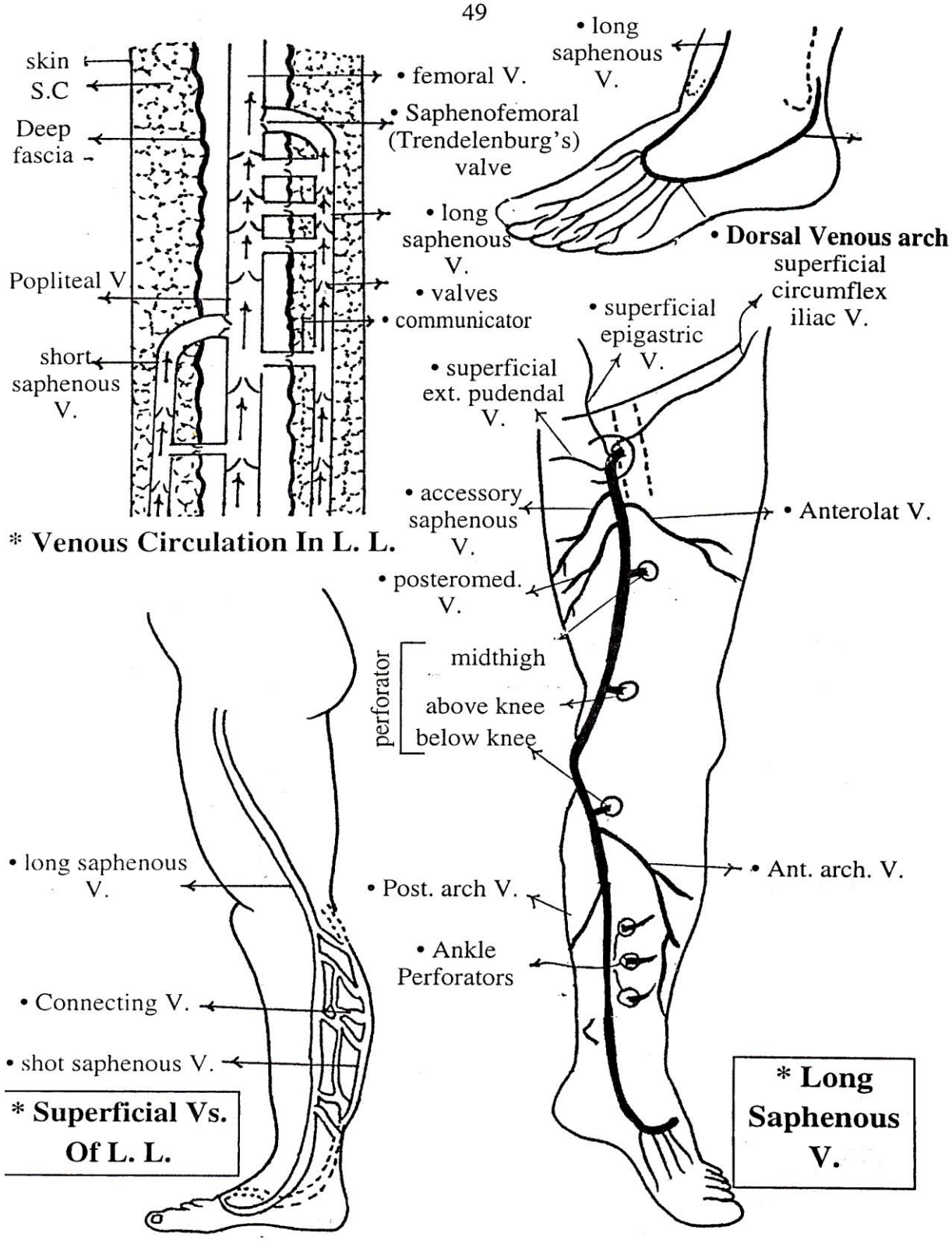

skin
S.C
Deep fascia
Popliteal V
short saphenous V.
• femoral V.
• Saphenofemoral (Trendelenburg's) valve
• long saphenous V.
• valves
• communicator
* Venous Circulation In L. L.
• long saphenous V.
• Dorsal Venous arch
superficial circumflex iliac V.
• superficial epigastric V.
• superficial ext. pudendal V.
• accessory saphenous V.
• Anterolat V.
• posteromed. V.
perforator
midthigh
above knee
below knee
• Ant. arch. V.
• Post. arch V.
• Ankle Perforators
• long saphenous V.
• Connecting V.
• shot saphenous V.
* Superficial Vs. Of L. L.
* Long Saphenous V.

Introduction

* All veins of lower limbs have **bicuspid unidirectional valves** which allow blood to pass from distal to proximal and from superficial to deep.
  - **Inferior vena cava** are exceptions as they have no valves.
* Veins of lower limbs are divided into **4 groups:**

I. Deep veins:

- Lie deep to the deep fascia & they including the intra and inter-muscular veins as well as the vena commitants of the named arteries .
- These veins drain the structures deep to the deep fascia & receive blood from the superficial veins through the communicators veins.

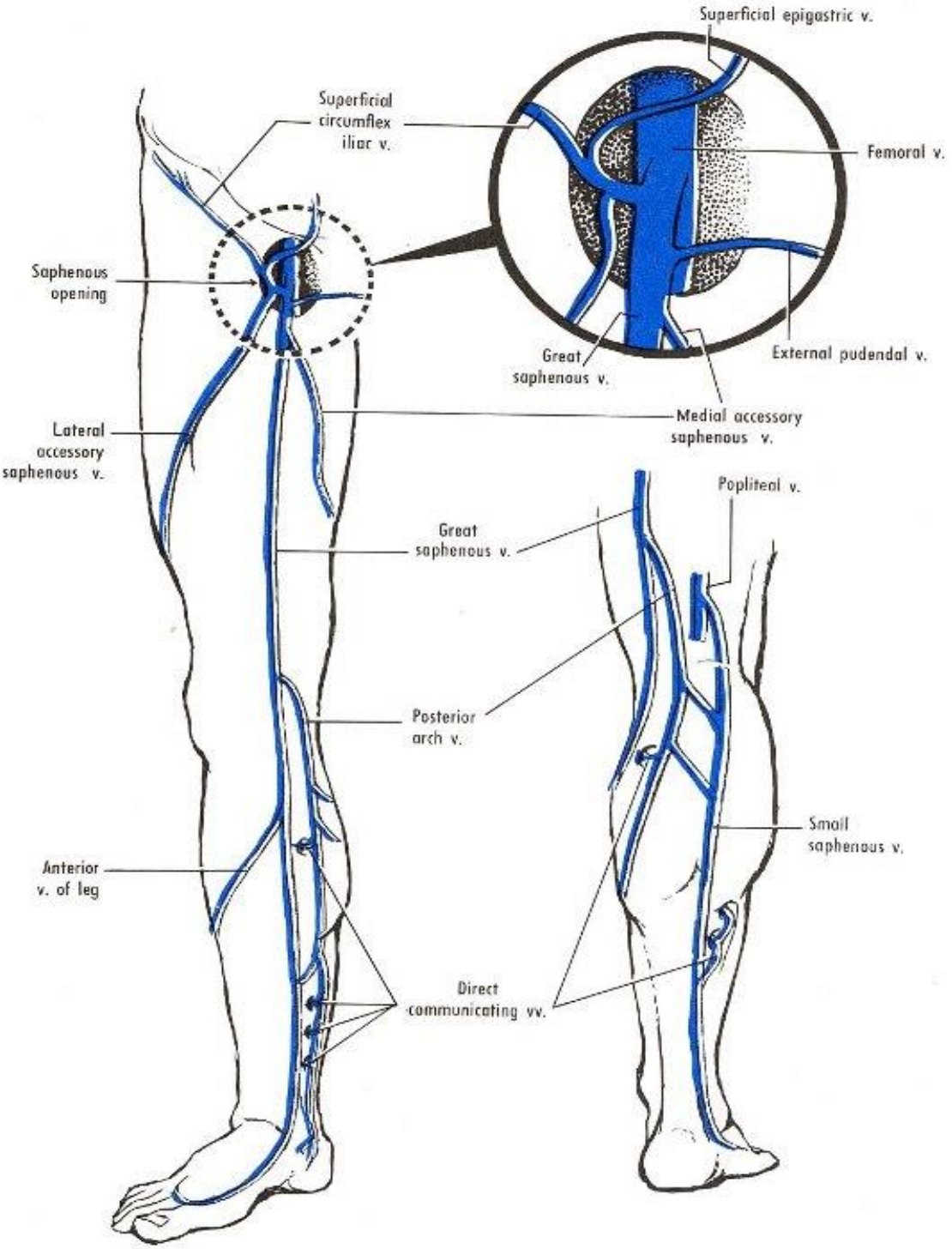
II. Superficial veins:

- Lie superficial to the deep fascia (i.e. unsupported in the loose S.C. tissue and liable for dilatation , elongation & tortousity i.e ***varicose veins***).
- Drain the skin & S.C. tissues of lower limb except the skin of lower 1/3 of medial aspect of the leg (ulcer bearing area) is an exception as it is drained by the ankle perforators which pierce the deep fascia to ends directly in the deep veins .***Therefore venous ulcer usually occurs in this area .***
- Superficial veins include:

1. Long (great) saphenous vein

2. Short (Lesser) Saphenous Vein

3. Tributaries of long and short saphenous veins and veins connecting them.

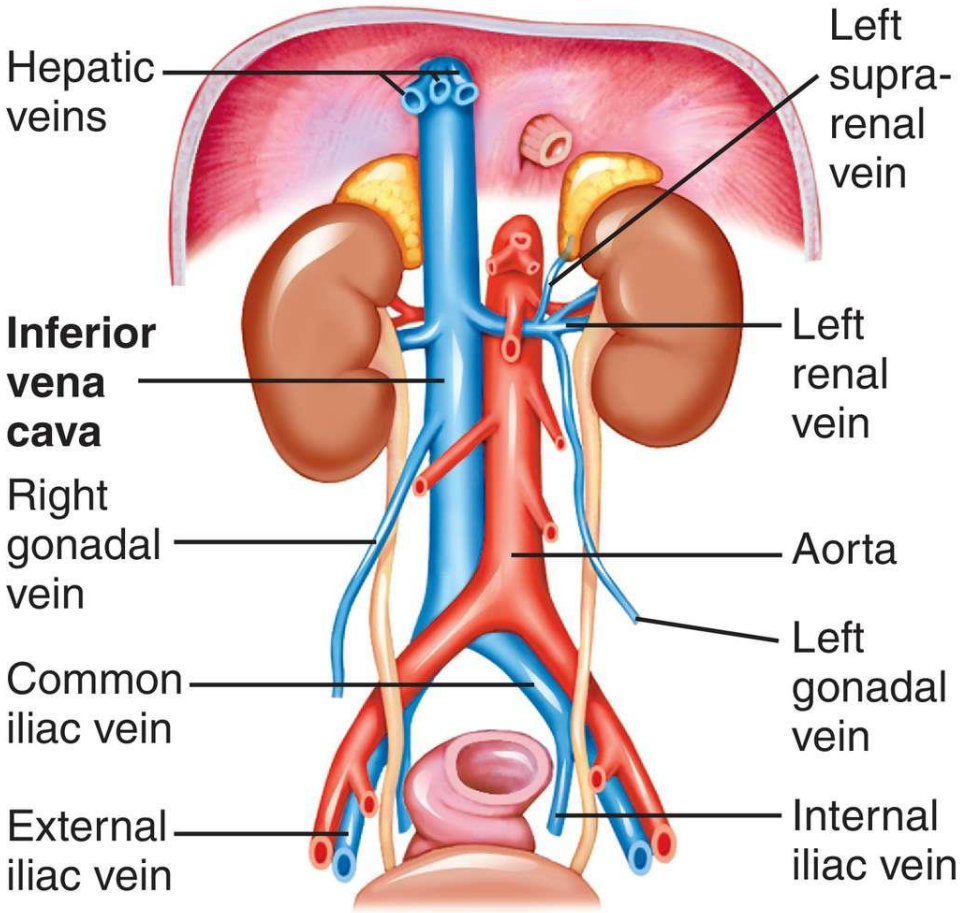


III. Communicators : These are veins piercing the deep fascia and connecting the superficial & deep veins .

IV. Perforators veins: These veins drains the skin above the medial malleolus (ulcer bearing area) directly to the deep veins (posterior tibial veins) they include **3 Medial leg perforators** (ankle perforators), 2, 4, 6 inches above the medial malleolus one lateral perforator .

* **Surgical facts related to veins of L.L.:**

1- ***Varicose veins & DVT are much more common on the left side*** due to passage of right common iliac artery in front of left common iliac vein.



2- **Applied anatomy:** In the deep veins blood pass only in one direction towards the heart except the soleus venous plexus which drains anterior into vena commitants of posterior tibial artery. This drainage is against gravity if the patient in the recumbent position → High incidence of **D.V.T** in these veins during prolonged recumbancy in bed or during operation.

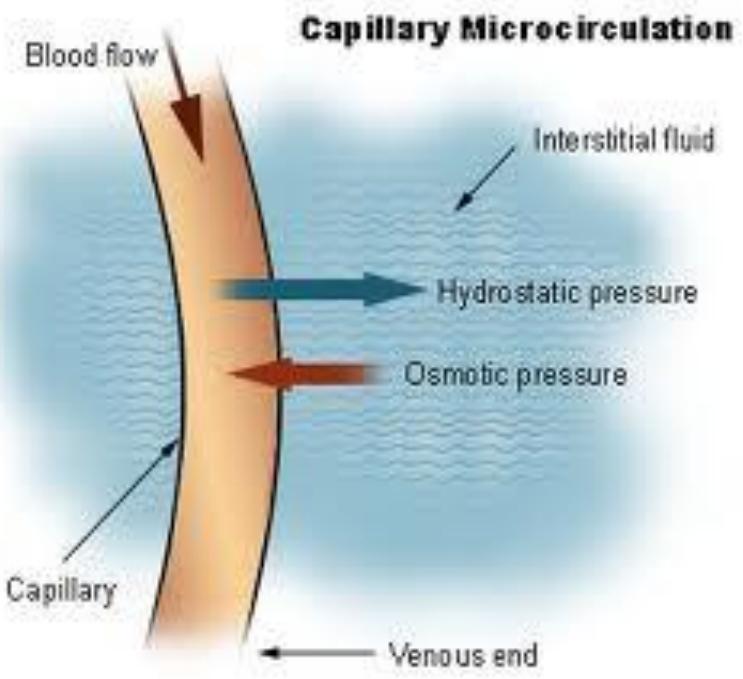
3- **Venous drainage of lower limbs against gravity depends on :**

- **Muscular pump mechanism** : Contraction of strong muscles , specially calf muscles , within tight deep fascia .
- **Unidirectional bicuspid valve** .
- **Transmitted arterial pulsation to the neighboring veins .**
- **Negative intra-thoracic pressure .**

4-Venous hypertension due to any cause leads to **distension of veins** → **valve incompetence & valve dysfunction** in the deep veins , communicator & perforators →**Reflux** (back flow) of blood into the veins → **vicious circle** .

5- Venous hypertenion → impairment of absorption of extracellular fluid → **oedema** .

3- Venous hypertension → **distension of veins** → stimulation of stretch receptors in the wall of the veins → **venous pain** .


Capillary Microcirculation
Blood flow
Interstitial fluid
Hydrostatic pressure
Osmotic pressure
Capillary
Venous end

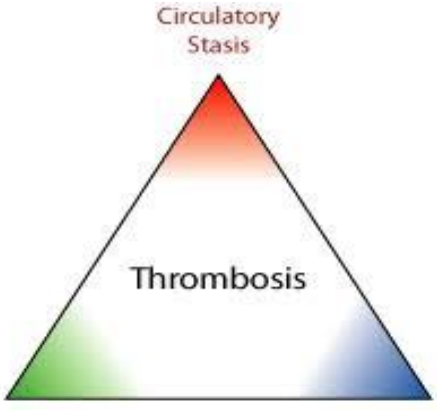
DEEP VENOUS THROMBOSIS

★ **Incidence:** The true incidence of DVT is unknown as most cases pass unnoticed .

★ **Aetiology :** ***Virchow's triad.***

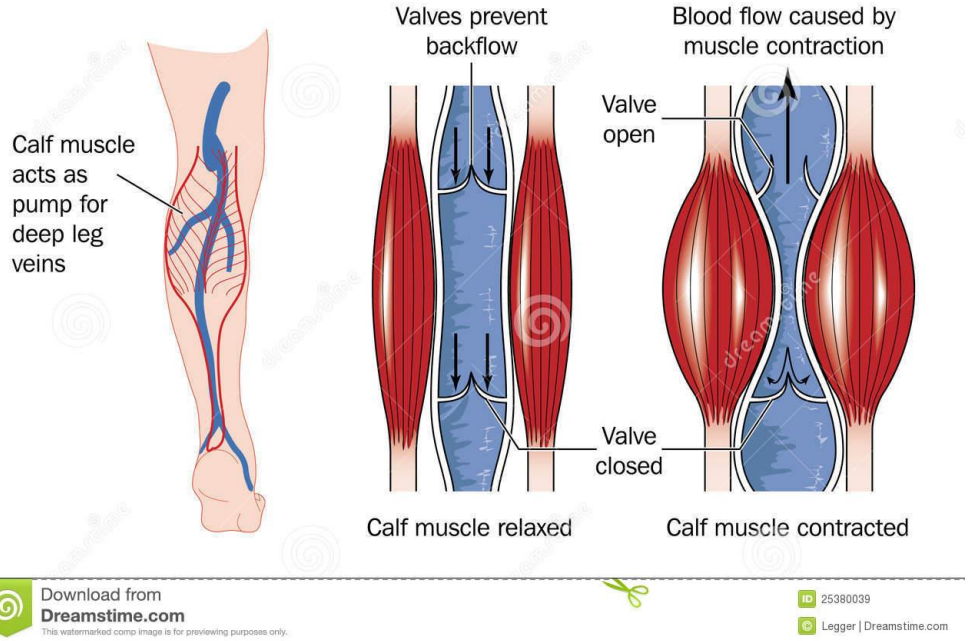
1. ***Endothelial damage****:* may be due to
   - ♦ Injury of deep veins e.g. pelvic or abdominal operations .
   - ♦ Inflammation of veins e.g. Pelvic sepsis .
2. ***Stasis of blood flow****:* may be due to
   - ♦ Compression of veins by abdominal or pelvic tumour or pregnant uterus .
   - ♦ Prolonged recumbancy in bed , long trip or plaster cast.
   - ♦ Congestive heart failure .
3. ***Hypercoagulability****:* due to increase blood viscosity or changes in blood composition e.g.
   - ♦ Polycythaemia , leukemia or hyperfibrinogenaemia .
   - ♦ Deficiency of antithrombin III , protein S & C , macroglobulins or antitrypsin .
   - ♦ **Factor V Leiden** : is a genetic mutation of one of the clotting factors in the blood.

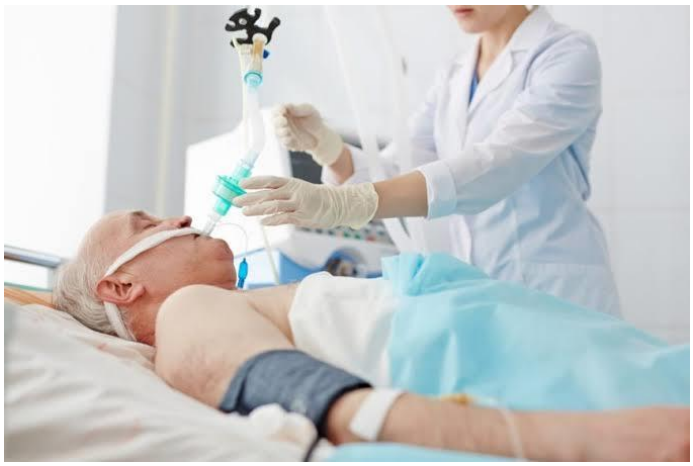
Virchow's triad.

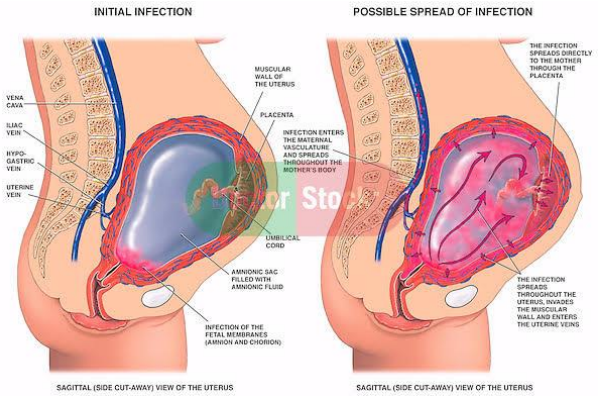


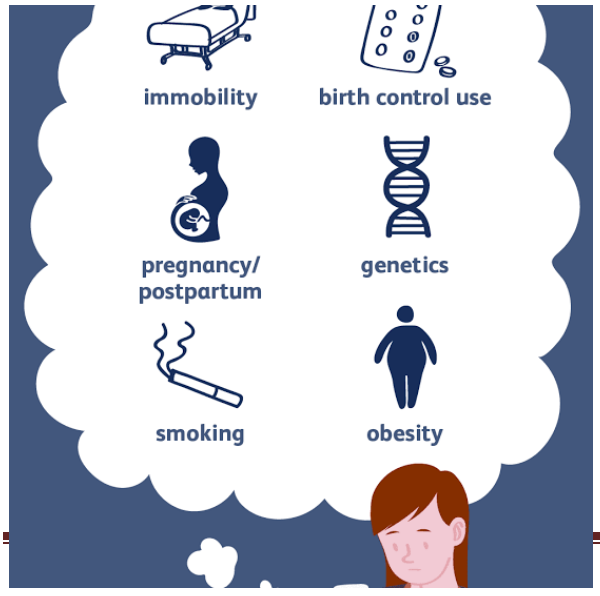
★ **High risk group:** (remember major surgery, female , ICU & past history)

1. Prolonged ***compression of calf veins*** by a hard operating table. (Stasis).
2. Operations on malignant ***abdominal or pelvic tumors***.
3. ***Major surgery*** as abdominal, pelvic, gynaecological or hip operations (injury).
4. Prolonged ***recumbancy*** in bed. (Stasis of blood flow).
5. ***Dehydration*** (hyperviscosity), e.g post-operative, severe vomiting or diarrhea.
6. ***Pregnancy,*** puerperium, contraceptive pills, obesity.
7. ***Elderly*** patient , myocardial infarction, H.F., malignancy & smocking.
8. V.Vs. , ***previous*** D.V.T. or pulmonary embolism.






INITIAL INFECTION
POSSIBLE SPREAD OF INFECTION
VENA CAVA
ILIAC VEIN
HYPO-GASTRIC VEIN
UTERINE VEIN
MUSCULAR WALL OF THE UTERUS
PLACENTA
INFECTION ENTERS THE MATERNAL VASCULATURE AND SPREADS THROUGHOUT THE MOTHER'S BODY
UMBILICAL CORD
AMNIONIC SAC FILLED WITH AMNIONIC FLUID
INFECTION OF THE FETAL MEMBRANES (AMNION AND CHORION)
THE INFECTION SPREADS DIRECTLY TO THE MOTHER THROUGH THE PLACENTA
THE INFECTION SPREADS THROUGHOUT THE UTERUS, INVADES THE MUSCULAR WALL AND ENTERS THE UTERINE VEINS
SAGITTAL (SIDE CUT-AWAY) VIEW OF THE UTERUS
SAGITTAL (SIDE CUT-AWAY) VIEW OF THE UTERUS


immobility
birth control use
pregnancy/ postpartum
genetics
smoking
obesity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★ Pathology:

I. Site:

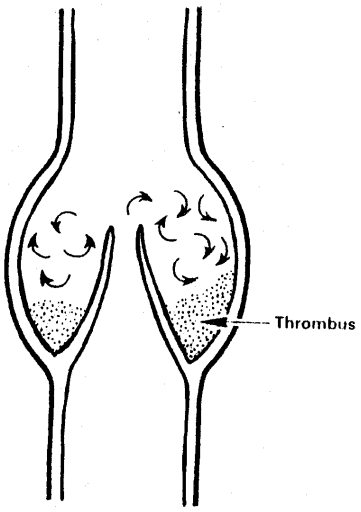
- D.V.T usually begins on the valve cusps (areas of relative stasis).
- D.V.T usually occurs in the venous sinuses in the calf muscles or ilio-femoral veins & rarely IVC , subclavian , axillary or portal veins .

II. Pathogenesis: Thrombosis is passing through the following stages:

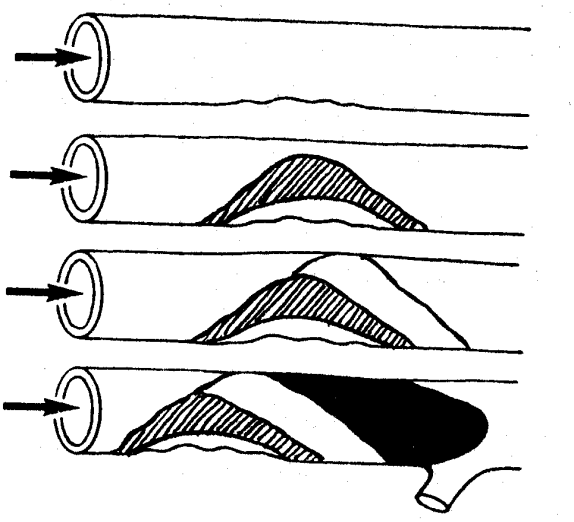
a. ***Pale thrombus:*** the initial thrombus is composed of platelets which stick to the vascular wall & to each other.

b. ***Mixed thrombus:*** fibrin *&* RBCs becoming deposited between layers of platelets → laminated appearance known as the **lines of Zahn**.

c. ***Propagating thrombus:*** non-adherent, jelly-like, red clot spreads into the vein as far as the next major tributary.



Thrombosis on cusps of valves



Stages of thrombosis

★ Effects & complications:

I. General: Pulmonary embolism due detachment of early non-adherent thrombus (see medicine).

II. Local:

A)**On the affected veins :** For late adherent thrombus one of the followings may occur :

1- **Recanalization:** within 3-6 months by fibrinolysis and phagositosis → gradual partial opening of the lumen but the valves are destroyed with valve dysfunction → chronic venous insufficiency & post-phlebitic limb.

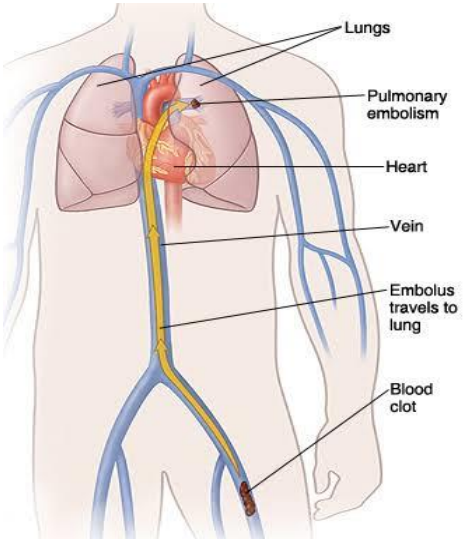
2- **Organization**→ fibrosis → permanent occlusion of the lumen .

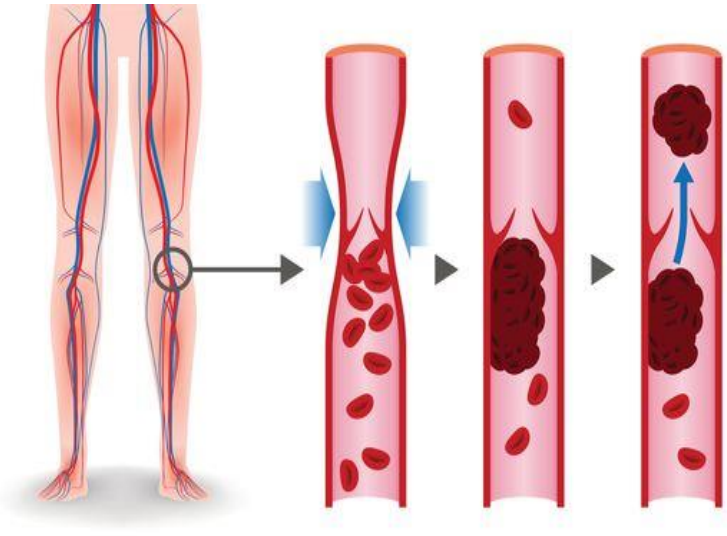
3- **Calcification of the thrombus** → phlebolith → permanent occlusion of the lumen .

B) Effect on the part of the limb distal to the thrombus :

1- Early : oedema .

2- **Late :** secondary varicose veins & post-phlebitic limb .





★ Clinical picture:

I. History of the **predisposing factors** e.g. post-operative

II. Asymptomatic group: This is common.

- There are ***no local manifestations*** and the patient may ***present later*** with either pulmonary embolism or post-phlebitic limb.
- It is ***suspected by*** the presence of unexplained post-operative fever or tachycardia.

III. The classical picture: There is ***a triad of***

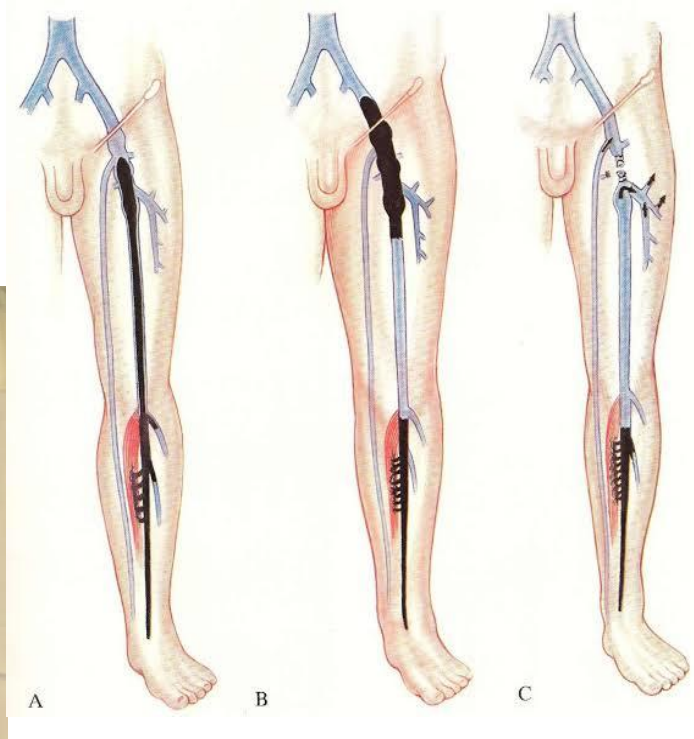
1. Pain*:* There is usually aching, discomfort & tightness in the calf or thigh which are aggravated by muscular exercise.

2. Tenderness on compressing the muscles.

- **Homan's sign,** sudden dorsiflexion of the foot → pain and spasm in the calf due to stretch of thrombosed veins. It should be avoided as it is unreliable test & it may be complicated by pulmonary embolism.

4. ***Swelling*** (oedema) is the most reliable sign.

- **It** is evidenced by measuring the difference in the circumference of the limb on both sides.
- **The level of oedema is diagnostic for the level of venous occlusion :**
  - In **calf veins** thrombosis : oedema affect the foot and ankle .
  - In **femoro-popliteal** thrombosis : oedema reaches up to the level of lower 1/3 of the thigh .
  - In **ilio-femoral** thrombosis : There is massive oedema affect the whole lower limb.
  - In **IVC** thrombosis : oedema affect both lower limbs .


A
B
C


Isolated Thrombolysis Catheter
Symptom Relief
Pain and swelling caused by iliofemoral DVT
Reduced swelling following Isolated Thrombolysis

III. Picture of complications: May be the presentation.

1. ***Phlegmasia alba dolens:*** (Painful white swelling).
   - This is a severe type of ilio-femoral vein thrombosis associate with arterial spasm which occurs after puerperal sepsis.
   - The whole limb is greatly swollen, cold, pale and painful with weak or absent arterial pulsations.

Phlegmasia cerulae dolens **Phlegmasia alba dolens**

2. ***Phlegmasia cerulae dolens:*** (Painful blue swelling)
   - This is a more severe massive type of ilio-femoral vein thrombosis in which there is complete obstruction of venous drainage of the lower limb .
   - The whole limb is greatly swollen, and painful with cyanosis
   - If the condition is not treated , venous gangrene may occur within few hours .

3. ***Venous gangrene :*** It is moist massive gangrene of the whole affected limb.
4. ***Pulmonary embolism*** (see medical notes).
5. ***Post-phlebitic syndrome*** : Chronic leg pain, oedema, skin complications & secondary varicose veins. (Mention in short).

Post-phlebitic syndrome

★ Investigations: As the clinical picture is not reliable, investigations should be done before starting treatment.

1. ***Doppler ultrasound:***
   - In femoral or popliteal Vs. thrombosis, the normall venous hum does not change into a roar.
   - It is accurate in 80% of cases but insensitive in calf veins thrombosis.
2. ***Duplex ultrasound:*** (**The most important**)
   - It allows colour flow imaging with Doppler flow analysis.
   - It determines partial occlusion, turbulance, flow direction & incompetent valves and communicators.
   - It is accurate in 90-100 % of cases

- Comparison between Doppler & Doplex scan of normal veins & DVT

	Normal veins	**DVT**
Vein diameter	Normal	Dilated veins
Blood flow	Spontaneous	Poor
Vein compressibility	Normal	Poor
Echogenic material in the lumen	None	Present
Distal compression	Augments blood flow	poor
Blood flow with respiration	Phasic flow with respiration	Loose of Phasic flow with respiration

★ **D.D. :** ***Other causes of pain & swelling in L.L.*** (See D.D. in surgery).

★ Treatment:

A- Prophylactic:

I - *Measures to reduce venous stasis:*

1. Avoid compression of calf veins during operation by ***Elevating the heel***.
2. Graduated compression ***Elastic stockings:*** exerting pressure from below upwards .
3. Intermittent External ***pneumatic compression*** of legs by special device.
4. ***Correct*** any dehydration or shock.
5. ***Leg*** *Elevation* ***for 20 degrees.***
6. Breathing and limb ***Exercises*** , ***massage & mobilization*** as soon as possible.

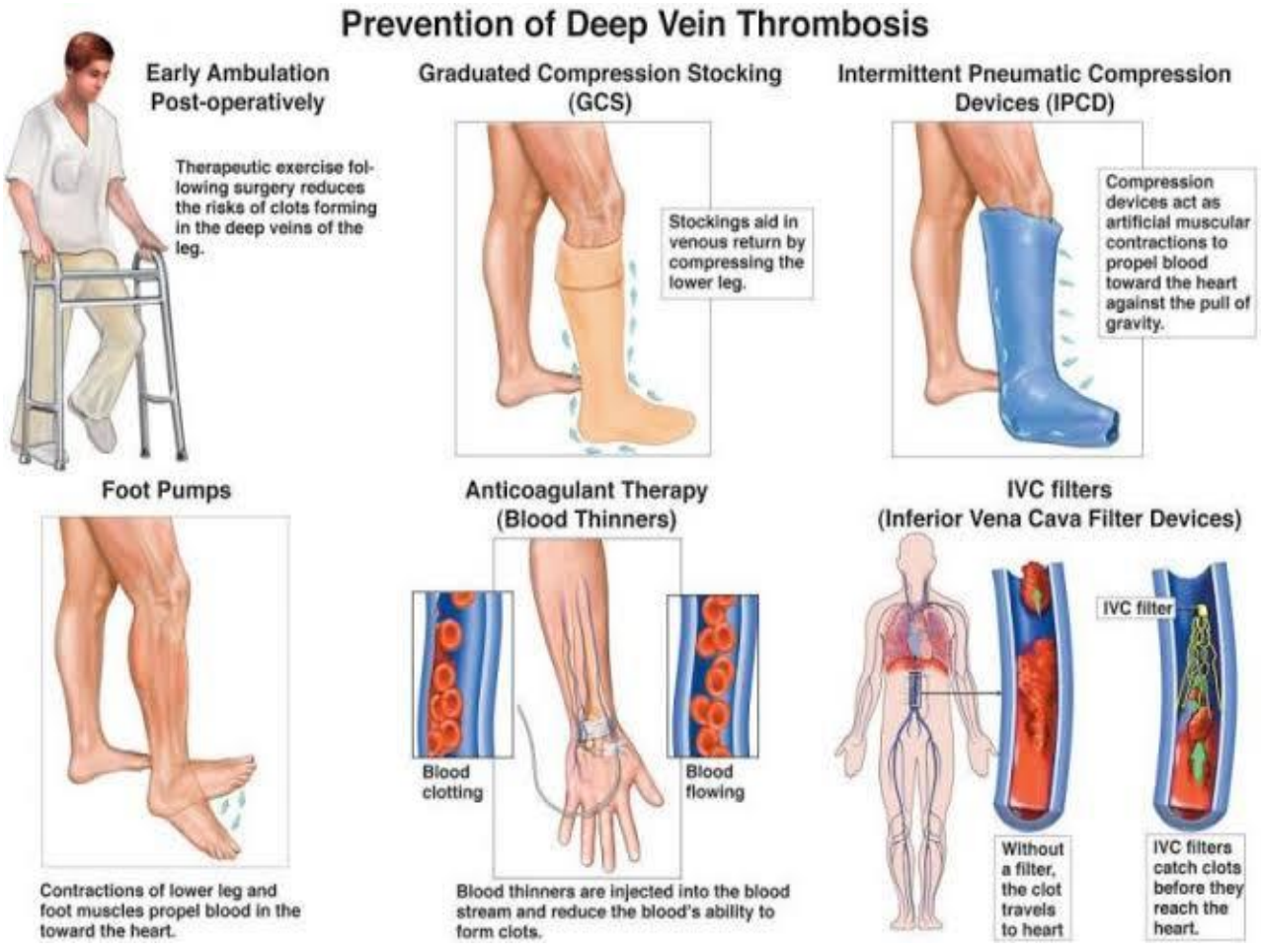
7. The calves and feet should be ***Examined daily*** for local signs of DVT.

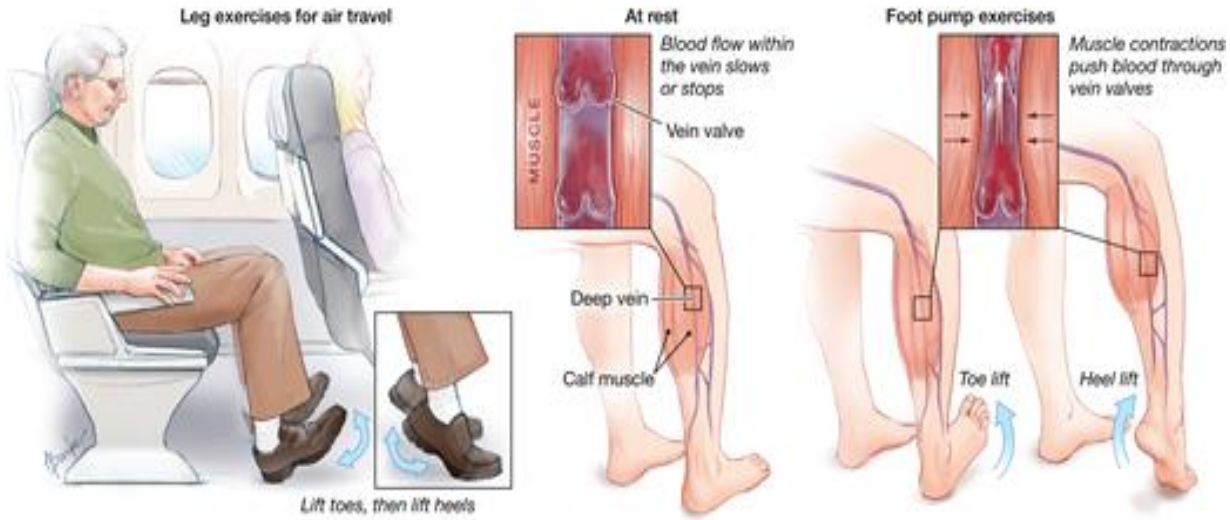
II- *Prophylactic Anticoagulants:*

- **Indications :**In high risk patients.
- **Contraindications :** It should be avoided where an operation is likely to leave raw areas or where a post-operative hge is suspected
- **Methods :**

a)Low dose heparin: 5000 units S.C., 2 hours before operation and continued twice-daily until the patient is fully mobilized.

b) ***Low molecular weight heparin*** is more popular because it is given once daily and has lower risk of bleeding .





MARIA PLATT - EVANS / PHOTO RESEARCHERS,INC

B - Curative:

I- Conservative: (the main line of treatment)

- **Aim**: Prevention of new thrombi , thrombus propagation & embolization.
- **Method:**

1) ***Anticoagulants:*** Heparin should be started as soon as possible (see medicine).
2) ***Patient care :***

♦ ***Complete rest in bed*** with the limb is elevated for 20 degrees , for at least 7-10 days which is the time needed for the thrombus to become adherent..

♦ After this period of rest, ***gradual mobilization*** with elastic stocking .

♦ ***Avoid prolonged standing or sitting.***

3) ***Thrombolytic (fibrinolytic) therapy :***

♦ **Indications :** Severe early diagnose cases of DVT .

♦ **Contraindications :** History of bleeding tendency , old age , hypertension or peptic ulcer .

♦ Fibrinolytic activators include streptokinase & urokinase which

are not used nowadays in which **tissue plasminogen activators** (prepared by recombinant gene technology) are always recommended .

- The effect is maximum if they are given in the **first 3 days of thrombosis** after that they have no advantage.
- **Effects :** Fibrinolytic activators dissolve fresh thrombi and preserve the valves → prevent post-phlebitic limb.
- **Complications:** Allergic reaction , bleeding & expensive.

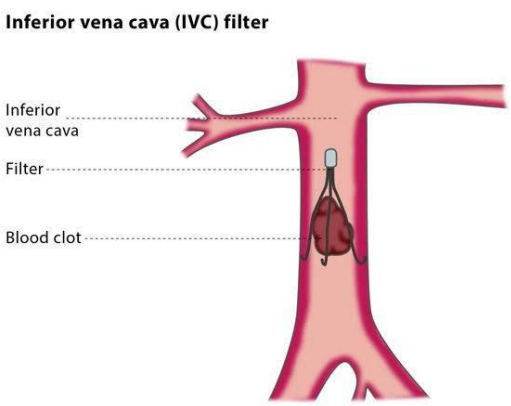
II- Surgical:

a) ***Introduction of intraluminal device*** (filter) into I.V.C. to trap large emboli .

- **Indication** : Recurrent pulmonary embolism .
- **Method** : Under local anesthesia & radiological control , percutaneous fixation of a filter into the infra-renal part of IVC , through a catheter introduced into the femoral vein or IJV .

b) ***Venous thrombectomy****:* In case of affection of a big vein e.g. phlegmasia cerulae dolens to prevent venous gangrene. It is rarely performed nowadays as it is replaced by thrombolytic therapy

c) ***Pulmonary embolectomy****:* (Trendlenburg's operation) in massive pulmonary embolism.

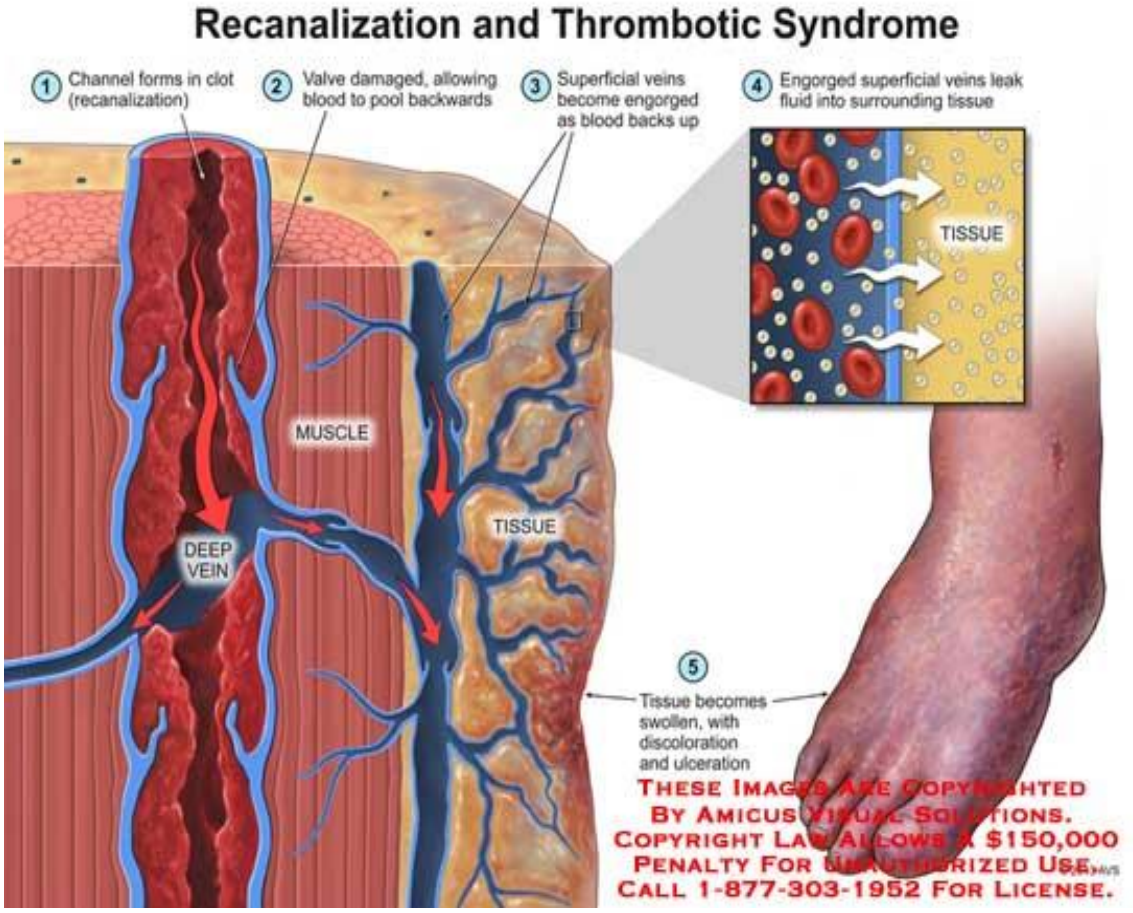


★ POST-PHLEBITIC SYNDROME ★

★ **Definition:** It is chronic deep venous insufficiency which occurs after DVT.

★ **Aetiology:** It usually occurs as a late complication of ilio-femoral V. thrombosis (rarely after isolated calf veins thrombosis) high → venous pressure especially during walking (walking venous hypertension) due to:

1. Persistent obstruction from incomplete recanalization.
2. Destruction of valves.
3. Reflux of blood from incompetent perforators.



★ **Complications:** Severe early skin complications (see varicose veins).

★ **C/P:**

1- Usually , there is history suggestive DVT .

2- Chronic venous pain (see varicose veins) .

3- Chronic marked oedema .

4- Early severe skin complications : pigmentation , eczema and venous ulcer .

5- Secondary Varicose veins. (Mention in short).

★ **Investigations:** Doppler & Duplex ultrasound.

★ **Treatment:** for secondary Varicose veins & its complications.

★ Superficial Venous Thormbosis ★

★ **Aetiology :** It may be idiopathic or occurs in varicose veins, varicocele, canulated vein , injection of irritant drugs , irradiation, trauma, Buerger's disease or presence of visceral cancer.

★ **Complications :** proximal spread with risk of spread to the deep system through the communicators .

★ **Clinical picture:**

1. Pain, oedema, redness *&* firm tender nodule at the site of the thrombus.

2. **Thrombophlebitis migrans:** May occur in the early stages of Buerger's disease or in association with some visceral carcinoma (***Trousseou's sign***) due to roughness of the intima with increased blood coagulability. The condition subsides within few weeks but tends to recur at any vein.

★ **Treatment:** Correct any predisposing factor.

- ♦ Analgesics, elastic stocking, antibiotics and mobilisation to prevent spread.
- ♦ Ligation & division of long saphenous vein if the thrombus approaches the saphenofemoral junction.