

THROMBOSIS

- Def - formation of a semisolid mass from constituents of blood within the vascular system during life
- coagulation involves formation of thrombi in artery/vein/capillary

Clot forms:

- In test tubes
- After vascular injury
- After death

Virchow's triad

- I. Endothelial damage or altered endothelial function eg atheromatous plaques, endocardium overlying MI
- II. Stasis or perturbation of blood flow
- Stasis important in venous circulation, high viscosity seen in polycythaemia results in stasis due to loss of laminar flow allowing platelets to get in contact with endothelium, stasis allows accumulation of activated factors

- Turbulence reduces endothelial PGI-2 and plasminogen activator formation. (PA prevents PLT aggregation)
- III. Blood composition change that favours plt aggregation and fibrin
- Formation eg hypercoagulability after trauma, surgery, late pregnancy and delivery, disseminated carcinomatosis
- plt count is elevated, they are more sticky, coagulation factors are high

- Antithrombin III and protein C levels are reduced, autoantibodies eg cardiolipin, LUPUS anticoagulants are also raised
- cigarette smoking and coagulability obesity, E2 contain oral contract
- Composition is determined by rate of flow of blood
- Rapid flow in arteries gives plt aggregates with some fibrin, it also enlarges slowly with few rbc's hence pale in appearance

...E2 containing oral contraceptives, estradiol

- Stagnant flow eg obstructed vessels and veins shows thrombi that resemble test tube clots
- soft, dark red and gelatinous
- composed of meshwork of rbc, wbc, plts. May be laminated
- Postmortem clot has chicken fat appearance

- **VENOUS THROMBOSIS**
- vein readily thrombosed due to slow flow
- pelvic and leg vein principle sites
- Deep vein of calf muscles may extend to posterior tibial, popliteal, femoral and iliac vein occasionally reaching the inferior vena cava
- propagation may be rapid or in stages

- Develops in immobilized pt esp after abdominal surgery, severe injury, MI, CCF
- high incidences in middle age to age, in late PG, and after child birth.
- Deep vein of calf muscles may extend to posterior tibial, popliteal, femoral and iliac vein occasionally reaching the inferior vena cava

...middle age to old age...

- propagation may be rapid or in stages
- Pelvic vein thrombosis is less common, may occur in hypertrophied pelvic veins
- extends to internal and common iliac veins
- hypercoag is seen soon after trauma
- Approximately 2 weeks after surgery. Inhibition of abdominal and leg movement contributes to venous thrombosis

- most patient are undiagnosed but some may present with tenderness
- And edema of the affected limb
- other predisposing factors include malnutrition, debilitating infections, wasting diseases called marantic thrombosis and can involve cranial sinuses in children

...esp superior sagittal sinus

- Can be a complication of myeloproliferative disorders
- phlebitis promotes thrombosis, migratory thrombophlebitis maybe associated with cancer esp pancreas, septic may give septicemia

Arterial thrombosis

- Rapid flow of blood prevents formation unless there is vessel damage
- atheroma is the commonest predisposing factor
- plaque produces turbulence and

- May ulcerate result in fibrin and plt thrombi that causing narrowing and obstruction
- also aneurysm may results in thrombi with laminated appearance
- arteritis leads to thrombosis

Venular thrombosis heals faster

- Malignant hypertension may cause thrombosis of necrotized small arteries and arterioles
- **CARDIAC THROMBOSIS**
- Thrombi may form on the endocardium and valve cusps
- Atrial thrombosis seen in atrial appendages of the right atrium in CF and atrial fibrillation in MS
- left atrium may be filled with thrombus

MS: mitral stenosis

- ventral mural thrombus form on Endocardium overlying MI
- small vegetation of PLT thrombi form in Rheumatic fever
- thrombotic vegetation occur in normal valves and endocardium in chronic ds assoc with hypercoagual

PLT: platelet

Capillary thrombosis

- Seen in acute inflammation due to endothelial damage. Composed of packed red cells
- In Arther reaction (Type 3) thrombi formation is due to endothelial damage by toxic metabolism, PMN enzymes

An Arthus reaction is a local vasculitis associated with deposition of immune complexes and activation of complement - type 3 hypersensitivity

	Arterial thrombi	Venous thrombi
Arteries and heart		veins
Aorta, coronary, cerebral etc		Superficial varicose veins, deep leg veins
Endothelial cell injury Causes-atherosclerosis, vasculitis, trauma		Venous stasis
Usually mural, not occluding lumen		Invariably occlusive
Grey- white, friable with lines of Zahn		Red-blue with fibrin strands with line of Zahn
Grows retrograde		Grows in the direction of blood flow
Meshwork of platelets, fibrin, red cells and degenerating leucocytes		More enmeshed RBC s and few platelets (red or stasis thrombi)

General Morphology / Characteristics of Arterial & venous Thrombi

Characteristics	Arterial/ Cardiac Thrombus	Venous/Red/Stasis/ Phlebo-thrombus
Location	At the site of endothelial injury or turbulence	At the sites of Stasis
Direction	Retrograde dir. From pt. of attachment	In a direction of blood flow
Nature	Usually Occlusive	Almost invariably occlusive
	Gray - white, Firmly adhered to arterial wall	Red/stasis thrombus

FATE OF A THROMBUS

- I. Propagate on along the vessel wall
- II. Detached to form embolus
- III. Removed through
- a. Shrinkage -thrombus contracts due to the fibrin contraction
- B. lysis by plasma proteolytic enzymes together with those of the PMN

- c. organization thru digestion by macrophages and ingrowth of fibrovascular tissue
- d. incorporation into vessel wall by growth of epithelium over it i.e. endothelialization
- importance of the outcome depends on the site- arterial thrombus endothelialisation leads to

- Growth of atheromatous plaque
- occlusive venous thrombus
- red thrombus contracts and may remain attached to wall resulting in organization and granulation tissue formation.

- Digestion by macrophages and plasmin lead to channels that endothelialize and create other capillary channels that may unite and lead to recanalization.
- The whole vessel form solid cord

- Dystrophic calcification may form phleboliths esp in pelvic veins
- arterial thrombi are mainly organized however recanalization seldomly restores normal blood flow unlike in the veins

- Mural thrombi grow granulation tissue from underlying heart muscle that anchor the thrombus to the wall .
- Large thrombi persist for years but are endothelialised so emboli less

Mural thrombi mostly don't undergo embolisation

