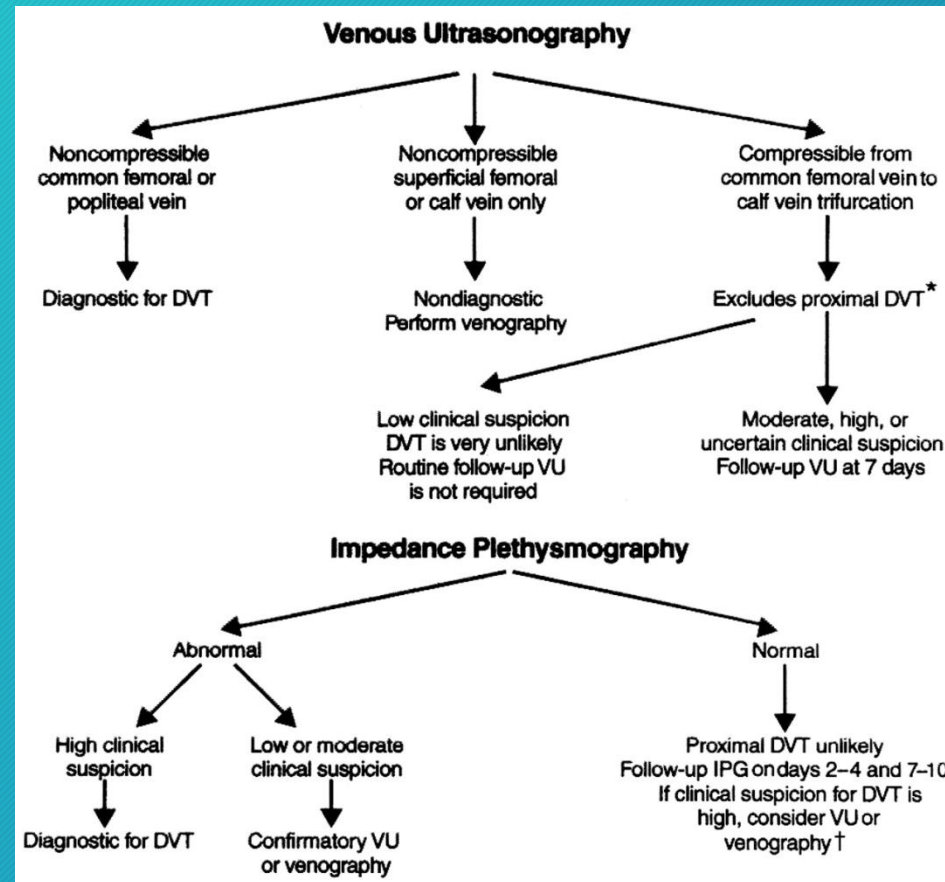
- Imaging

- Impedance Plethysmography
- Venography
- Radionuclide Imaging
- MR Imaging
- Ultrasound
 - B-mode
 - power / colour Doppler
 - Spectral Doppler



Impedance Plethysmography

- Advantages
 - Cheap
 - Portable
 - Single Operator
 - Non-invasive
- Disadvantages
 - Non-specific



Liquid Crystal Thermography

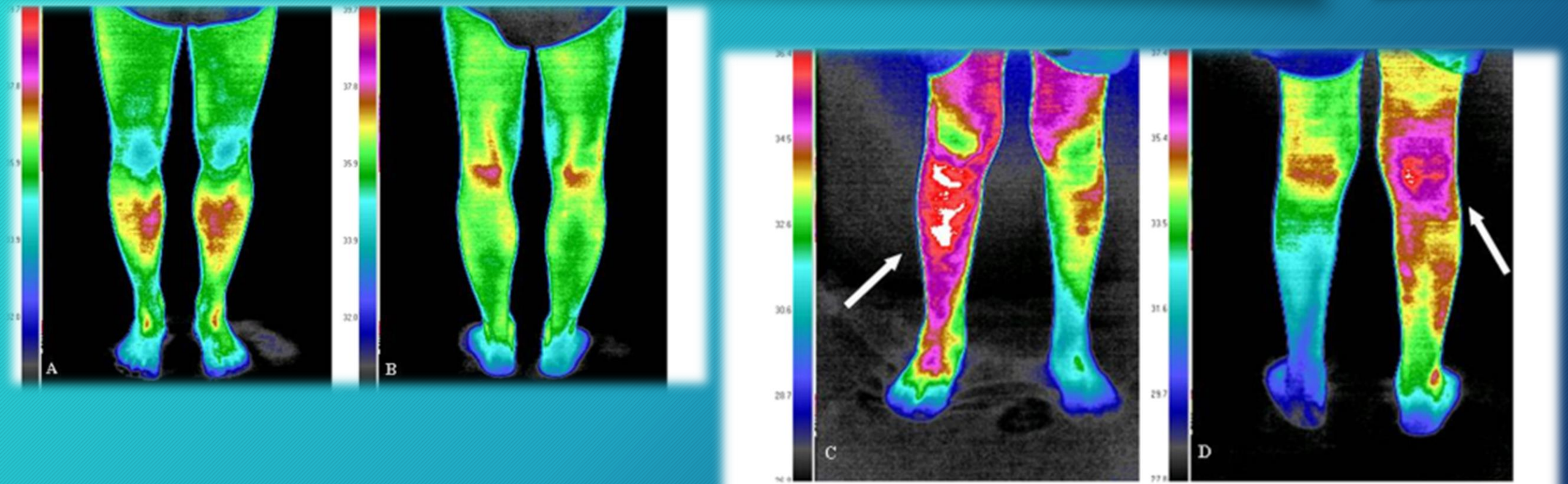
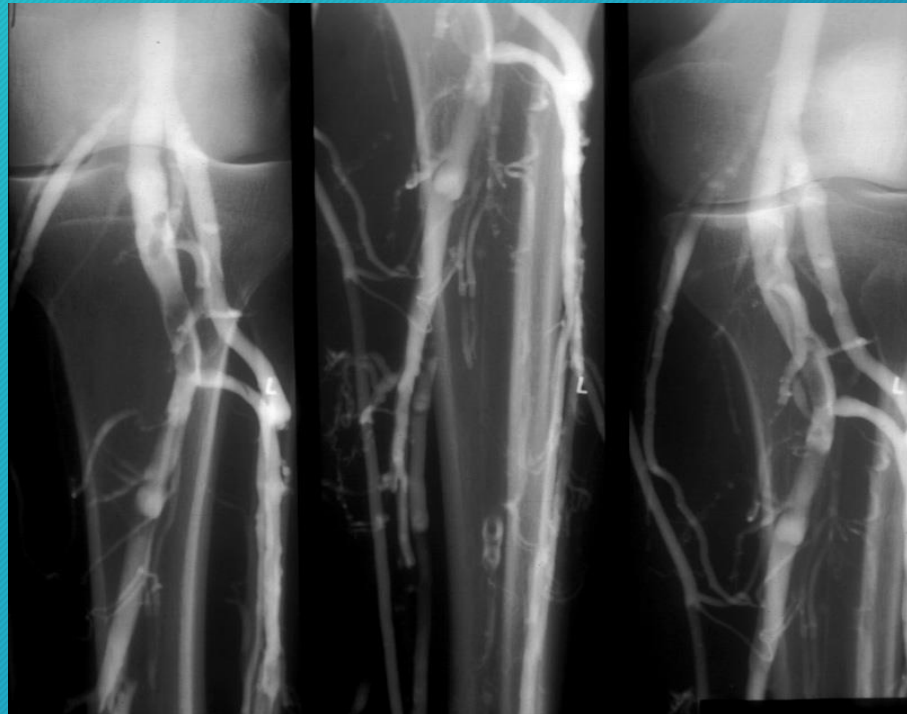


FIG. 3. IRTI PDCs in healthy volunteers and DVT patients. (A) and (B) Healthy volunteers. (C) and (D) DVT patients.

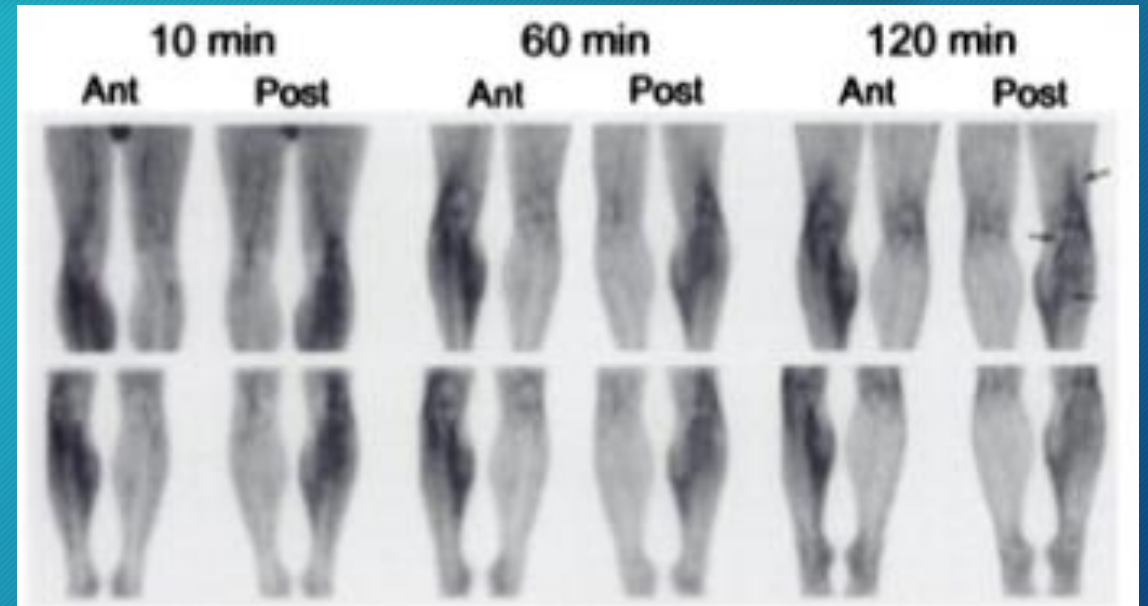
Venography

- Advantages
 - Gold Standard
 - Accurate
- Disadvantages
 - Invasive
 - Contrast Reactions
 - Ionising Radiation
 - Cost



Radionuclide Imaging

- Blood pool scintigraphy
- ^{125}I Fibrinogen scanning
- $\text{Tc}^{99\text{m}}$ pertechnetate injection
- $\text{T}^{99\text{m}}$ HMPAO labelled platelets
- ^{111}In antifibrin antibodies
 - Sensitivity 61%
 - Specificity 88%



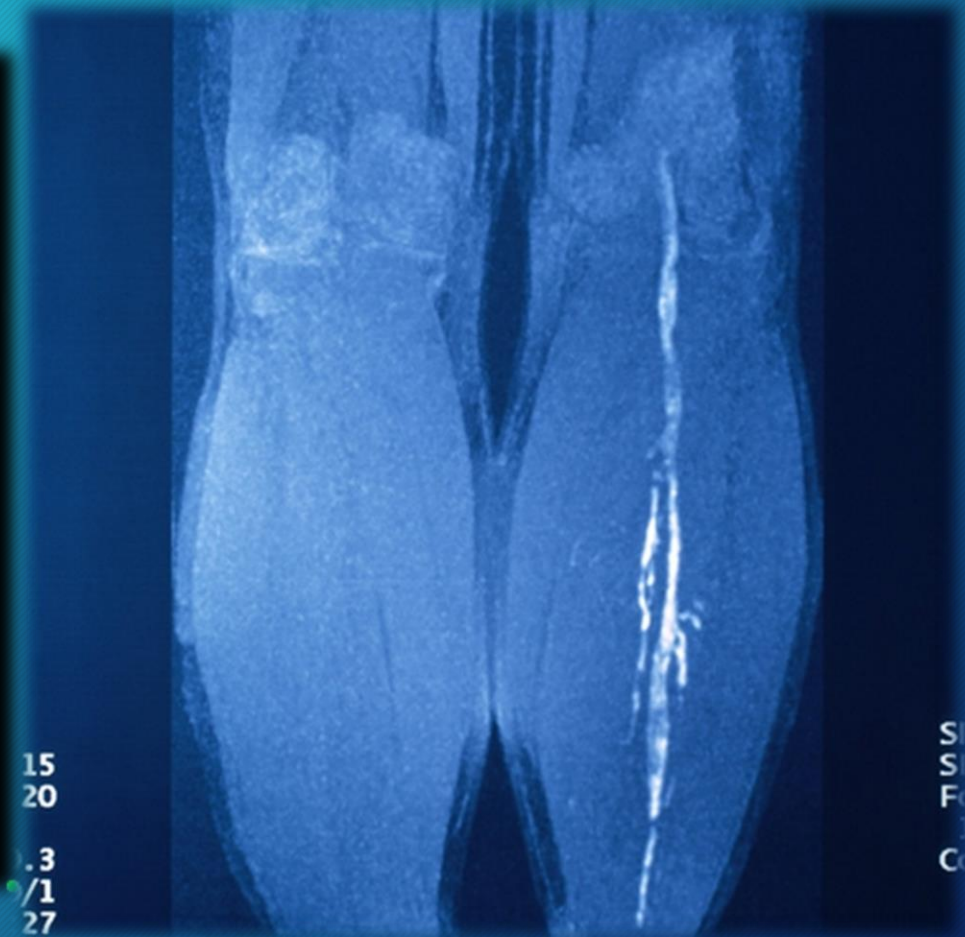
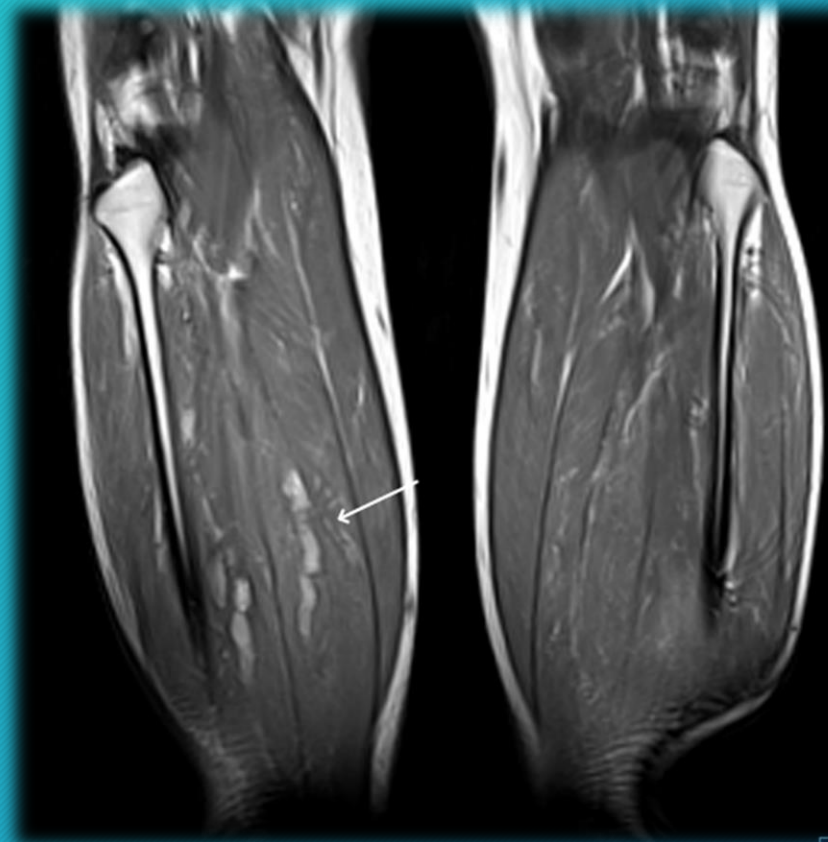
Computed Tomography

- IVC
- Pelvic vessels
- CFV
- FV
- LSV



MR Imaging

- Advantages
 - Very Accurate
- Disadvantages
 - Availability
 - Cost



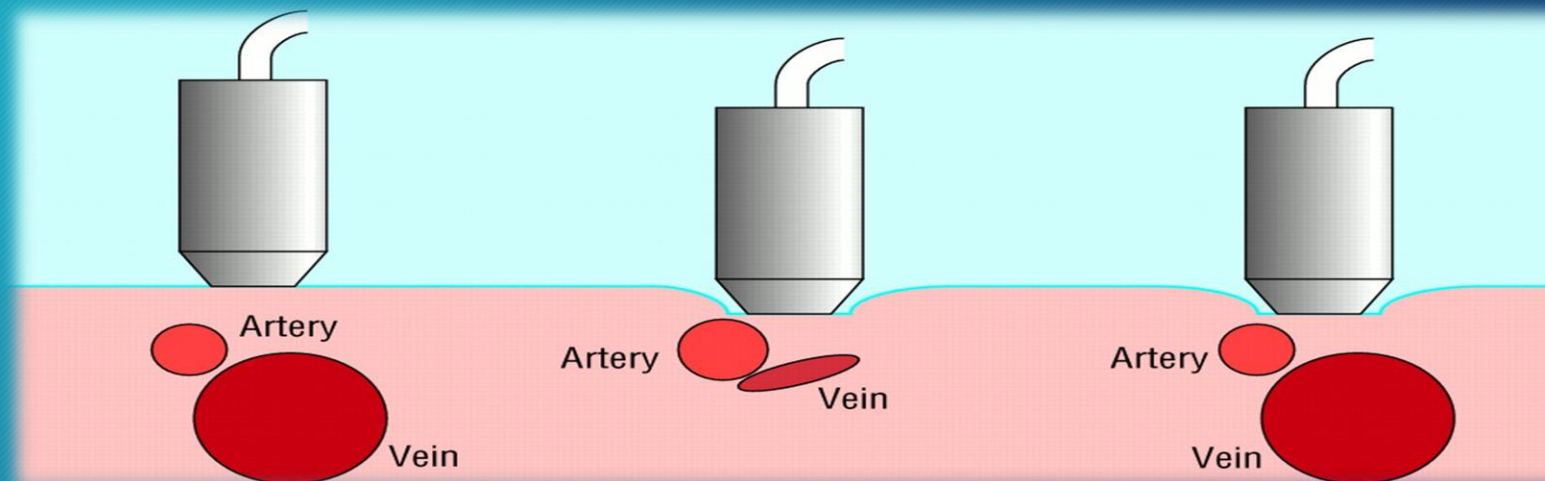
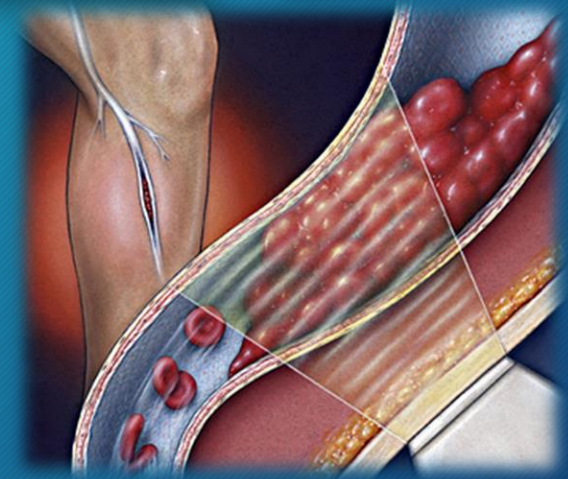
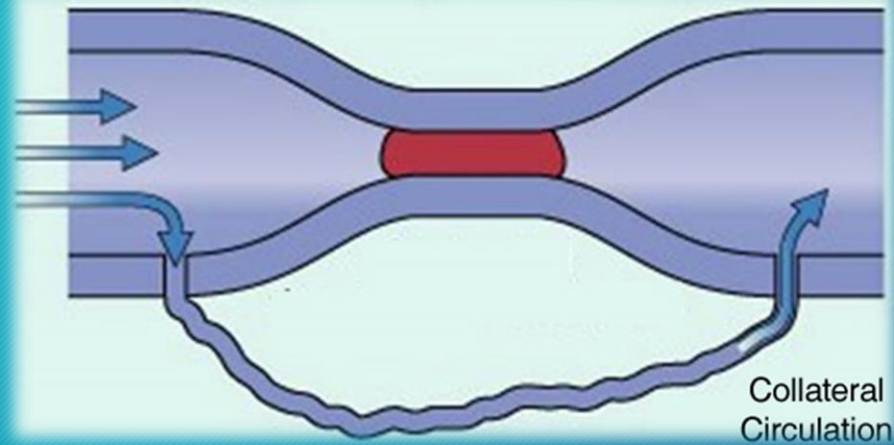
Ultrasound

- Advantages

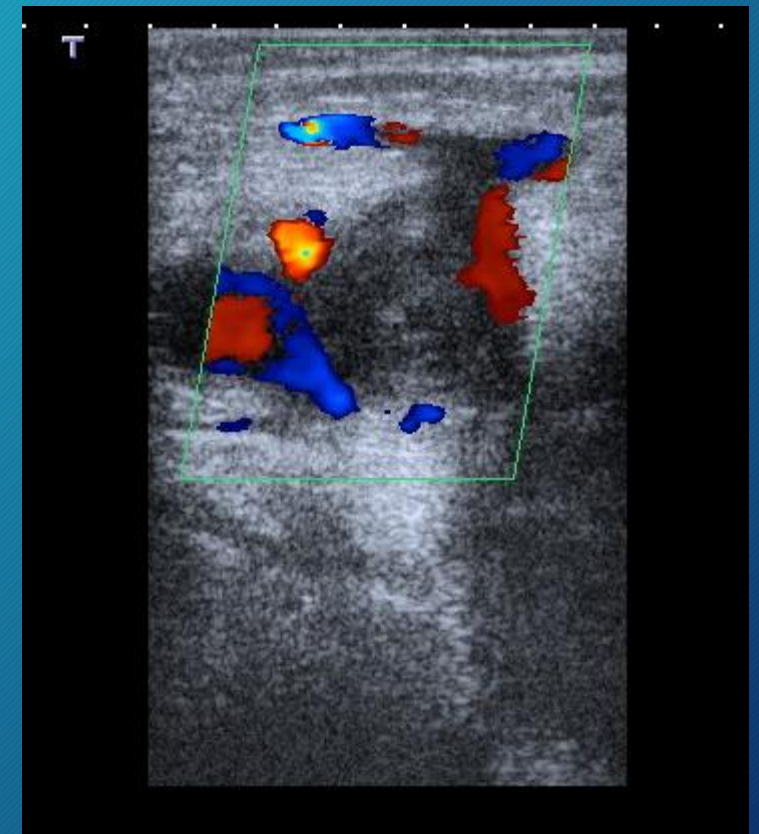
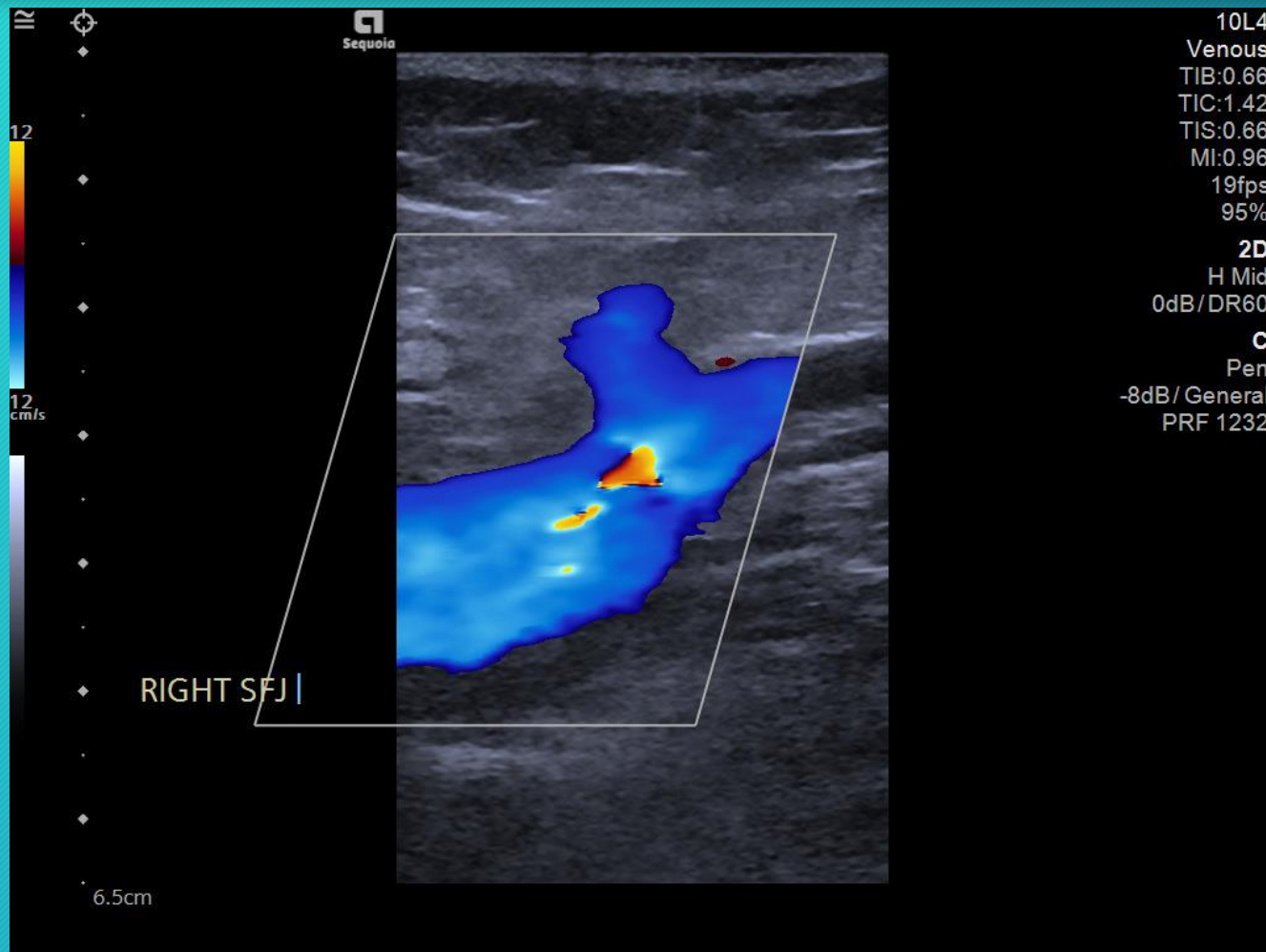
- Non-invasive
- Accurate
- Relatively quick
- Other pathology

- Disadvantages

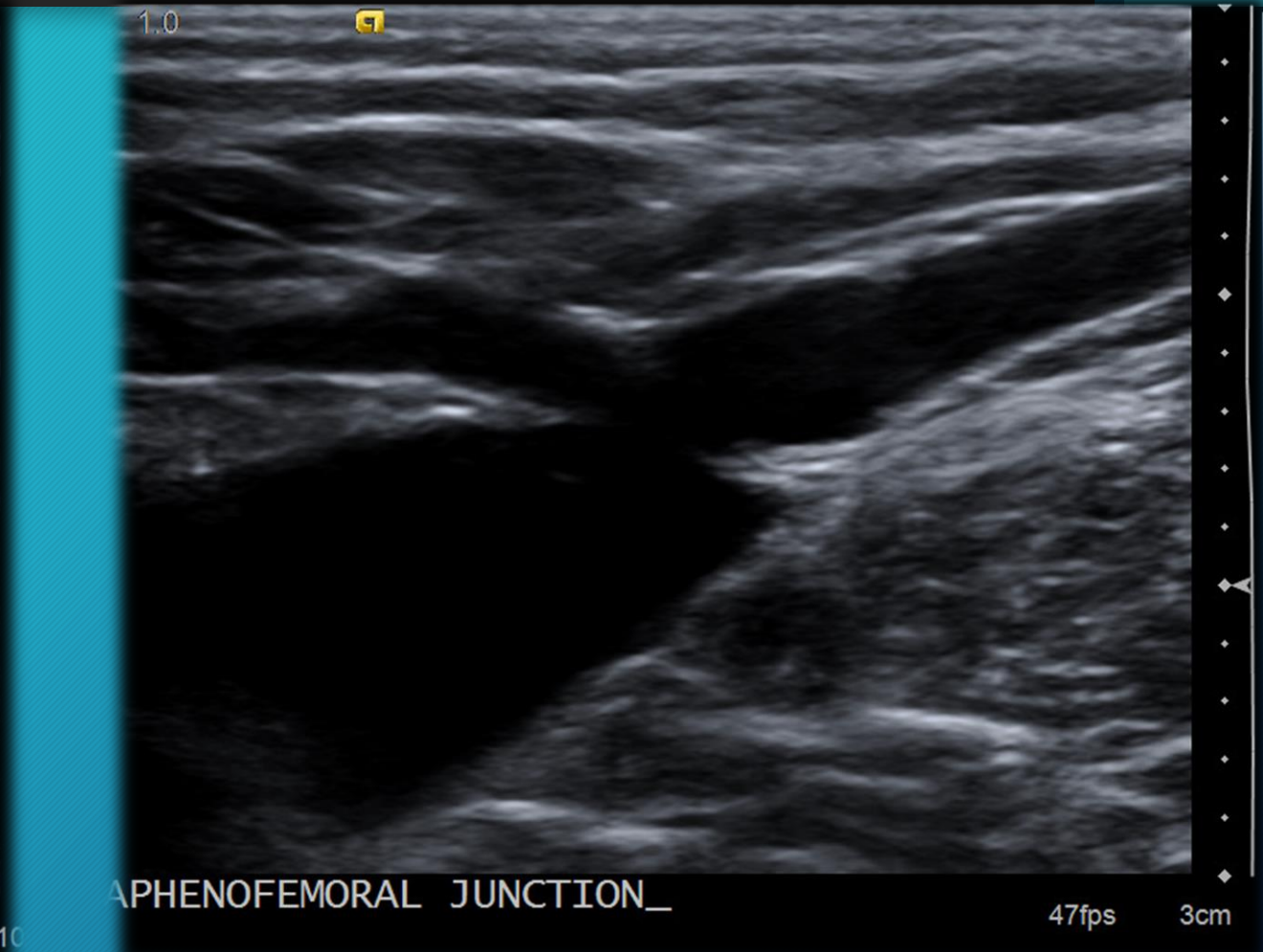
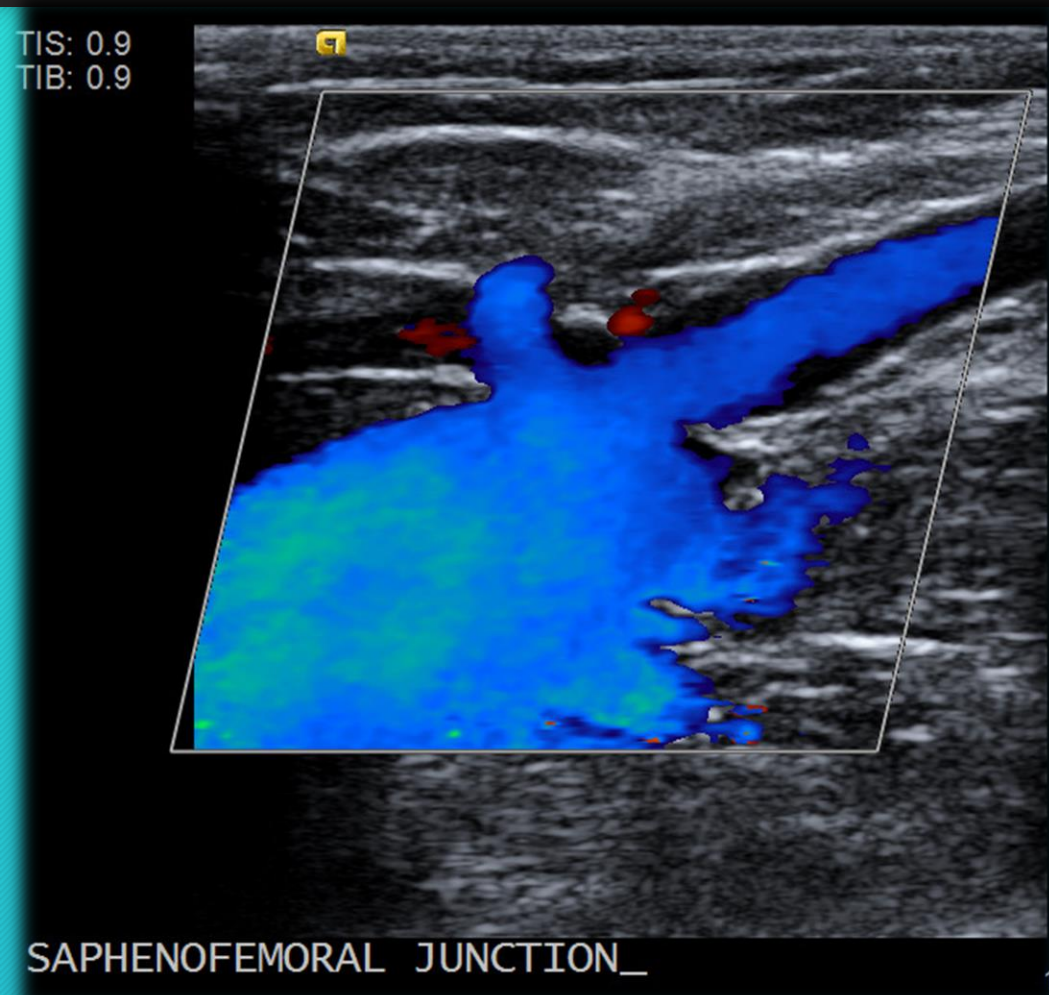
- Highly skilled operator required
- Fat Legs
- IVDU anatomy
- Ex-Fix / Frames



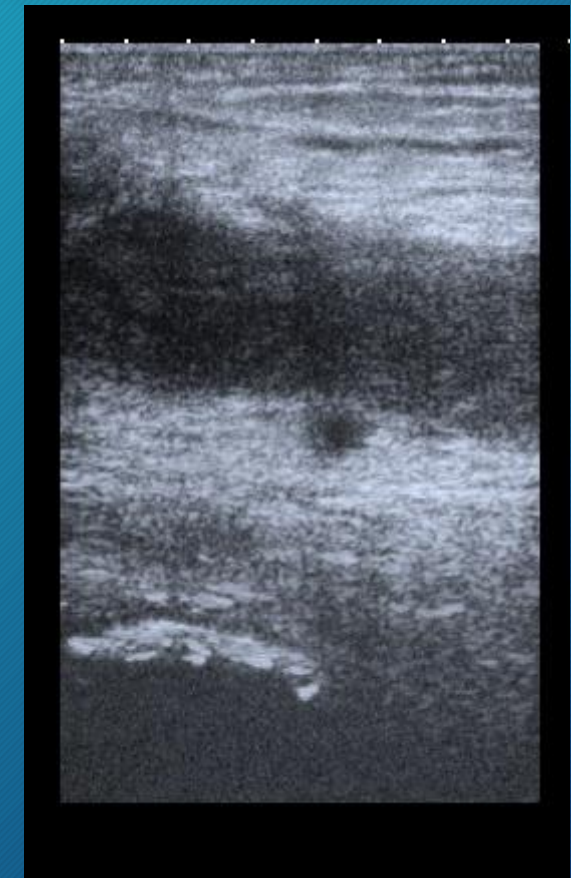
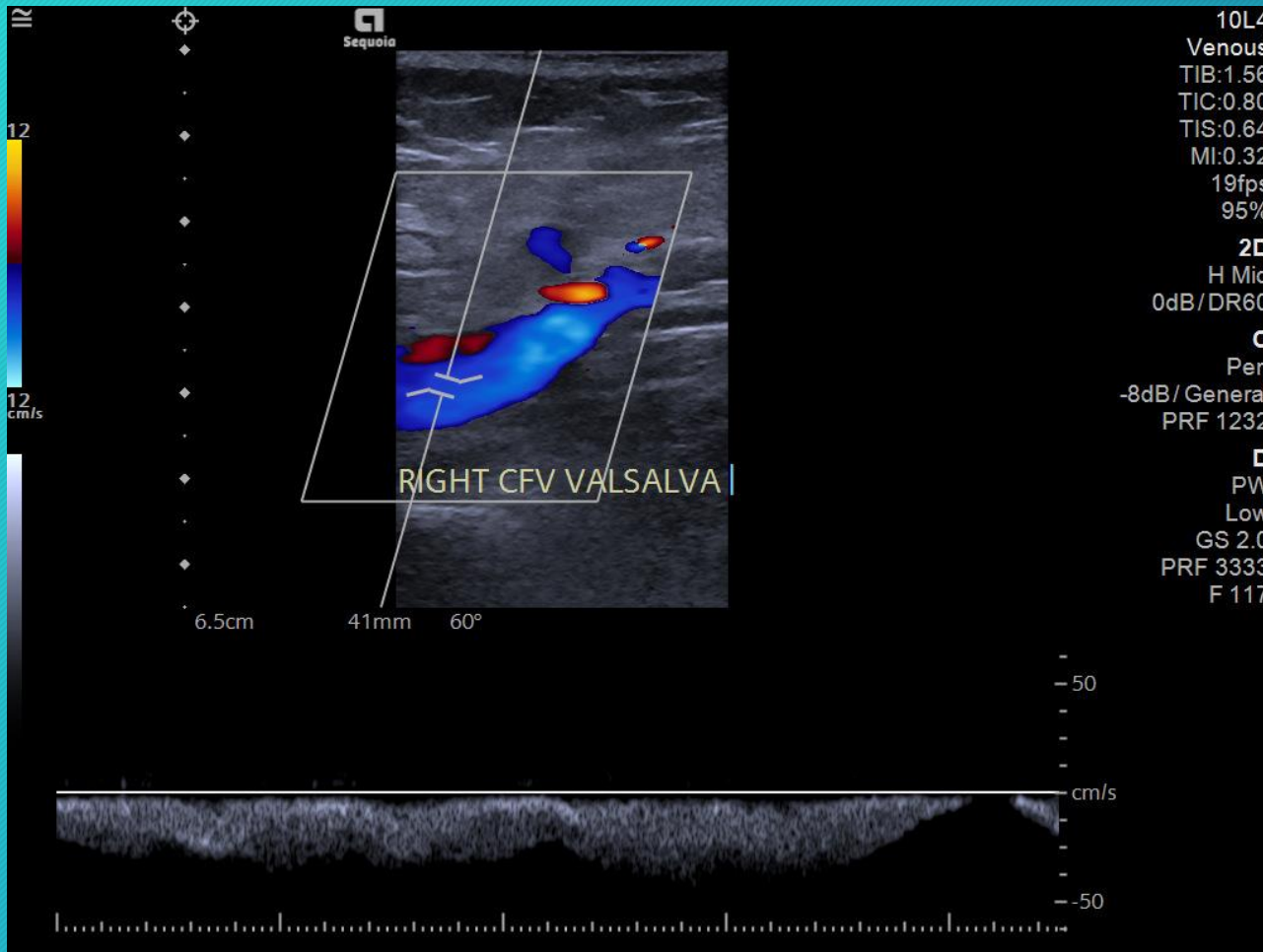
Saphenofemoral Junction



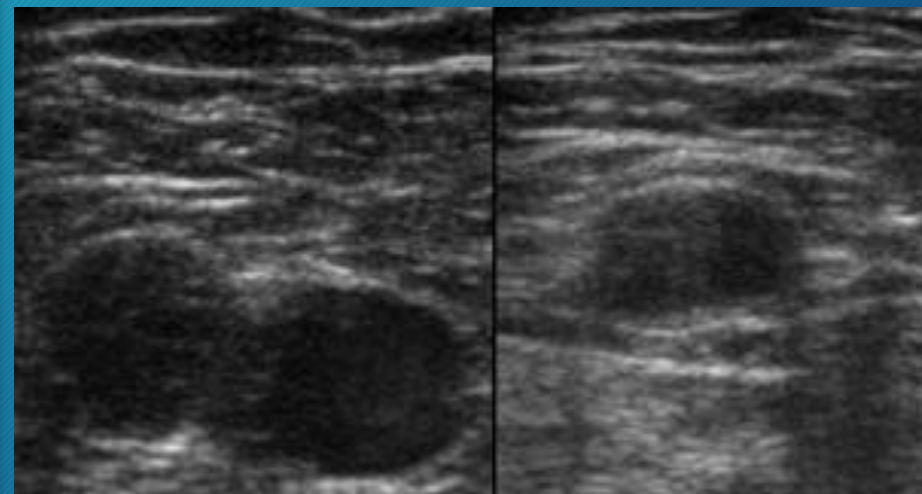
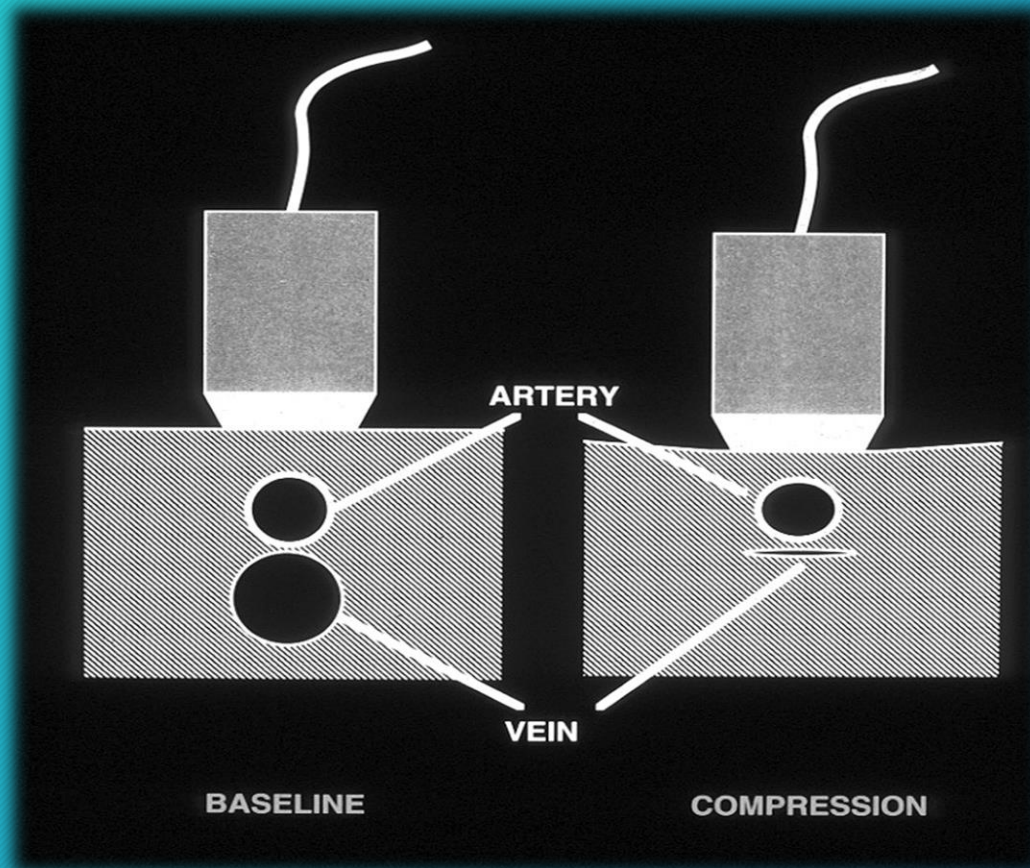
Saphenofemoral Junction



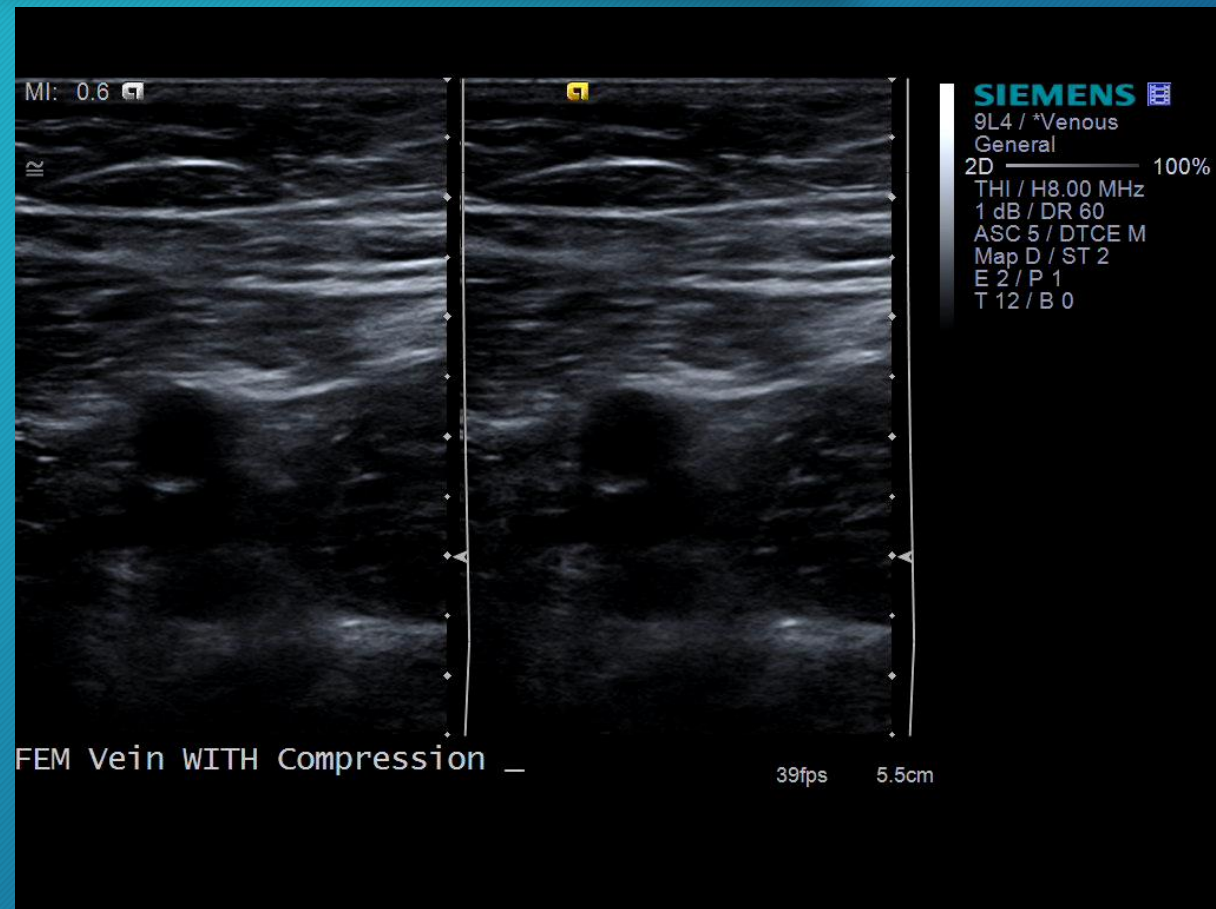
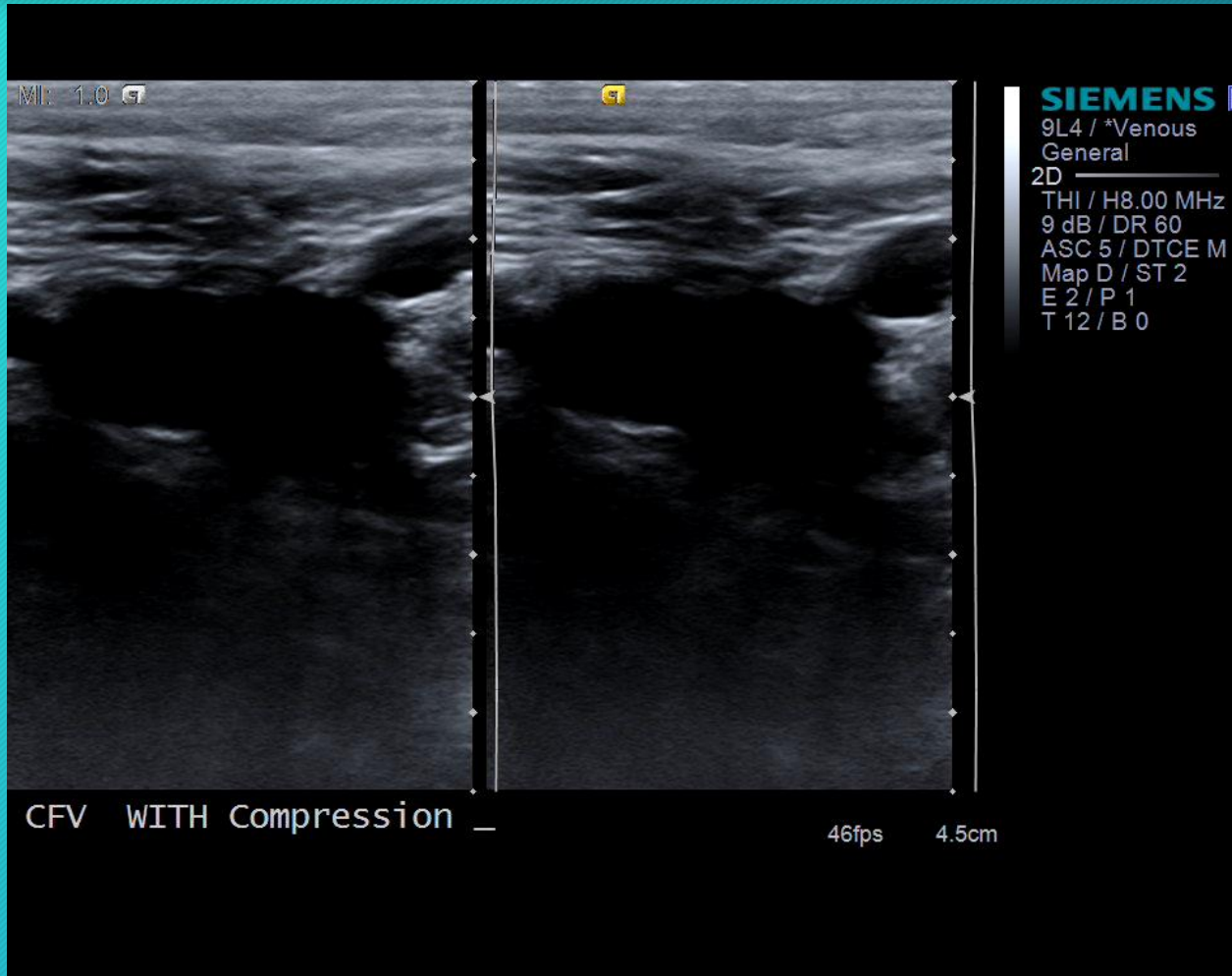
Common Femoral Vein



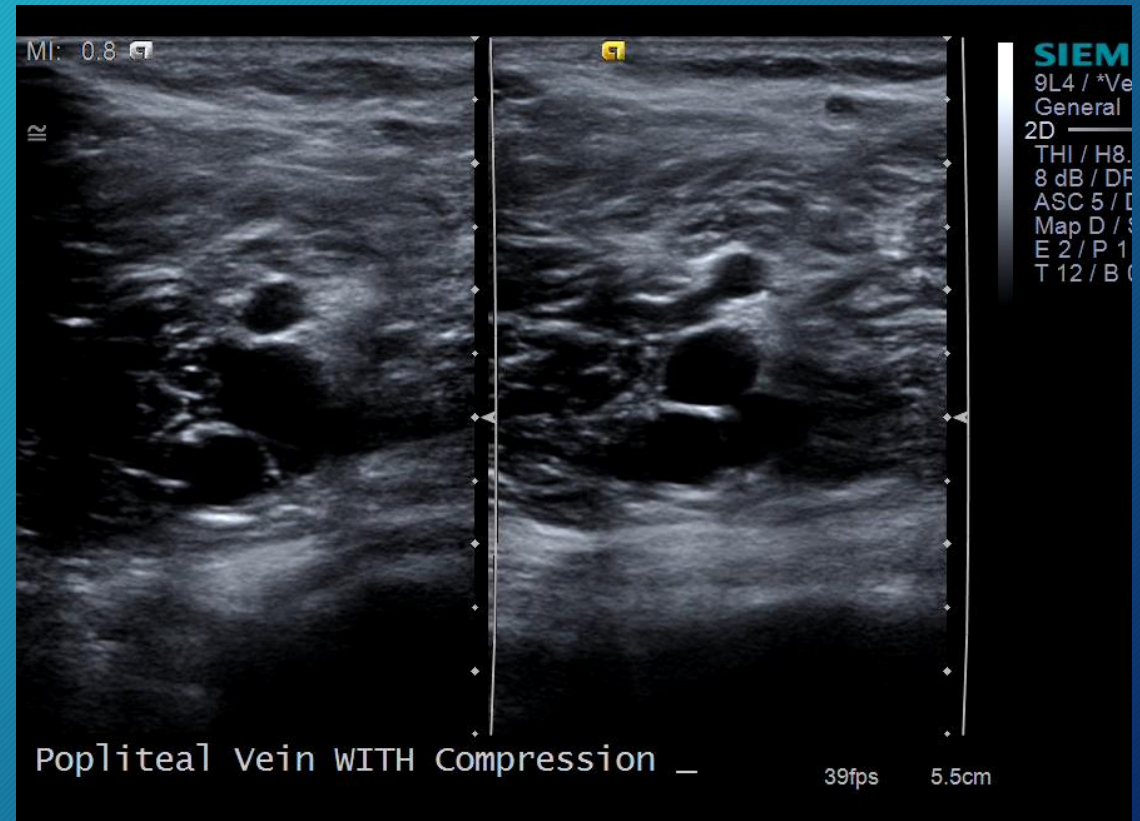
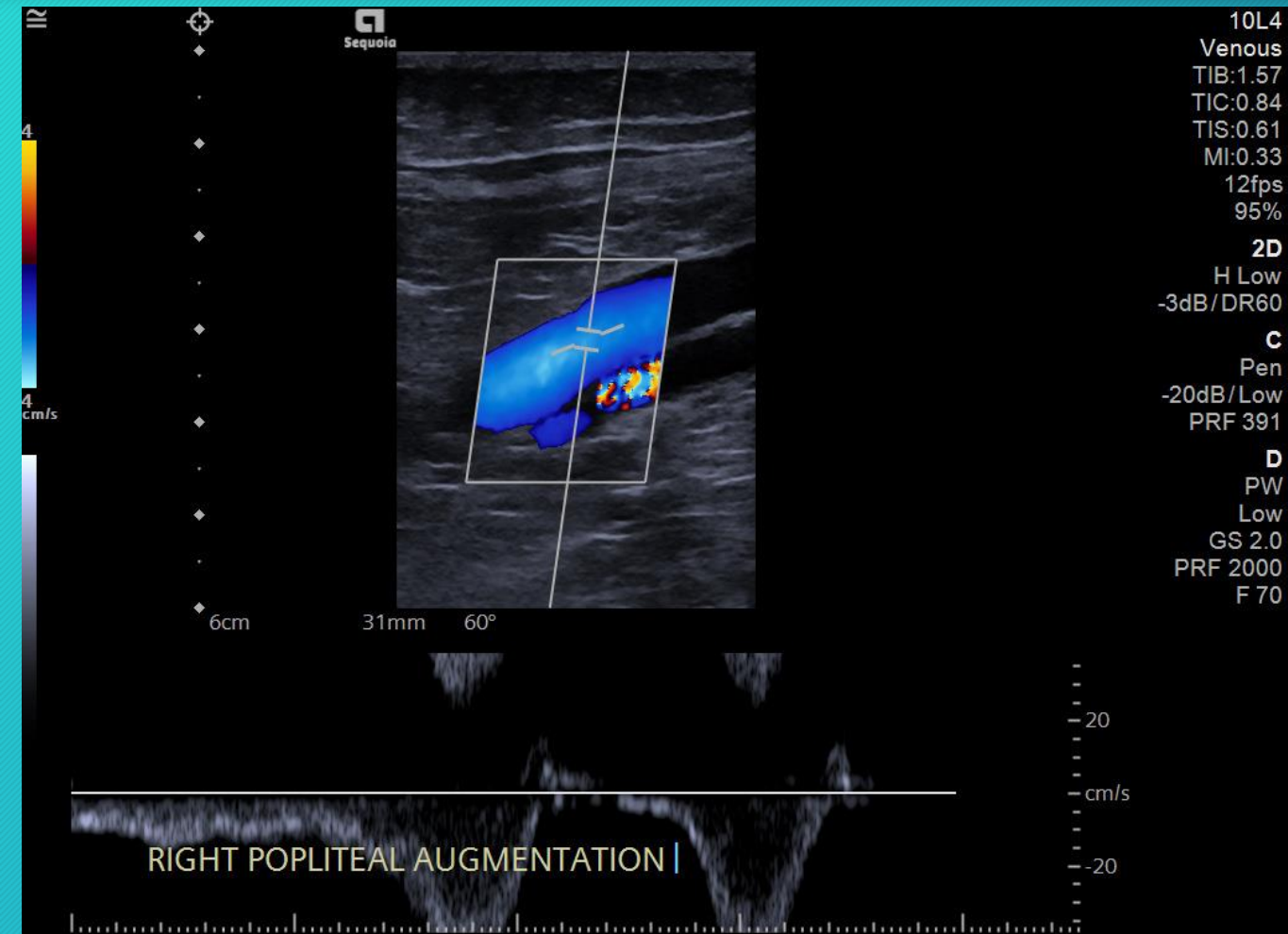
Femoral Vein



CFV & Femoral Vein Compressions



Popliteal Vein



Popliteal Fossa



Characterisation of Thrombus

➤ Occlusive vs Partially-occlusive (mural)

- **Acute**
 - echo-poor → no flow
- **Organisation**
 - dilated vessel with some material inside
- **Recanalising**
 - Old clot starting to break down
- **Chronic**
 - Occluded vein, normal size with internal echoes, collaterals
- **Acute-on-chronic**
 - Report as cannot exclude “acute-on-chronic” and treat as +ve

Differential Diagnosis

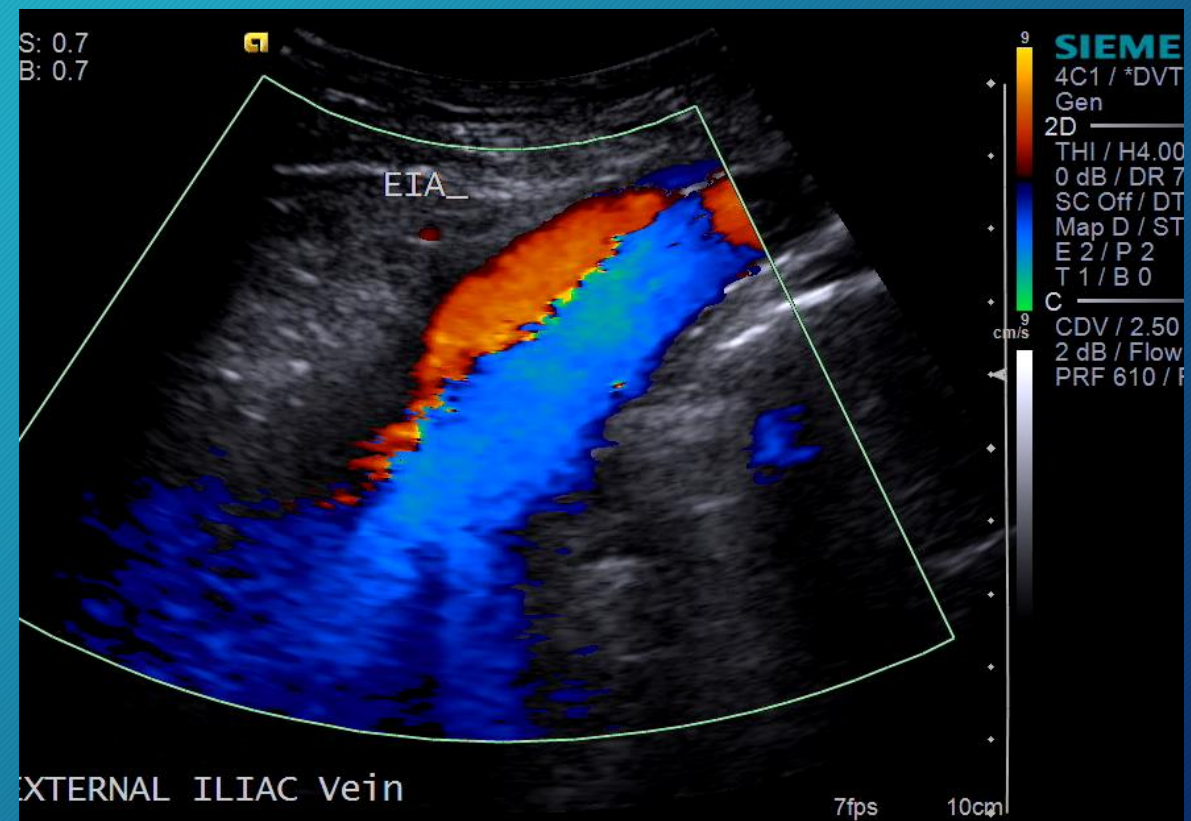
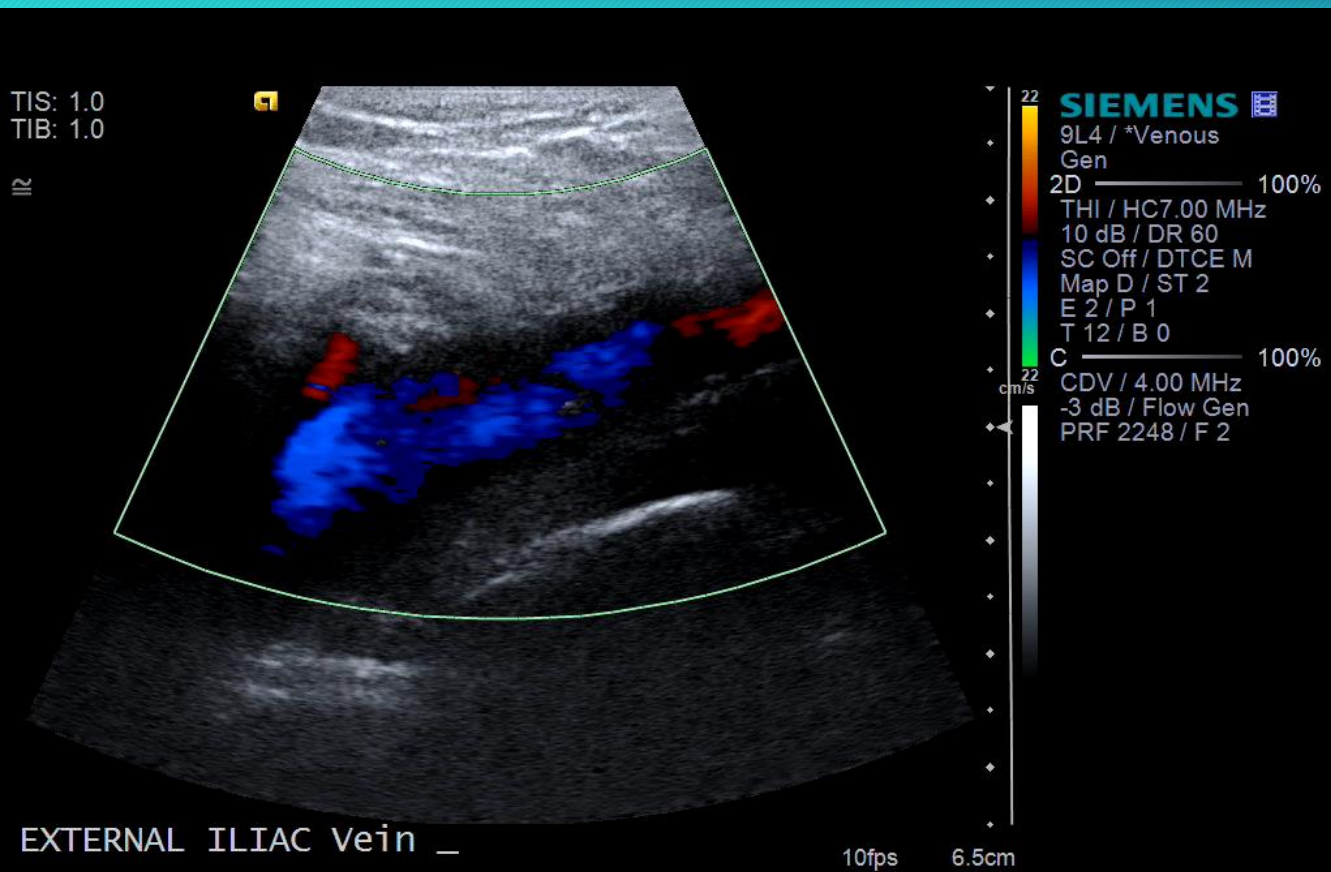
- Superficial thrombophlebitis
- Haematoma
- Cellulitis
- Subcutaneous oedema
- Popliteal (Baker's) cyst
- Abscess
- Muscle tear

Make sure not to forget!

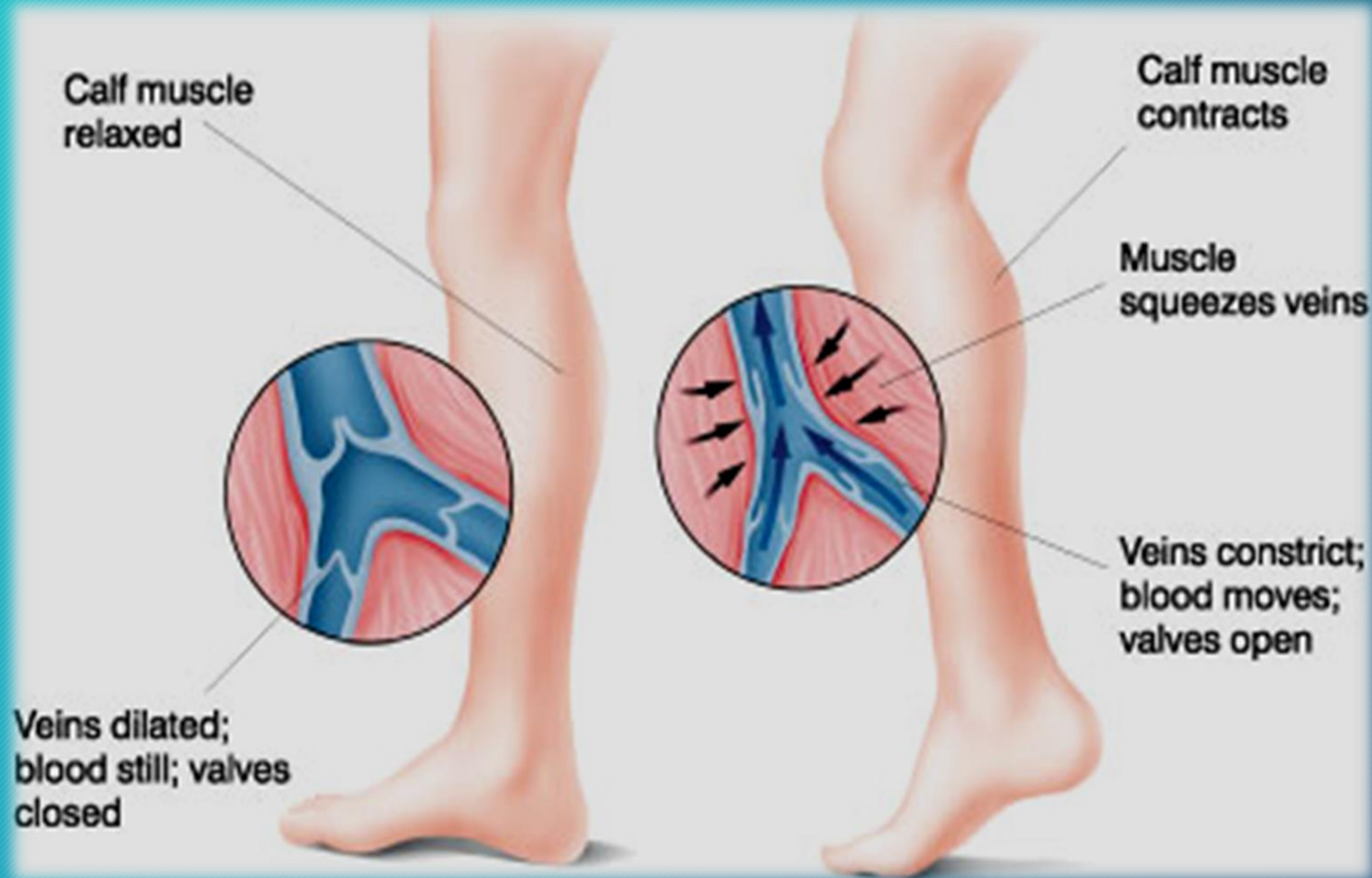
- When there is thrombus within the CFV
- You *MUST* assess the iliac vessels up to the IVC

- This is required for treatment planning, i.e. the need for IVC filters

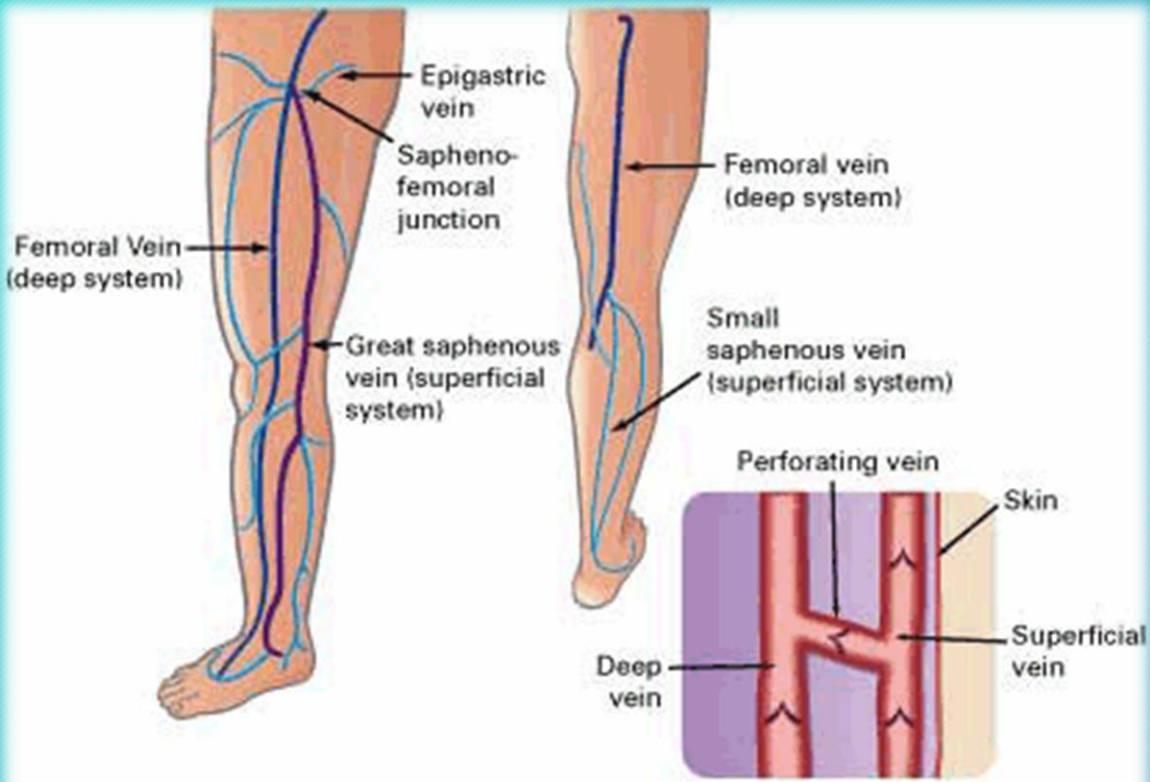
Iliac Veins



Calf Muscle Pump

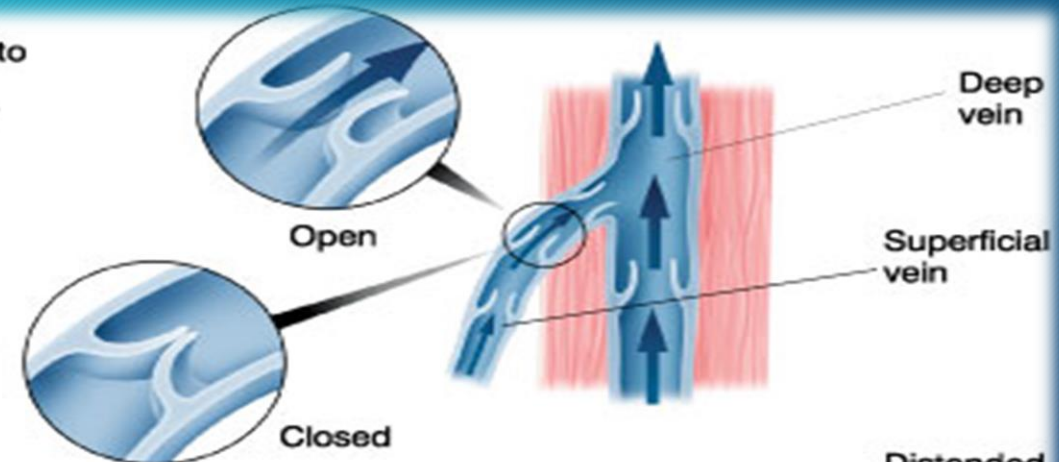


Venous Insufficiency

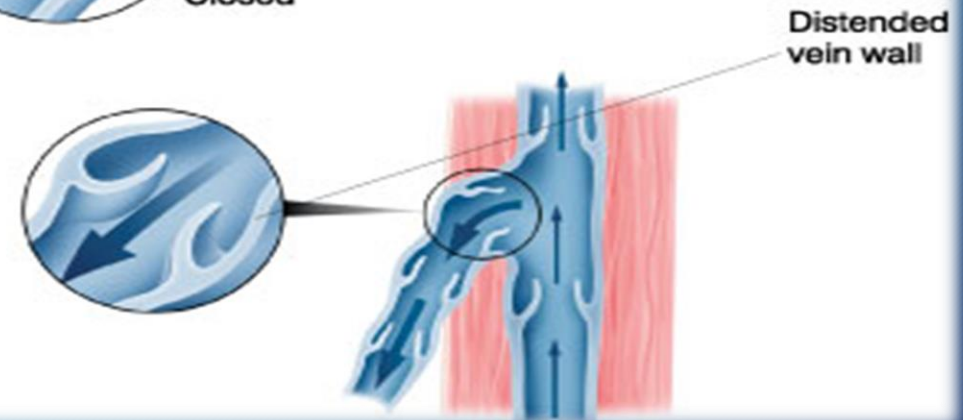


Perforating veins connect the deep system with the superficial system

Normal valve
Allows blood to flow in one direction only



Incompetent valve
Blood under force of gravity distends the section of vein below it, causing further valves to fail



Venous Insufficiency

Weakness in collagen fibres causes weakness in the valve causing a pressure force that cause downward flow problems

- Risk factors

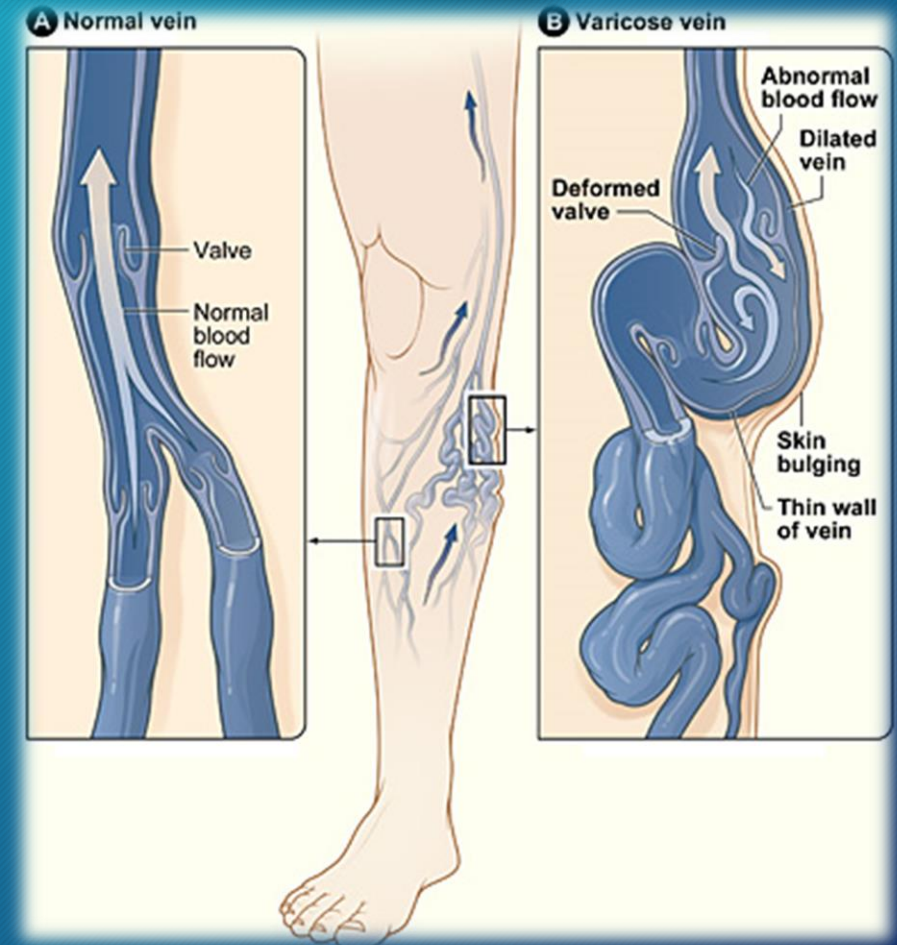
- Past thrombotic syndrome
- Obesity
- Arthritis
- Immobility

TREATMENT OPTIONS

- Compression
- Injection
- Surgery
- Laser ablation (EVLT)

Varicose Veins

- Primary - hereditary
- Secondary - post DVT
- Recurrent - post surgery or sclerotherapy
- Types
 - Trunk (thick knobbly veins)
 - Reticular (network of small red veins)
- 20% of people aged 20
- 80% of people aged 60
- Most common vascular surgery
 - 30% of presentations are recurrent
 - 66% due to inadequate surgery



Examination Protocol

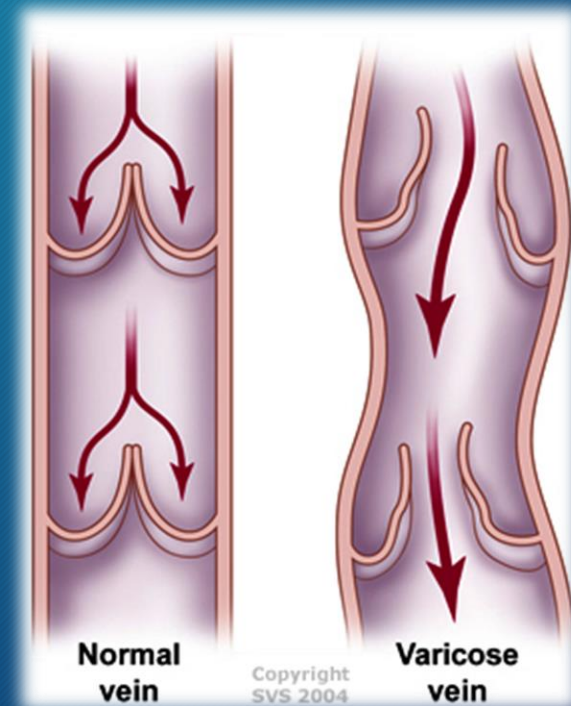
- Deep veins
 - Patency, compressibility and reflux
- Saphenofemoral junction & LSV
 - Reflux and patency
- Thigh perforators
 - Competency (superficial to deep is normal)
- Saphenopopliteal junction & SSV
 - Competency
- Calf

Grading of Venous Reflux

- Normal - Reflux duration less than 0.5 s
- Moderate - Reflux duration of 0.5 - 1.0.s
- Severe - Reflux duration of greater than 1s

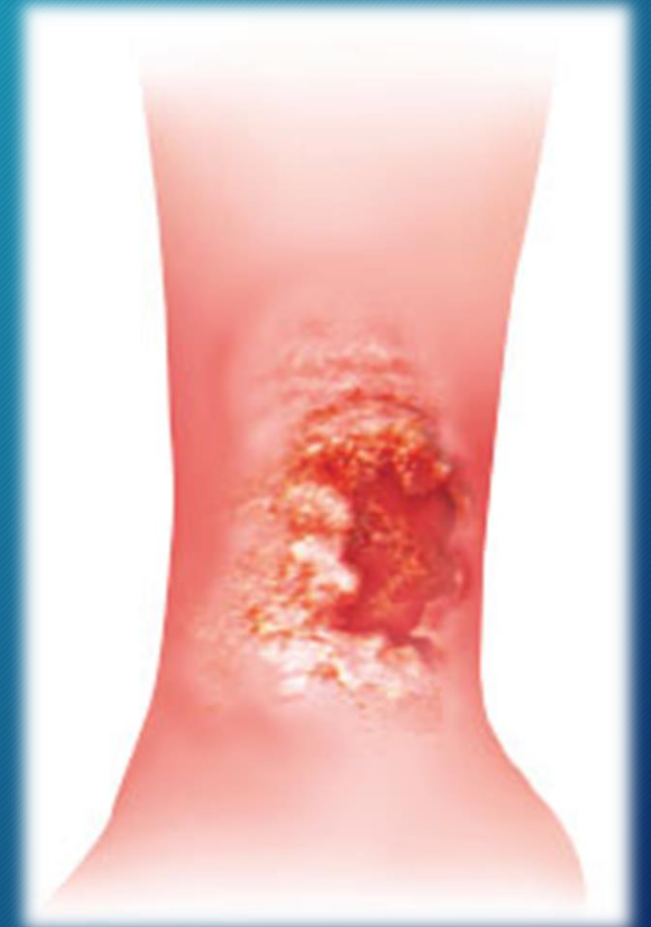
- Erect position

- Test for valve incompetence
 - Cough
 - Valsalva
 - Muscle squeeze / augmentation
 - Most effective



Venous Ulcer

- Improper functioning venous valves
- Chronic wounds
- 48% recurrence



Everything Else...

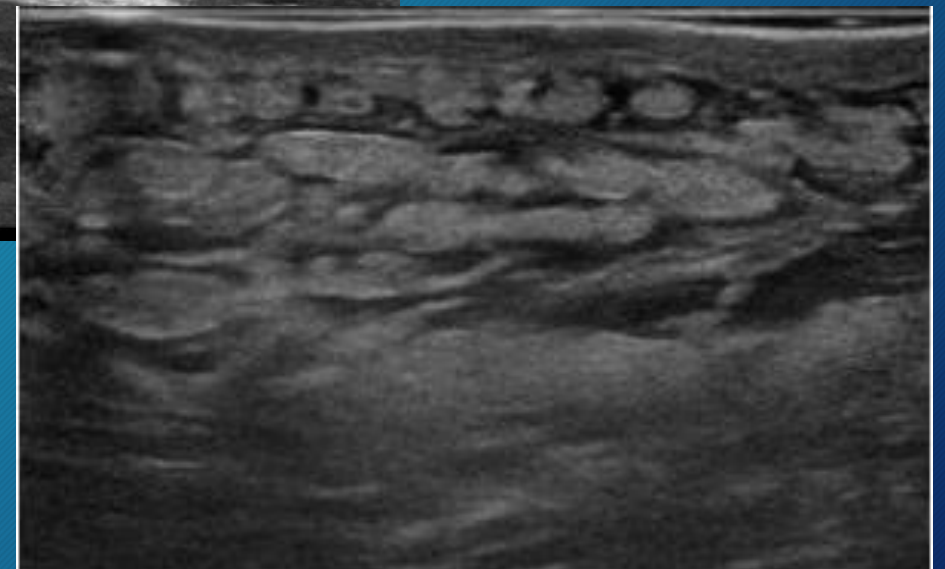
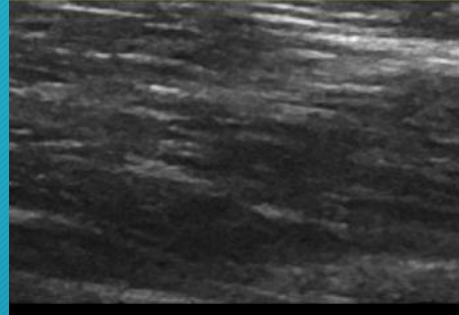
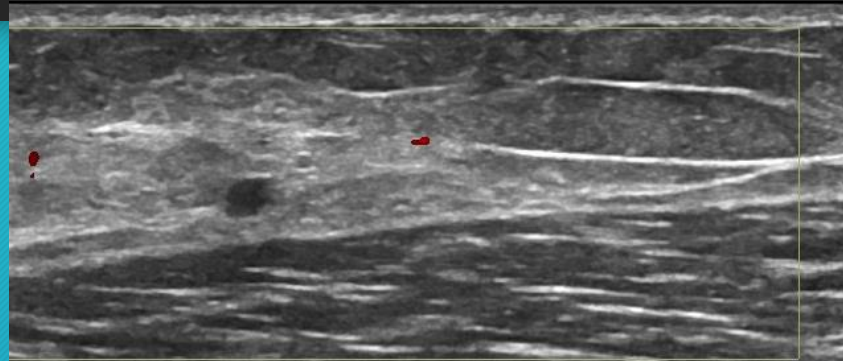
Non-Vascular Findings in lower limb US

Traumatic injuries

- Contusion common
- Range from simple haemorrhagic infiltration of fat lobules to fat necrosis, haematomas and abscesses
- Bloody fat infiltrate
 - Increased echogenicity of fatty lobules, makes separation from hyperechoic skin and connective tissue strands of subcut tissues undefined, absence of anechoic septa distinguishes from simple oedema

Oedema

- Early
 - hyperechoic fat lobules
- Progressive
 - connective septa enlarge and anechoic
 - distension of lymphatic channels, outline hyperechoic fat lobules,
 - graded pressure does not collapse channels.



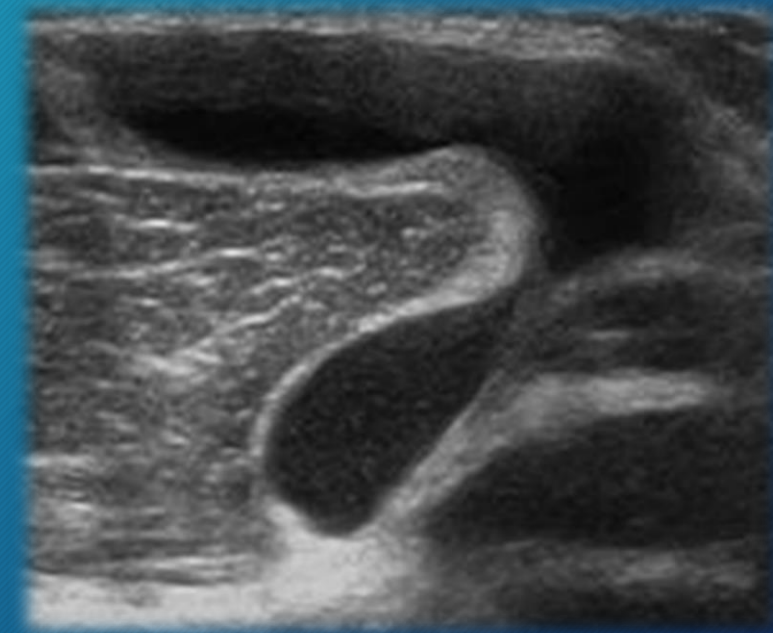
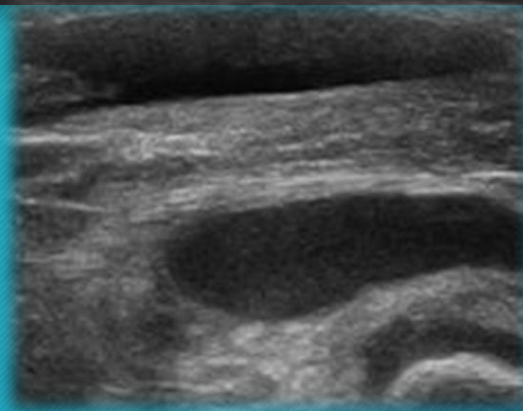
Abscess

- Variable appearance
 - Superficial/deep
 - Simple anechoic → mixed echogenic
 - Well defined → ill defined
 - Thin → thick walled
 - +/- surrounding hyperaemia
 - +/- displacing internal echogenic material
 - +/- gas

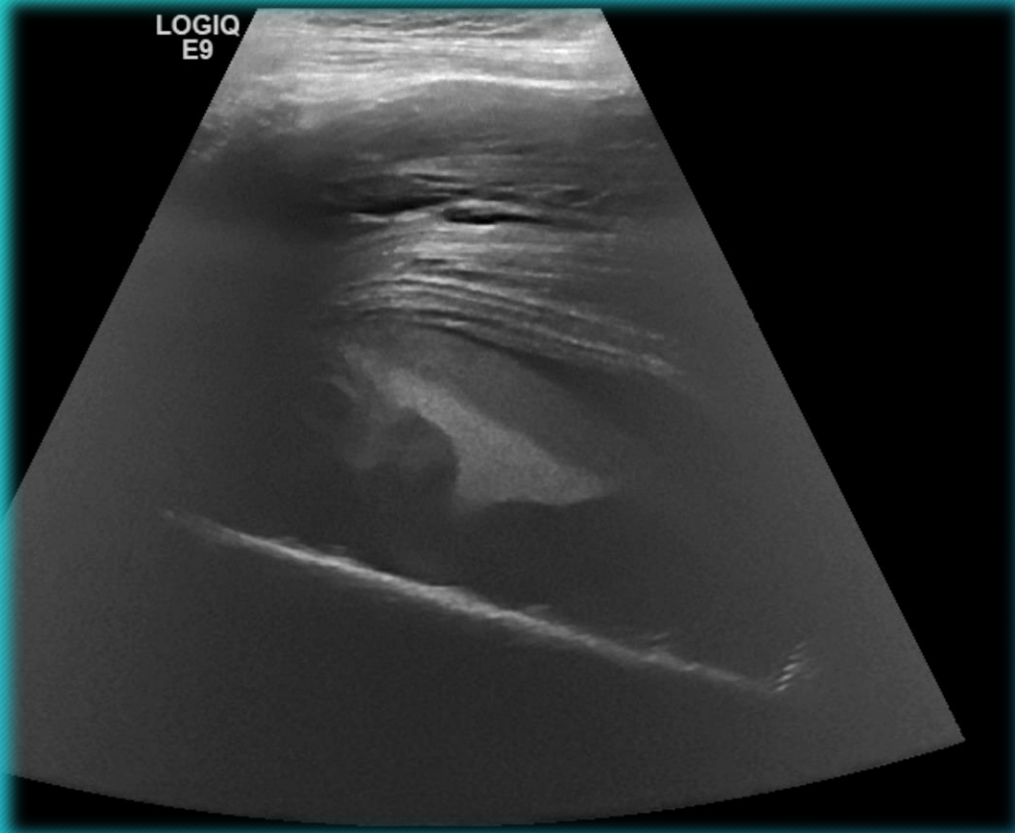


Synovial cyst

- Lined by synovial tissue
- Communicate with joint space
- Baker's cyst
 - Posteromedial knee
 - OA/inflamm arth/meniscal tears/chronic effusions
 - Synovitis/debris/bodies
 - Complications
- AC joint cyst
 - 'Geyser' sign



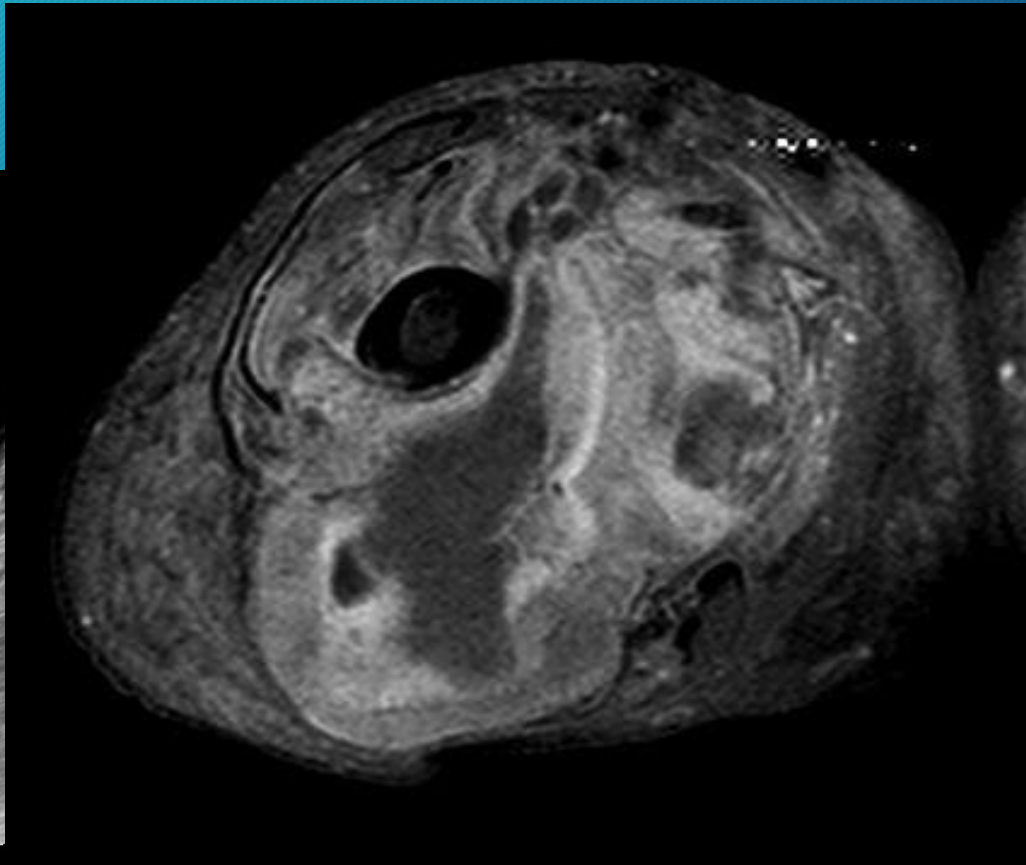
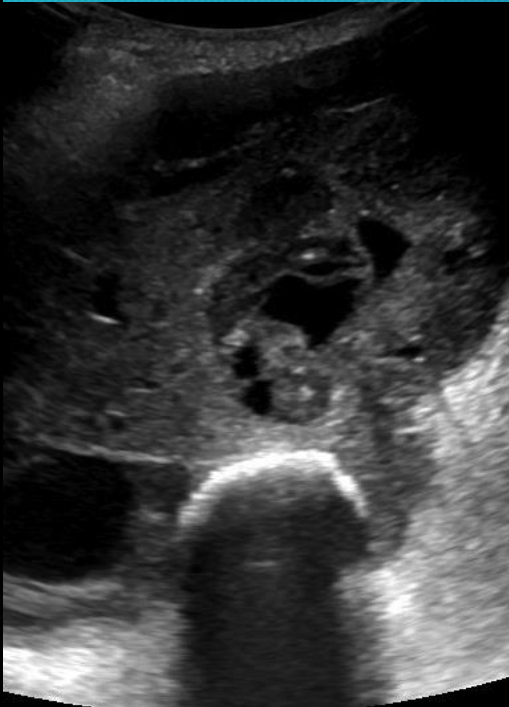
Haematoma



- Variable appearance
- Age
- Acute
 - Fluid fluid levels
 - Plasma, red cell, fat, thrombus,
 - Heterogeneous
- Chronic
 - Liquefaction
 - Septations
 - Expanding mimic mass lesion

Beware the spontaneous haematoma

- especially in patients without anti-coagulation & insignificant trauma
- Repeat imaging after 6-8 weeks



To Sum Up

Ultrasound has many uses

- Lower Limb DVT
- Venous Insufficiency
- Trauma
- Soft tissue Lumps and Bumps

Any Questions?