

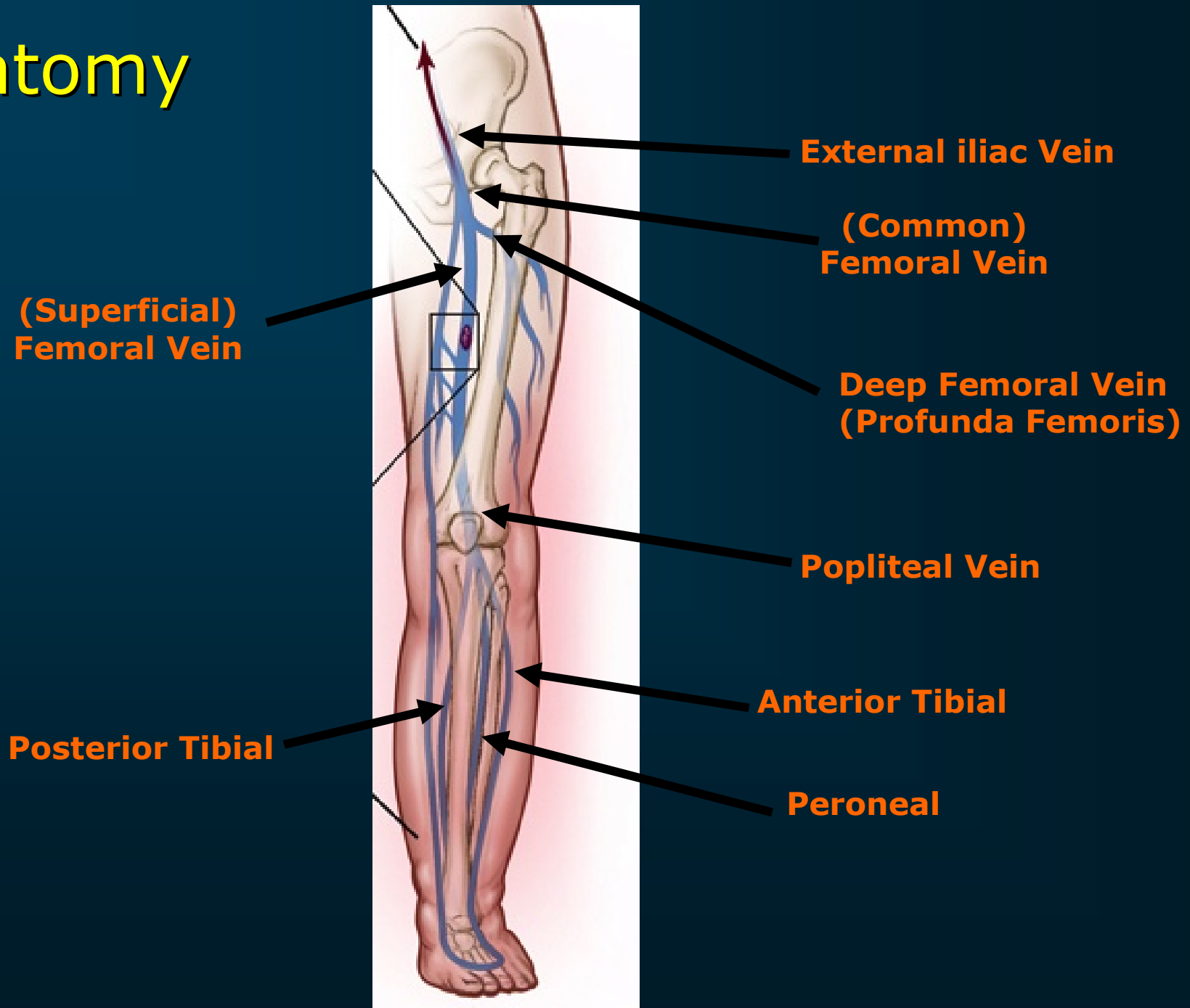
# Deep Vein Thrombosis and Post-Thrombotic Syndrome

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# Deep Vein Thrombosis

# Anatomy



# Proximal vs Distal DVT

## Proximal

- Femoral/Popliteal veins = "Above knee"

## Distal

- Tibial/Peroneal veins
- Gastrocnemius/Soleal veins = "Below knee"

# What is Deep Vein Thrombosis?

- Formation of thrombus within the deep veins of the upper or lower limb
- Primary pathology of venous system
- Results in significant morbidity and mortality
- Inpatients
  - 48 per 100,000 develop DVT
  - 23 per 100,000 develop PE
  - Inpatient mortality from VTE = 12%

# Incidence

- 1-2 per 1000 per year
  - 2/3 are DVT
  - 1/3 PE
  - Risk doubles every decade after age 40
- Major complications
  - Post thrombotic syndrome (PTS)
  - Death (PE)
  - Bleeding (Warfarin)

# Risk Factors

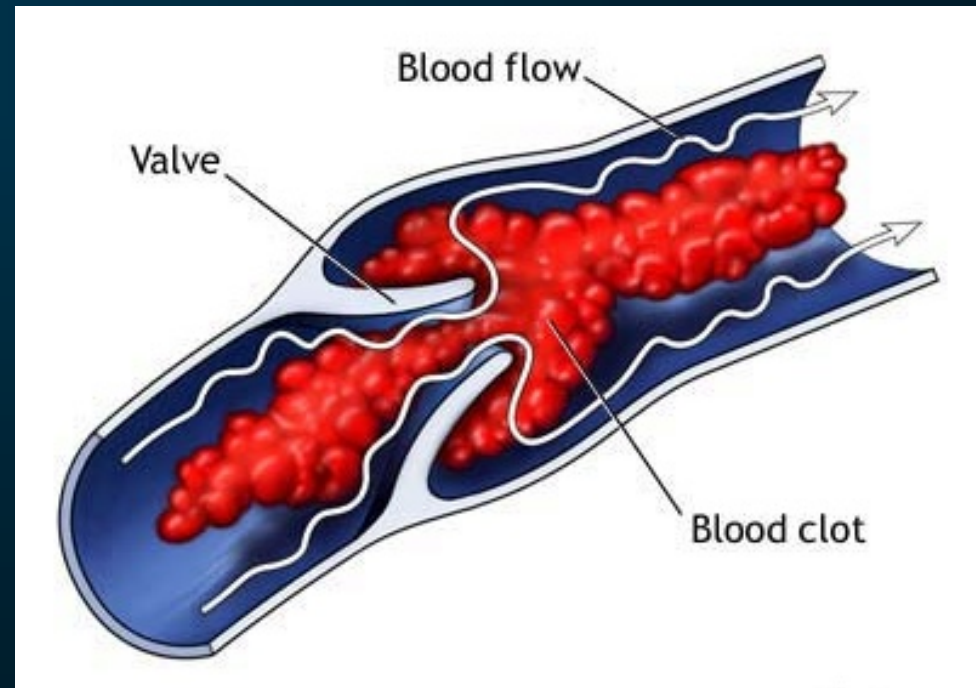
- Surgery 20%
- Trauma 12%
- PHx - DVT / PE 25%
- Immobility (Hospital or Nursing Home) 8%
- Lower Extremity paresis 3%
- Cancer 4-6%
- Hormone replacement therapy 2%
- Oral Contraceptive pill 3%
- Inherited Thrombophilia
  - Factor V Leiden
  - Protein C, S deficiency
  - Lupus

- Pregnancy
- Heart Disease
- Obesity
- Sepsis
- Age
- Gender (Female > Male)
- Sedentary occupation
  - Seated Immobility Thromboembolism Syndrome (SIT)

# Pathogenesis

## Virchow's triad (1856)

- Stasis
  - Venous Injury
  - Hypercoagulability
- 
- Location
    - Valve pockets
    - Site of venous injury
    - Calf usually 1° site



# Symptoms of DVT

- Swelling
- Pain, Tenderness
- Pitting Oedema
- Distension of superficial vessels
- Positive Homan's sign
- Shortness of breath
- Cutaneous erythema



# Clinical Assessment

- Large differential diagnosis
  - Ruptured Baker's cyst
  - Cellulitis
  - Haematoma
  - Compartment syndrome
  - Superficial thrombophlebitis
  - Lymphoedema
  - CHF
  - Adenopathy
- Need standardised procedure...

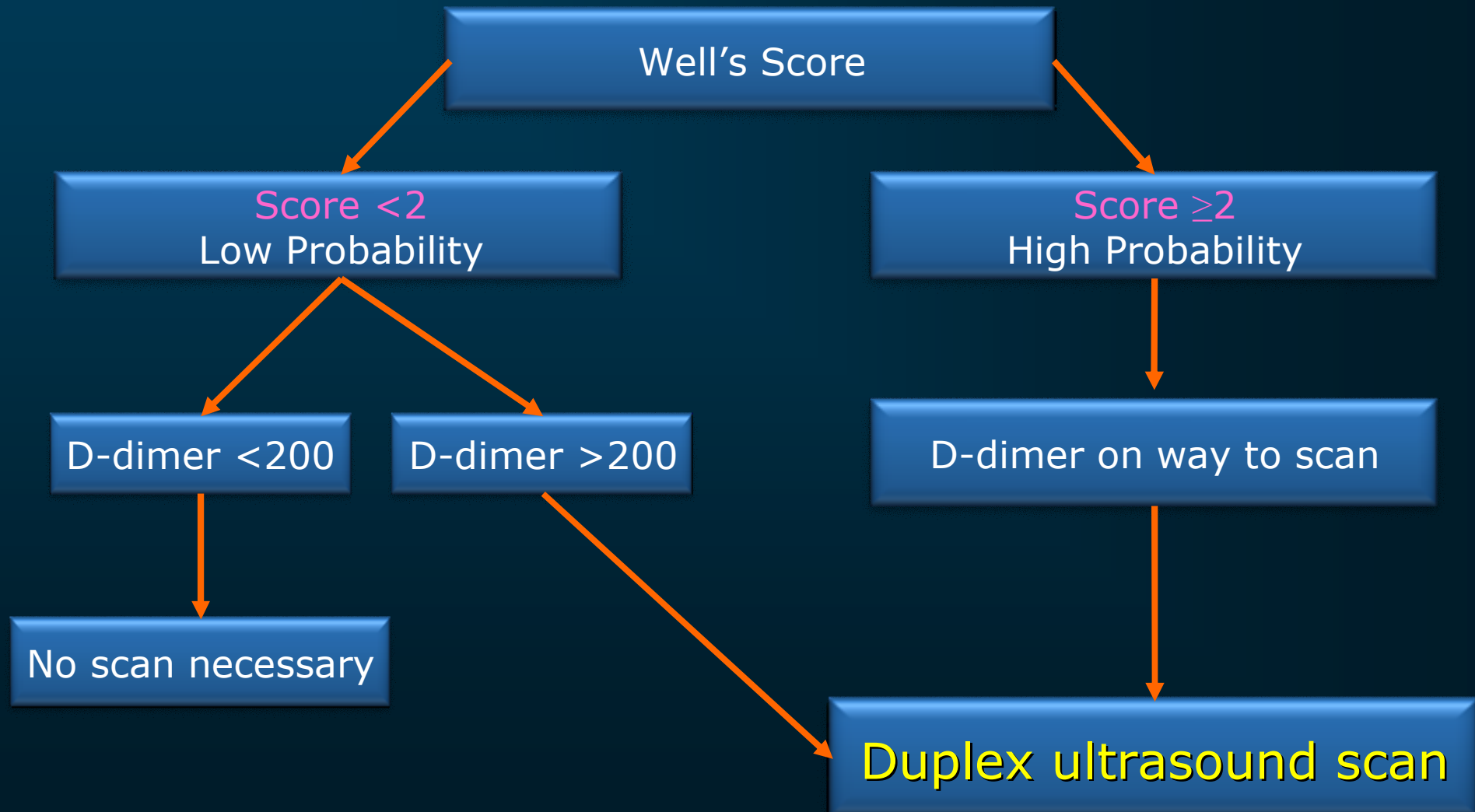
# Well's Criteria

Clinical Features	Score
Active cancer (treatment ongoing, or within 6/12 or palliative)	1
Paralysis or recent plaster immobilization of the lower extremities	1
Recently bedridden for >3/7 or major surgery <4/52	1
Localized tenderness along the distribution of the deep venous system	1
Entire leg swelling	1
Calf swelling >3 cm compared to the asymptomatic leg	1
Pitting edema (greater in the symptomatic leg)	1
Previous DVT documented	1
Collateral superficial veins (non varicose)	1
Alternative diagnosis (as likely or > that of DVT)	-2

# D-dimer

- Byproduct of Fibrinolysis
- Diagnoses thrombotic activity
- Non-specific in diagnosis of DVT
  - -ve D-dimer = DVT unlikely
  - +ve D-dimer = DVT or other coagulable state
- Other conditions cause raised D-dimer
  - Active cancer
  - Pregnancy
  - Infection
  - Post-surgery
  - Inflammatory processes
  - Trauma

# Algorithm



# Duplex Ultrasound

# What is Duplex Ultrasound?

Combination of conventional imaging and  
doppler flow information

# Advantages of Ultrasound

- Accurate
- Cost effective
- Non-invasive
- No ionizing radiation
- No nephrotoxic contrast
- No contraindications
- Portable
- Assessment of blood flow and anatomy
- “Real-time” examination
- Patient friendly

# Purpose

- Compressibility
- Visualisation of thrombus
  - Differentiate acute vs. chronic
- Assessment of venous flow
  - Spontaneous, Phasic, Augmentation
- Valve cusp movement

# Limitations of Ultrasound

## Accuracy

- Highly accurate when performed by experienced operator(s)
- Sensitivity: 97%, Specificity 96% from groin down

**Any imaging test is only as strong as its weakest link**

Patient, Equipment, Technique, or Operator

# Equipment

- Colour duplex ultrasound
- High definition imaging
- Appropriate transducer frequency



# Ultrasound Appearances

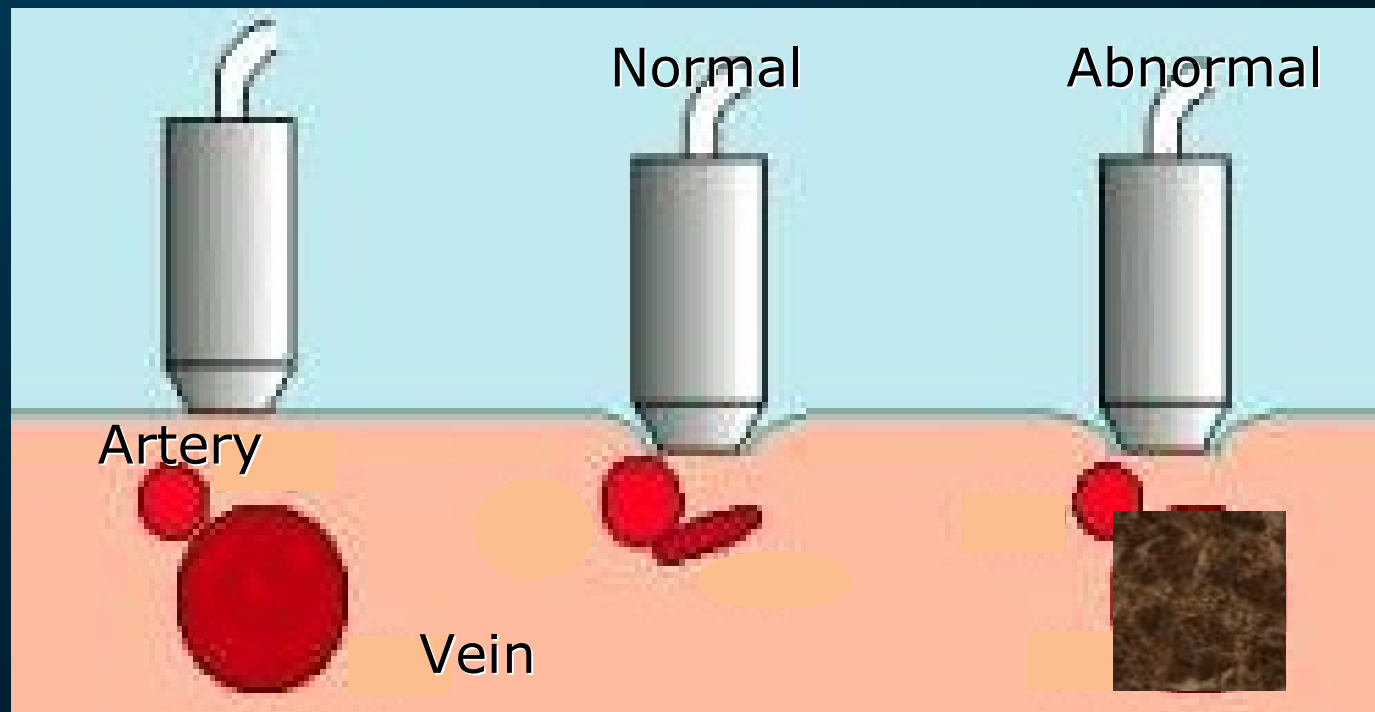
## ■ NORMAL

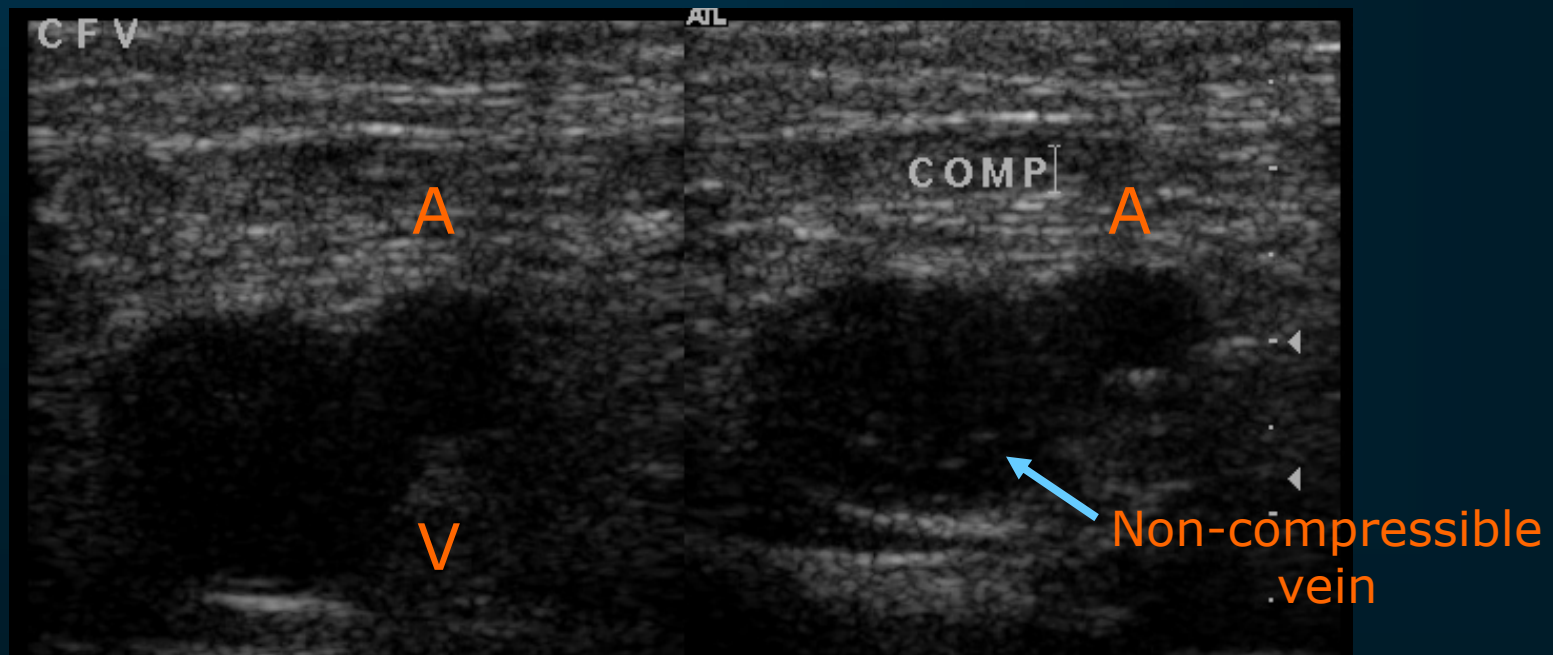
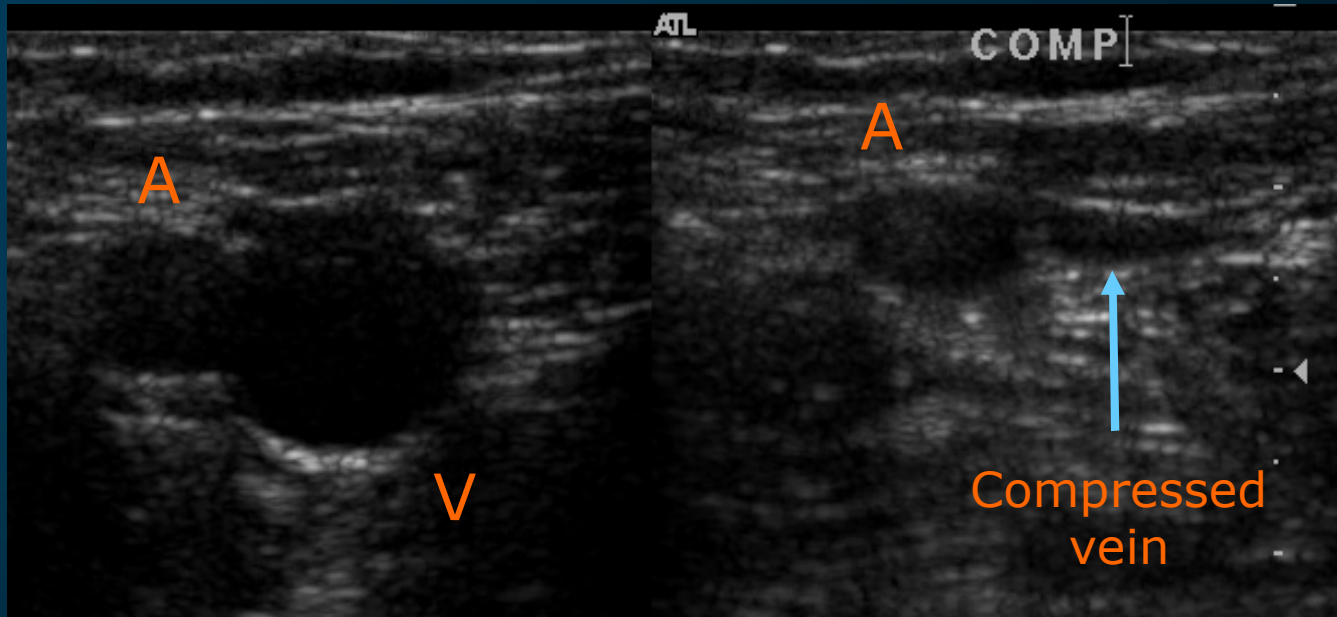
- Echo-free lumen
- Size – slightly larger than artery
- Compressible
- Spontaneous flow
- Phasic flow
- Augmentation with compression and release

## ■ ABNORMAL

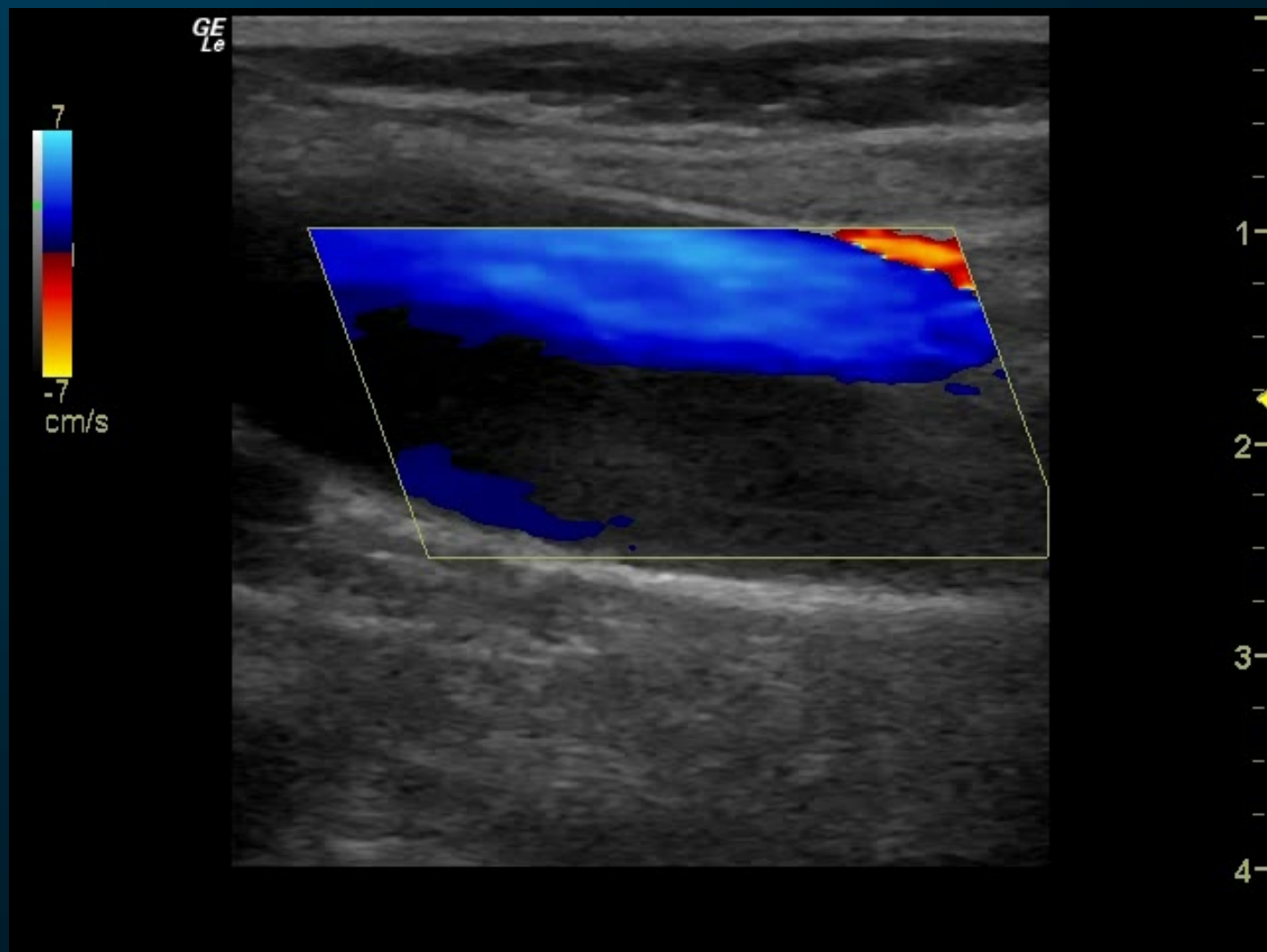
- Echogenic material within lumen
- Distended veins
- Non-compressible
- Absent / diminished flow
- Continuous flow
- Dampened / absent flow with augmentation

# Venous Compression

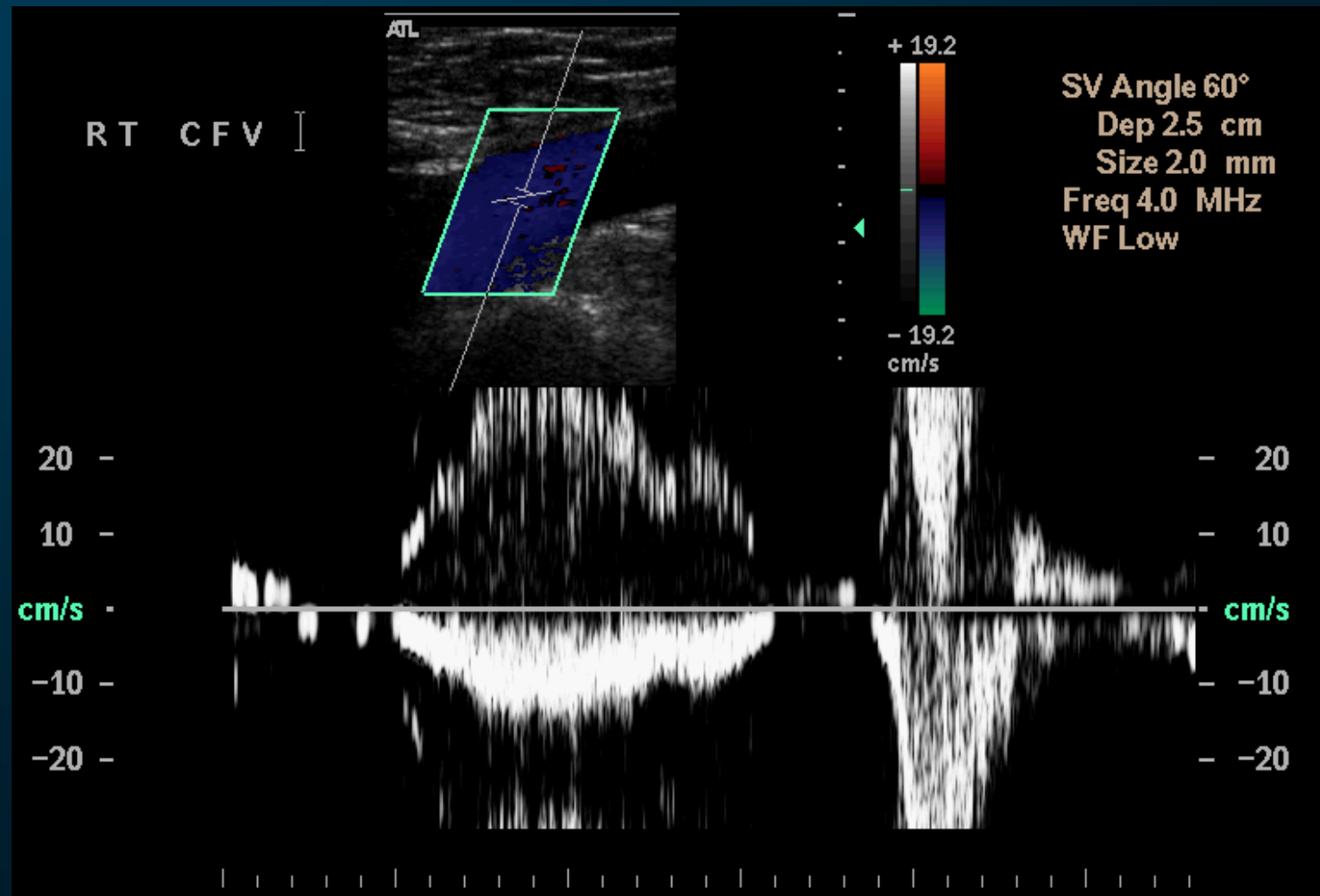




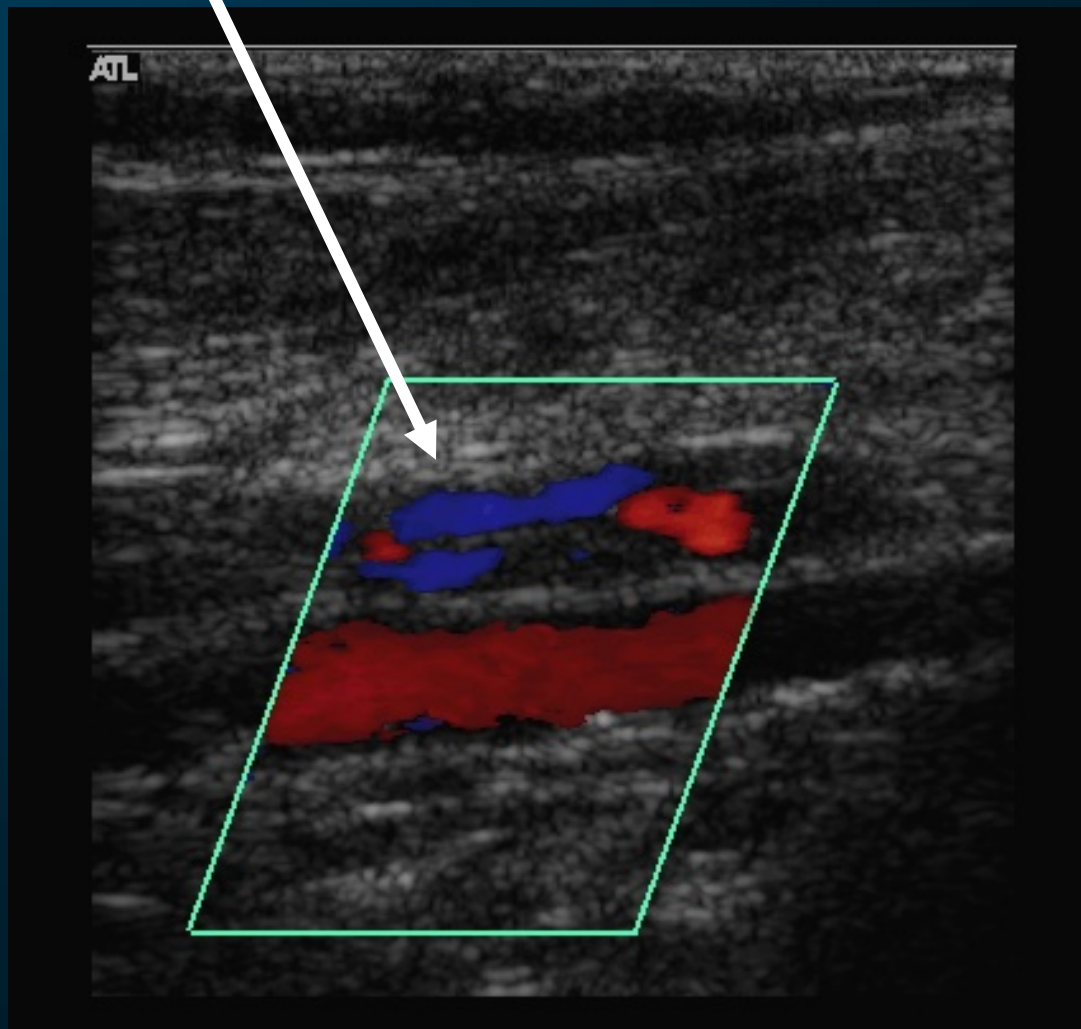
# Spontaneous flow



# Augmentation



# Chronic thrombosis



# Treatment of Proximal DVT

- 5 days LMWH (Clexane) until INR 2.0 – 3.0
- Warfarin therapy 3-6 mths
- Class 2 graduated compression stockings (below knee) for 1-2 years

NOT white TED stockings

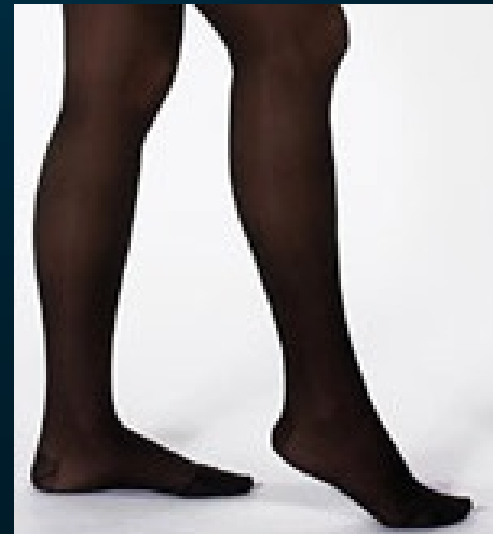
# Compression Therapy

- Graduated Compression
  - Higher pressure at ankle
  - Promote cephalad flow of blood
  
- Reducing ambulatory venous pressure:
  - Compress varicose veins
  - Prevent pooling at ankle
  - Reduce oedema



# Compression Classes

- Level of compression at the ankle
- European Standard
  - 1 – 18-21 mmHg
  - 2 – 25-32 mmHg
  - 3 – 36-48 mmHg
  - 4 – 48+ mmHg
  - Travel – 8-15mmHg



# TED anti-embolism stockings

- 18 mmHg
- Prevention of DVT intra and post-operatively

**Manufacturers Recommendation:**

**“For use in the non-ambulant convalescing patient”**





**NOT** designed for ambulant use

## 2 year Randomised Controlled Trial, 2003

- 180 patients
- Class 2 graduated compression hose
- 1-2 years post DVT
- Significant reduction of PTS risk of up to 50%

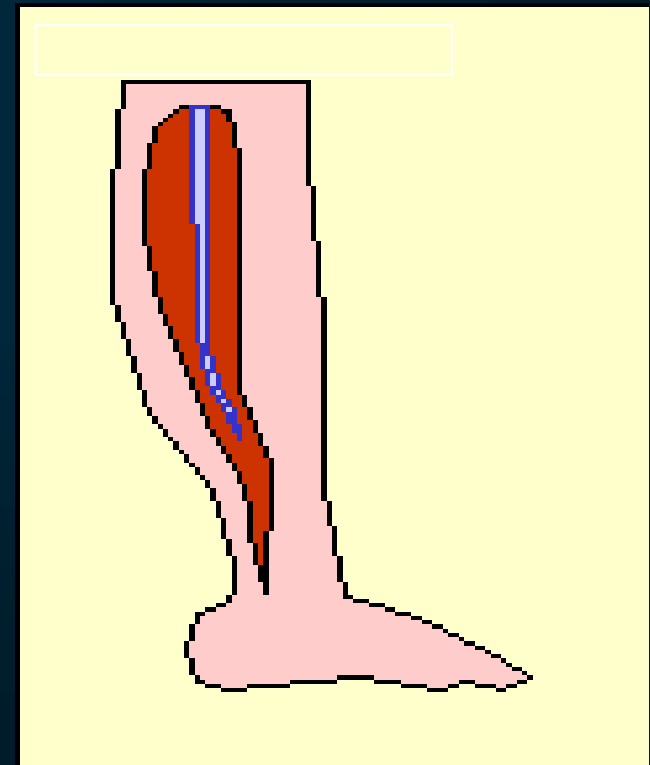
Recommendation:

Prescribe compression therapy for DVT.

# Long-term effects of DVT

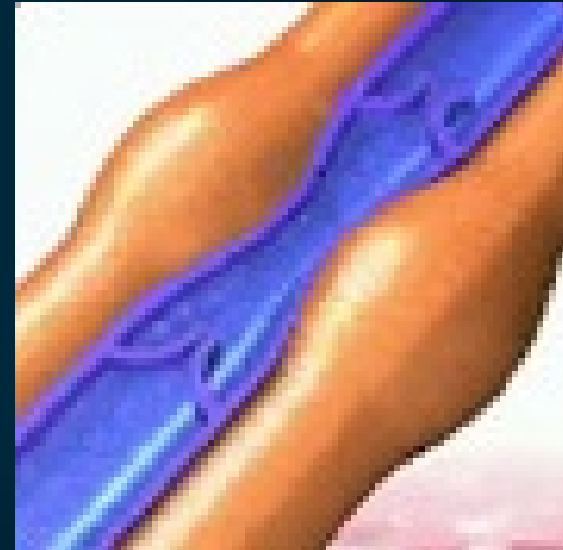
# Calf muscle pump

- Veins are pliable
- Constrict & dilate over wide range
- Contraction of Gastrocnemius and Soleus muscles
- Blood expelled into Popliteal V.
- Valve closure prevents reflux
- More valves in calf than thigh

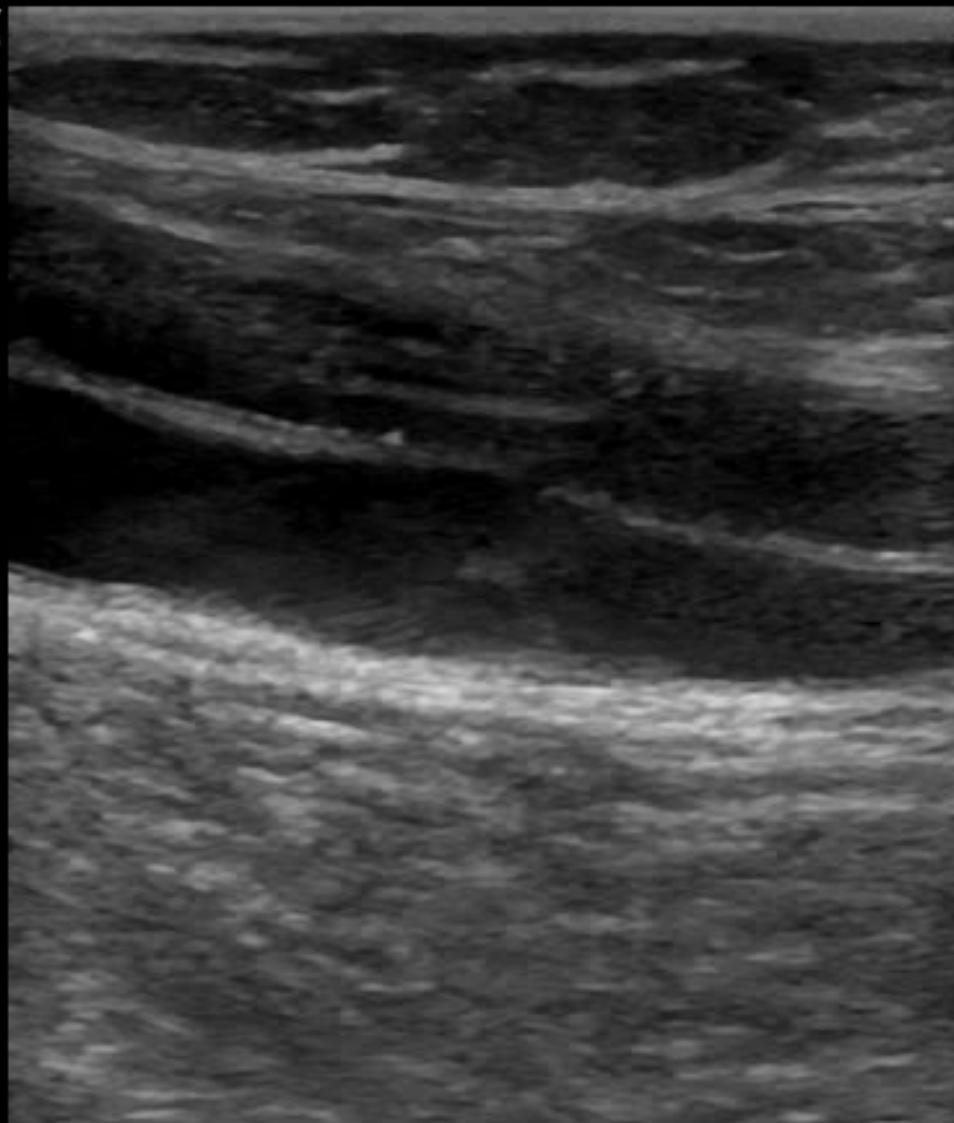


# Calf muscle pump at rest

- Veins fill via arterial inflow @ **1-2ml per second**
- Normal venous refill time at rest is approx **2 minutes**
- Valve failure = high volume reflux = venous refill time is **20-40 seconds**
- Leads to stasis in dependent veins



GE  
Le



1-

2-

3-

4-

# Post Thrombotic Syndrome (PTS)

- Long term sequelae of DVT
- Up to 80% of patients within 1-2 years of DVT event
- Chronic venous obstruction or valvular reflux
- Failure of calf muscle pump
- Venous hypertension

Valve leaflets damaged



Deep Venous Reflux



Chronic Venous Insufficiency



# Determinants of PTS

- Extent of DVT
- Rate of recanalisation (fibrosis)
- Venous valve function
- Recurrent DVT



Postthrombotic pigmentation



Healed skin ulcer and postthrombotic pigmentation



Chronic (left) leg swelling, skin hardening, and postthrombotic pigmentation

# Symptoms

- Pain
- Oedema
- Hyperpigmentation (7-23%)
- Ulceration (4-6%)
- Lipodermatosclerosis (champagne glass leg)
- Heaviness
- Cramps
- Itchiness
- Numbness or tingling
- Dilatation of superficial veins
- Redness



# Differential Diagnosis

- PVD
- Obesity
- Compartment syndrome
- Chronic Venous Insufficiency due to varicose veins
- Lymphoedema
- May-Thurner syndrome
- CHF

Diagnosis by duplex ultrasound

# Treatment Options

- Prevention better than cure
  - Adequate Rx of DVT
- Valves permanently damaged
  - Valve reconstruction
- Prevention of complications
  - Graduated Class 2 compression stockings
  - Regular exercise
  - Elevate limbs while seated

# Take-home messages

- Assessment and management of DVT within the community (as services allow)
- Awareness of possible long-term complications of DVT
- Compression Therapy

# Thank-you for your attention

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