



NOTES

VENOUS DYSFUNCTION

GENERALLY, WHAT IS IT?

PATHOLOGY & CAUSES

- Venous system defects affecting blood flow from lower extremities

CAUSES

- Blood clot partially/completely blocking way/venous valves failing to pump blood against gravity

Virchow's triad

- **Hypercoagulability**, increased clot formation
 - Factor V Leiden thrombophilia
 - Protein C and protein C deficiencies
- Venous stasis from prolonged immobilization (e.g. bed rest)
- Damage to endothelial lining

RISK FACTORS

- Prolonged immobility, hereditary clotting dysfunctions, high estrogen levels, obesity
- One venous dysfunction can lead to another



MNEMONIC: PHD

Virchow's Triad

Prolonged immobilization (stasis)

Hypercoagulability

Damage to endothelium

SIGNS & SYMPTOMS

- Localized pain, usually lower extremities
- Edema
- Pruritus

- Localized hyperpigmentation/skin discoloration
- Hard, cord-like veins/prominent dilated tortuous veins

DIAGNOSIS

DIAGNOSTIC IMAGING

Doppler ultrasound

- Assess vein diameter, thrombi, valve status, blood flow (anterograde vs. retrograde)

Venography

- X-ray, contrast medium injected into vein
- Assess status of vein network, detect thrombi

LAB RESULTS

- **D-Dimer**: High sensitivity (~100%) and negative predictive value (~100%) for detection of venous thromboembolism

TREATMENT

MEDICATIONS

- **Acute manifestation**: unfractionated heparin/low-molecular-weight heparins
- **Long-term management**: oral anticoagulants (e.g. warfarin)
- Prior DVT
 - Long term anticoagulation therapy, antiplatelet treatment, parenteral anticoagulants

SURGERY

- Vein transplant/repair/removal

OTHER INTERVENTIONS

- **Preventative:** calf exercises, compression stockings/devices, raise affected areas to decrease swelling

CHRONIC VENOUS INSUFFICIENCY (CVI)

osms.it/chronic-venous-insufficiency

PATHOLOGY & CAUSES

- Veins cannot push blood back to heart, resulting in **blood pooling in leg**

CAUSES

- Develops from **varicosities, DVT, phlebitis**
 - Varicose veins affect superficial veins, but blood sometimes rerouted to collateral veins deep in leg, preventing blood stagnation
- When deep veins carry more blood than normal
 - Deep veins stretch over time, blood pools
 - Blood flow stagnation in lower extremities causes inflammatory reaction in vessels, tissue, causing fibrosis, venous stasis ulcers

RISK FACTORS

- **Biological females, inactive standing/sitting** for long periods, aging, family history, ligamentous laxity, obesity, smoking, low-extremity trauma, prior venous thrombosis, arteriovenous shunt, pregnancy

SIGNS & SYMPTOMS

- **Calf/ankle pain** (most common symptom)
- Worse with prolonged standing/sitting, improves with leg elevation, movement
- **Brown hyperpigmentation of skin**

(hemosiderin deposits)

- **Pruritus, stasis dermatitis**
- Painless, wet ulcers, particularly on medial malleolus
- Edema
- **Atrophie blanche:** hypopigmented atrophic areas with telangiectasia (clusters of red/purple capillaries), red dots

DIAGNOSIS

DIAGNOSTIC IMAGING

Doppler ultrasound imaging

- Most common diagnostic
- **Modified vein diameter** (increased = acute thrombus, decreased = chronic thrombus)
- **Absent color flow:** vein completely occluded
- Increased flow in surrounding superficial veins

Venography

- Most effective, but invasive and cost-prohibitive

TREATMENT

SURGERY

- Vein transplant/repair/removal

OTHER INTERVENTIONS

- **Preventative:** calf exercises, compression stockings/devices, raise affected areas to decrease swelling



Figure 26.1 The clinical appearance of mild CVI. Hemosiderin deposition is clearly visible.

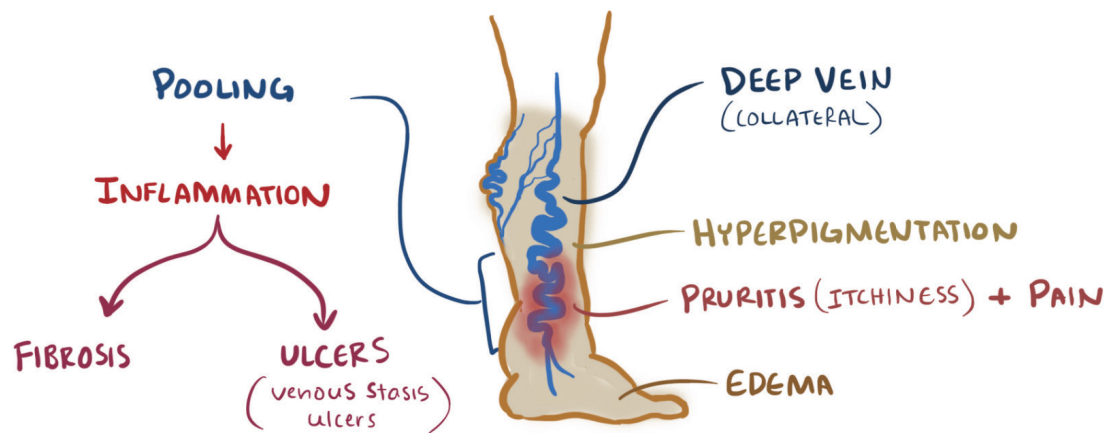


Figure 26.2 Illustration of varicose veins that have developed into a case of CVI.

DEEP VEIN THROMBOSIS (DVT)

osms.it/deep-vein-thrombosis

PATHOLOGY & CAUSES

- Blood clotting in deep leg veins (iliofemoral, popliteal, femoral veins)
- Arterial clots usually due to artery wall damage; venous clots don't require vein damage
- Valves inside veins can lower blood oxygen levels → venous stasis-associated hypoxemia can activate reactive oxygen species, other hypoxia-inducible factors → tissue factor released into blood
 - Tissue factor activation → prothrombin turns into thrombin → fibrin fibers form net → traps red blood cells, white blood cells, platelets → venous thrombus

CAUSES

- Virchow's triad
- Antiphospholipid syndrome
- Prolonged immobilization (bed rest, orthopedic casts, long-distance air travel)
- Genetic
 - Antithrombin, protein C, S deficiencies

RISK FACTORS

- Pregnancy, oral contraceptives, old age, major surgery (e.g. orthopedic surgery), malignancy, obesity, trauma, heart failure

COMPLICATIONS

- Pulmonary embolism (PE) most common
 - Can cause pulmonary infarction, death
- Post-thrombotic syndrome
 - Develops in 50% of individuals with DVT
- **Extreme cases:** phlegmasia cerulea dolens (blue, painful, swollen leg, possible venous gangrene)

SIGNS & SYMPTOMS

- 50% asymptomatic due to venous collateral channels
- Localized inflammation around clot
- High venous pressure engorges visible superficial veins
- **If PE occurs:** sudden dyspnea, chest pain
 - Fatal if enough lung tissue affected

DIAGNOSIS

DIAGNOSTIC IMAGING

Doppler ultrasound imaging

- Most common diagnostic
- Modified vein diameter
 - **Increased:** acute thrombus
 - **Decreased:** chronic thrombus
- **Absent colour flow:** vein completely occluded
- **Increased flow in surrounding superficial veins**

Venography

- Most effective, but invasive/cost-prohibitive

LAB RESULTS

- **D-dimers → rule out DVT**
 - **Increased level:** plasmin dissolves thrombus

OTHER DIAGNOSTICS

Wells' score

- Higher score indicates increased chance of DVT (Scale of -2 to 9 points)
 - **High score = high chance:** > 2 points
 - **Moderate score = moderate chance:** 1–2 points
 - **Low score = low chance:** < 1 point

WELLS' SCORE

| CRITERIA | POINTS |
|---|--------|
| ACTIVE MALIGNANCY | +2 |
| SWELLING IN ONE CALF ≥ 3 CM | +1 |
| SWELLING OF UNILATERAL SUPERFICIAL VEINS | +1 |
| PITTING EDEMA IN ONE LEG | +1 |
| HISTORY OF PREVIOUS DVT | +1 |
| UNILATERAL SWELLING OF LEG | +1 |
| LOCALIZED TENDERNESS | +1 |
| CAST IMMOBILIZATION OF LEGS AND PARESIS / PARALYSIS | +1 |
| RECENT IMMOBILITY > 3 DAYS OR SURGERY REQUIRING GENERAL ANESTHETIC IN PAST 3 MONTHS | +1 |
| LIKELY ALTERNATIVE DIAGNOSIS | -2 |

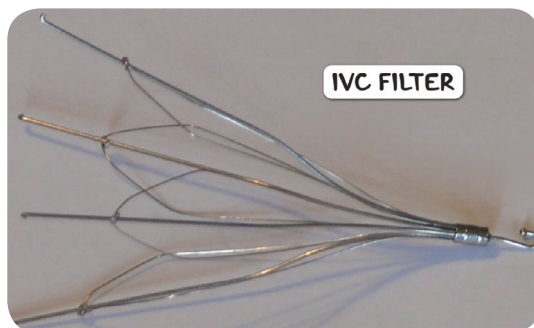


Figure 26.3 An IVC filter, used to prevent embolization of the deep vein thrombus into the pulmonary vasculature.

TREATMENT

MEDICATIONS

- **Acute manifestation:** unfractionated heparin/low-molecular-weight heparins
- **Long-term management:** oral anticoagulants (e.g. warfarin)
- **Prior DVT:** long term anticoagulation therapy, antiplatelet treatment, parenteral anticoagulants

OTHER INTERVENTIONS

- **Preventative:** calf exercises, compression stockings/devices, raise affected areas to decrease swelling



Figure 26.4 Clinical appearance of a deep vein thrombosis of the right leg. The lower leg is erythematous and swollen.

THROMBOPHLEBITIS

osms.it/thrombophlebitis

PATHOLOGY & CAUSES

- Vein inflammation caused by **clot in deep leg veins**
- **Increased coagulability** (Virchow's triad)
- Potential locations
 - Upper limbs (usually at site of IV cannula)
 - Lower limbs (coupled with varicose veins)
 - Periprostatic venous plexus in biological males
 - Pelvic venous plexus in biological females
 - Large veins of cranium, dural sinuses
 - Portal vein

TYPES

Migrating thrombophlebitis

- Occurs in several different locations, usually in pancreatic carcinomas due to pro-clotting factors secreted by tumoral cells

Superficial thrombophlebitis

- Thrombus develops in vein near skin's surface
 - **Mondor's syndrome**: thrombophlebitis of subcutaneous veins of breast/arm / penis; presents as lump

Suppurative (septic) thrombophlebitis

- Infection from IV cannula; possible purulence

CAUSES

- Most commonly: **needle/catheter**
- **Prolonged immobilization**: bed rest, orthopedic casts, long-distance air travel
- **High estrogen**: pregnancy, estrogen replacement therapy, oral contraceptives
- **Hereditary clotting disorders**: protein D/C deficiencies/factor V Leiden mutations
- Vasculitis, Behcet's disease

COMPLICATIONS

- DVT, superficial thrombophlebitis, pulmonary embolism

SIGNS & SYMPTOMS

- Pain, inflammation/swelling, hard, cord-like veins
- Sometimes asymptomatic, can be revealed by applying pressure
 - Hoffman's sign (forced dorsiflexion on foot creates soreness behind knee); not 100% accurate

DIAGNOSIS

DIAGNOSTIC IMAGING

Venous duplex ultrasound

- Thrombosed veins thickened, poorly compressible
- Completely occluded vein = hypoechoic (low level echoes)
- No internal flow present distal to clot

Imaging studies

- Thrombus detection (e.g. CT venography (CTV) with contrast, magnetic resonance (MR) venography)
- Blood coagulation tests (e.g. elevated D-dimers)

LAB RESULTS

Blood coagulation tests

- Elevated D-dimers

OTHER DIAGNOSTICS

- Inspection of affected area
 - Pulse (weak/absent)
 - Blood pressure (high)
 - Temperature (high)

TREATMENT

MEDICATIONS

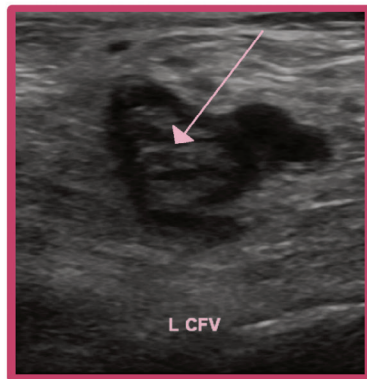
- Acute manifestation: unfractionated heparin/low-molecular-weight heparins
- Long-term management: oral anticoagulants

OTHER INTERVENTIONS

- Preventative: calf exercises, compression stockings/devices, raise affected areas to decrease swelling

DIAGNOSIS

ULTRASOUND



BLOOD CLOT in
COMMON FEMORAL VEIN

VENOGRAPHY



ALSO

D DIMER BLOOD TEST

FIBRIN BREAKDOWN
PRODUCTS
are HIGH when
there is a CLOT

Figure 26.5 Illustration showing blood clots discovered via imaging studies.

* LONG-TERM TREATMENT (PREVENTION)

↳ ANTICOAGULENT MEDICATIONS

- WARFARIN
- HEPARIN

* FILTER in the INFERIOR VENA CAVA to PREVENT PULMONARY EMBOLISMS

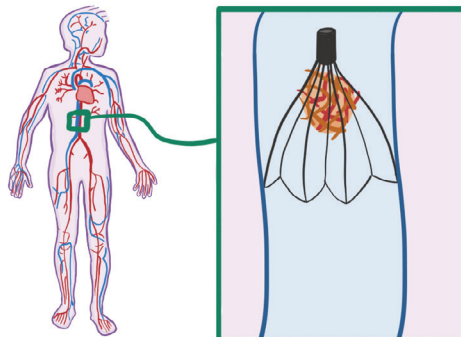


Figure 26.6 Illustration showing a surgically-implanted filter in the inferior vena cava preventing a pulmonary embolism.

VARICOSE VEINS

osms.it/varicose-veins

PATHOLOGY & CAUSES

- Enlarged, twisted superficial veins (most commonly in leg)
- Downward gravitational pull causes **walls of veins to stretch over time**, blood leaks backwards → extra blood volume twists veins → veins become varicose
- Blood sometimes rerouted to collateral veins deep in leg

TYPES

Varicocele

- Abnormal enlargement of pampiniform venous plexus in scrotum
- Mechanism same as varicose veins
- Most common in left testicle
 - Left testicular vein brings blood to left renal vein at 90° angle → difficult → blood backs up → vein becomes varicose → loops back and forth on itself
 - “Bag of worms” appearance

CAUSES

- Obesity, pregnancy, standing for long periods of time, menopause
 - Pelvic vein reflux (PVR): ovarian vein reflux, internal iliac vein reflux
- Hyperhomocysteinemia destroying structural proteins in vessels
- Chronic alcohol use

COMPLICATIONS

- Chronic venous insufficiency
- Venous ulcers
 - Can develop into carcinomas, sarcomas over time (rare)
- Superficial thrombophlebitis

SIGNS & SYMPTOMS

- Twisted superficial veins
- Edema, pain (usually in evening)
- Pruritus in affected area/stasis dermatitis because of undrained waste in leg
- Prolonged bleeding, slowed healing in injuries to adjacent areas
- Restless legs syndrome

DIAGNOSIS

DIAGNOSTIC IMAGING

Doppler ultrasound

- Used to discover subcutaneous varicosities, assess saphenofemoral junction
- If blood reflux spotted during Valsalva manoeuvre → valve incompetence
- Reflux > 1s → surgical intervention

OTHER DIAGNOSTICS

Trendelenburg test

- Person laid **back on flat surface**, leg raised **above heart**, blood will flow towards heart → compress upper thigh with tourniquet (not too tightly) → lower leg onto flat surface → person stands, refilling times assessed
 - Normal: superficial saphenous vein fills < 30–35s
 - Faster filling → valvular incompetence below compressed area → deep/communicating veins
 - Slower filling → tourniquet released → if filling sudden → incompetent superficial veins

TREATMENT

SURGERY

- Radiofrequency/laser ablation
- Sclerotherapy
- Ambulatory phlebectomy: removal of surface vein through slits in skin

OTHER INTERVENTIONS

- Preventative: compression stockings/ devices, avoid prolonged standing

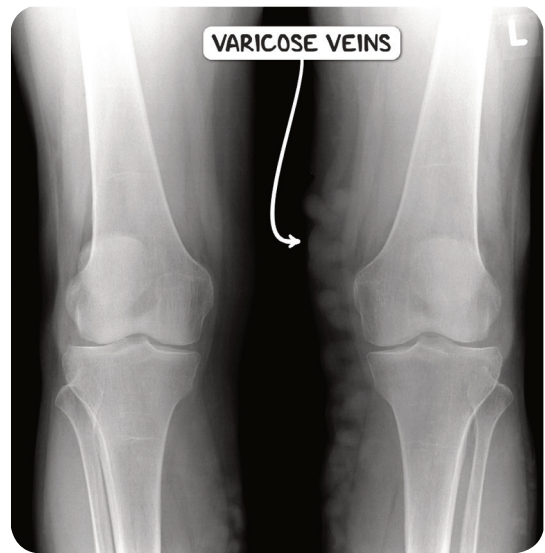


Figure 26.7 An X-ray image demonstrating varicose veins of the left leg.

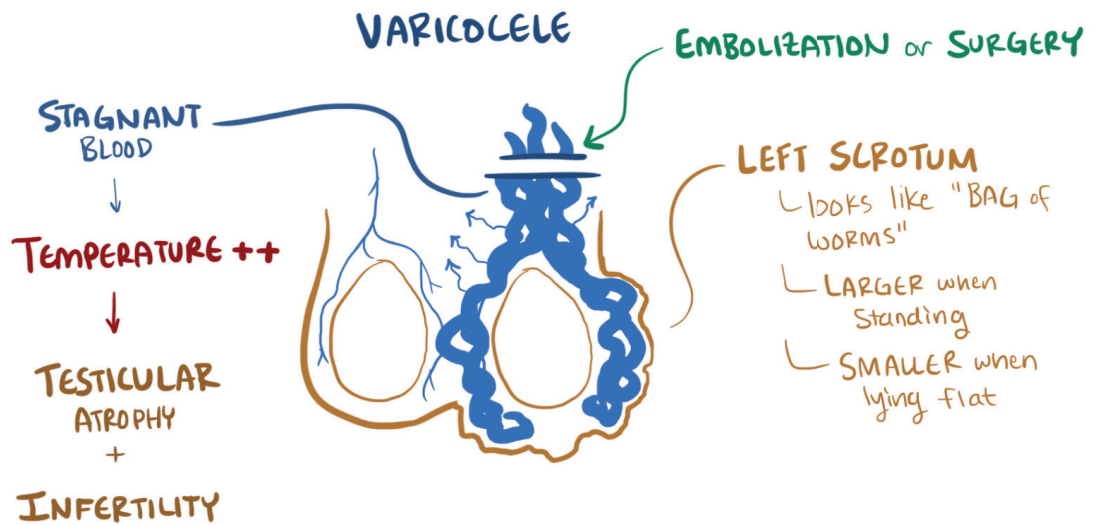


Figure 26.8 Illustration of a varicocele in the left testicle.