

Thrombosis and emboli

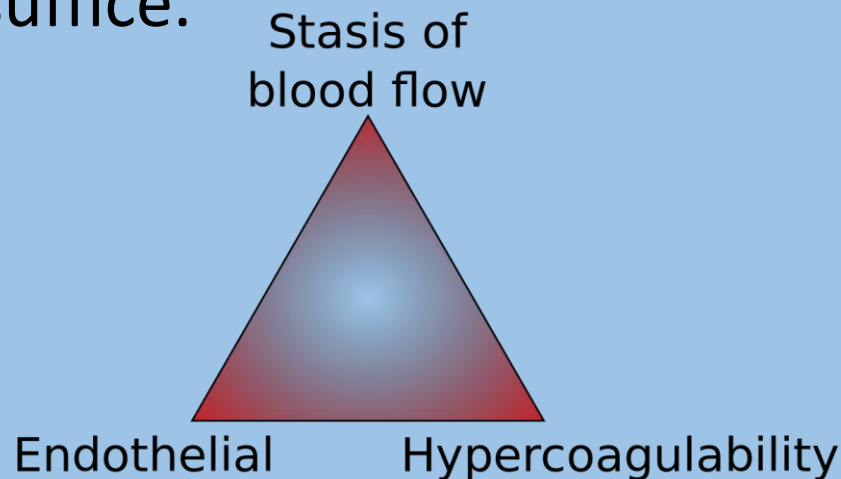
Peter Nagy

- A thrombus is any solid object developing from the blood in vivo within the vascular system or heart.
- Thrombosis is hemostasis in the wrong place.
- Major components, forms:
 - platelet aggregates
 - clotted blood
 - fibrin
 - platelet/white thrombus
 - red thrombus
 - fibrin thrombus

Pathogenesis of thrombosis (Virchow's triad)

- Changes in the vascular wall (endothelial damage)
- Changes in flow (slow or turbulent flow)
- Changes in the blood (hypercoagulability)

Thrombosis may occur even if the triad is not complete, just two of the conditions suffice.



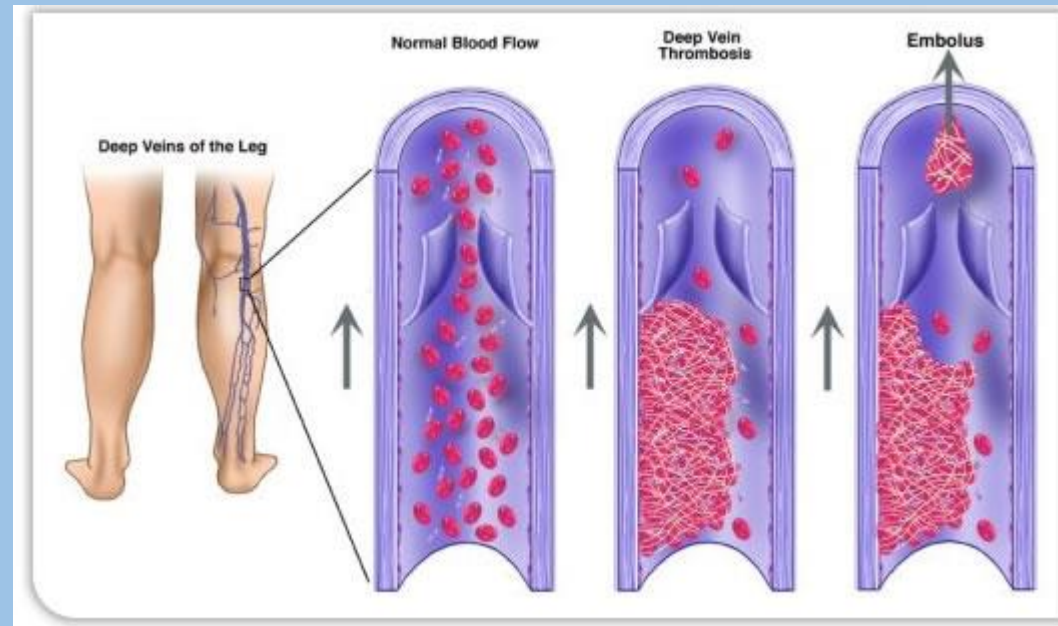
Changes in the vascular wall

- Atherosclerotic plaques
- Inflamed tissues, immunological reactions
- Necrotic tissues
- Surgical interventions
- Special conditions (TTP)



Changes in flow

- Sluggish flow (veins, bedridden patients, pregnancy)
- Turbulent flow



Changes in blood

- Acquired changes (cancer, pregnancy, antiphospholipid syndrome)
- Inherited conditions (Leiden mutation etc.)



Steps of thrombus formation

- Platelet aggregation, activation
- Fibrin formation with entrapped red blood cells
- Platelet aggregation



Lines of Zahn



The clotting stops at the level of the nearest branch, where flow dilutes the clotting factors.

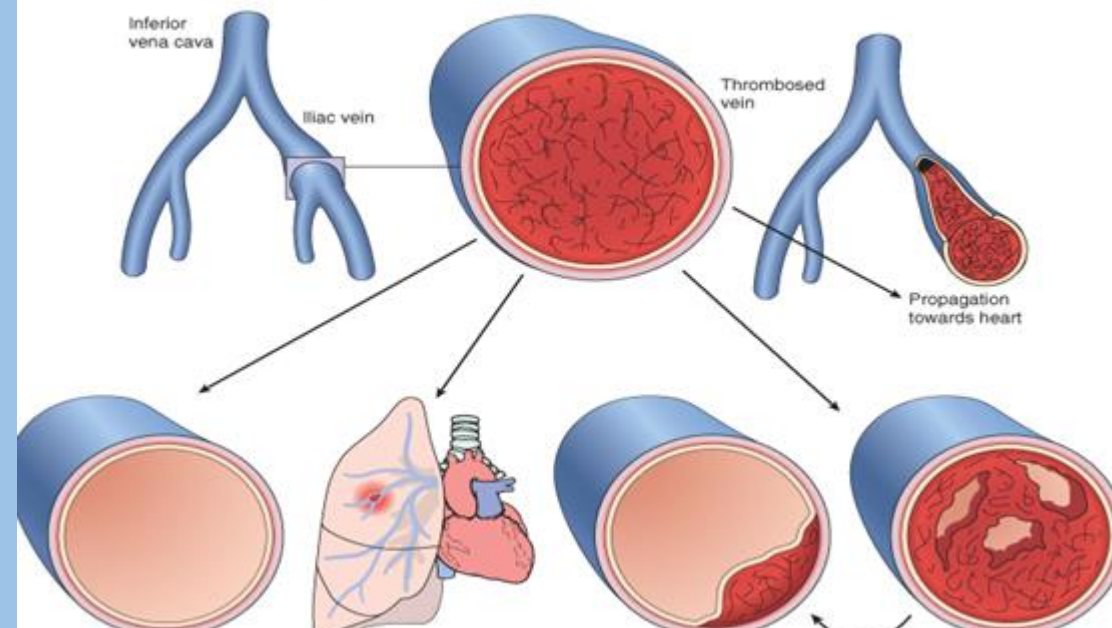
Thrombus: organized & recanalized

Fates of a thrombus

- Dissolves
- Propagation
- Breaks off and forms embolus
- Organizes
 - Recanalization
 - Calcification (phlebolith)

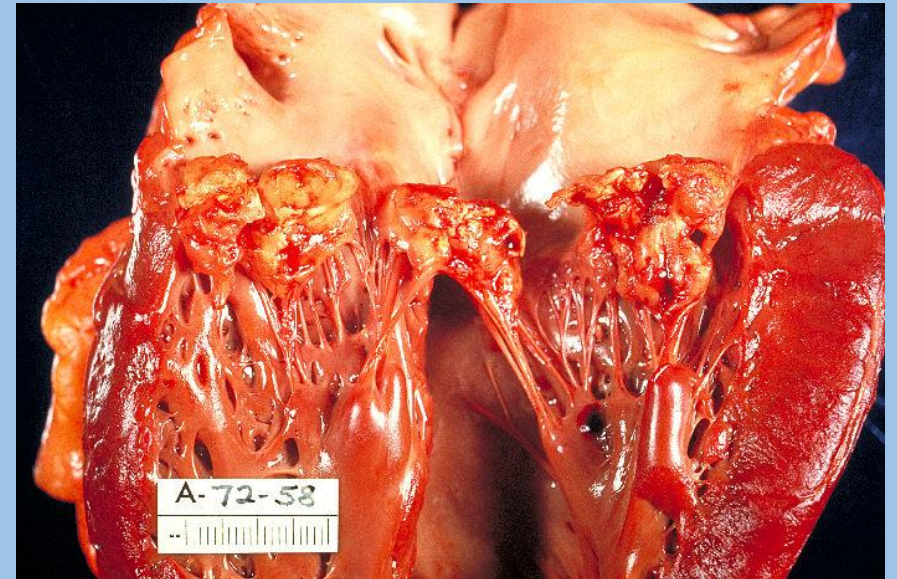


Potential outcomes of venous thrombosis



Types of thrombus

- Arterial thrombi (white thrombi, mostly platelet aggregation)
- Venous thrombi (red thrombi, coagulation)
- Vegetations (thrombus on a cardiac valve)
- Infected thrombi (spreading of infection)
- Migrating thrombophlebitis (paraneoplasia)
- Tumor thrombus
- Fibrin thrombi (DIC)



Disseminated intravascular coagulation (DIC)

(haemorrhagic microthrombosis)

- Acute (Gram negative sepsis, trauma, complications of birth, snake bite)
- Chronic (Paraneoplasia)
- 1. Generalized activation of the clotting cascade
- 2. Fibrinolysis
- Consumptive coagulopathy

Consequences of DIC

- I. Microvascular thrombosis (multifocal brain necroses, coma; superficial ulceration, gangrene of skin, mucous membranes; oliguria; ARDS)
- II. Hemorrhagic diathesis (intracerebral bleeding; petechiae; hematuria; epistaxis; GI bleeding)
- III. Microangiopathic hemolytic anemia



Most important clinical aspects of thrombosis

- Arterial occlusion (AMI, stroke)
- Deep vein thrombosis (pulmonary emboli)
- Thrombophlebitis
- Pylethrombosis (thrombus in vena portae)
- DIC

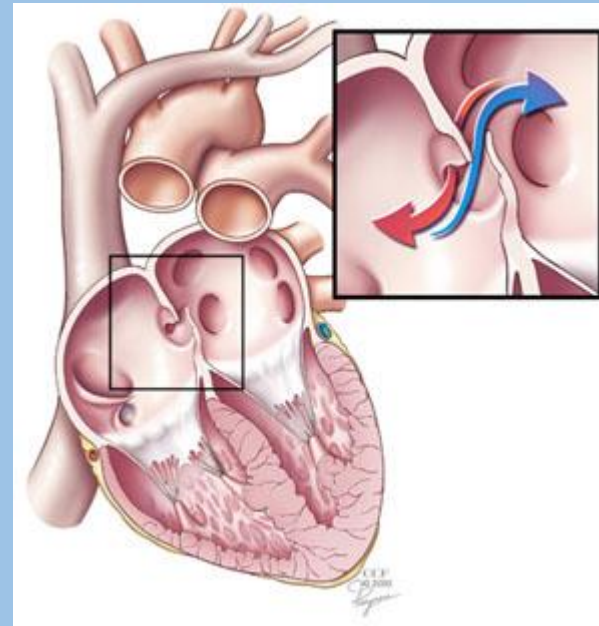


EMBOLI are solid, liquid or gaseous objects carried by the blood that can not mix with the blood and that are large enough to become impacted in the arterial or capillary lumen.

(Embolism can not occur in veins (except the portal vein) because venous blood flows from small to ever larger vessels)

Routes of embolization

- Emboli arising in the left heart or in the aorta (systemic embolization) can end up anywhere in the body except the lung.
- Emboli coming from the peripheral veins or from the right heart end up in the lungs
 - Paradoxical embolization: they come from the systemic veins but (instead of the lung) they embolize in systemic arteries.
 - Patent foramen ovale
 - Arteriovenous shunts of the lung



Types of emboli

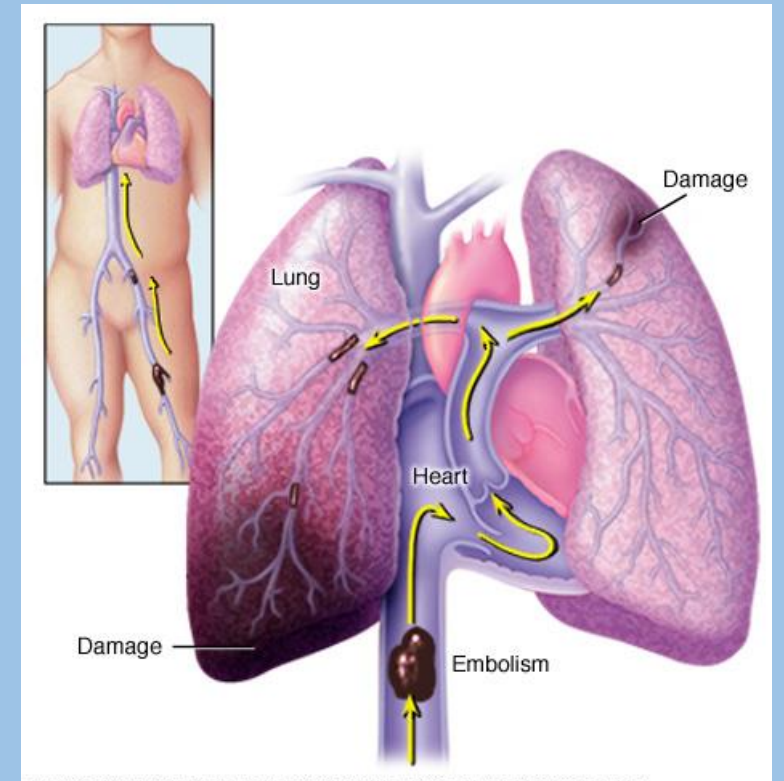
- Thromboemboli
- Fat or bone marrow emboli
- Gas emboli
- Amniotic fluid emboli
 - Atheroma emboli
 - Brain emboli
 - Therapeutic emboli

Thromboemboli

- Pulmonary emboli (most of them are silent)
 - Massive – sudden death
 - Medium - Small branch - - pulmonary haemorrhage/infarction
 - Repeated – pulmonary hypertension

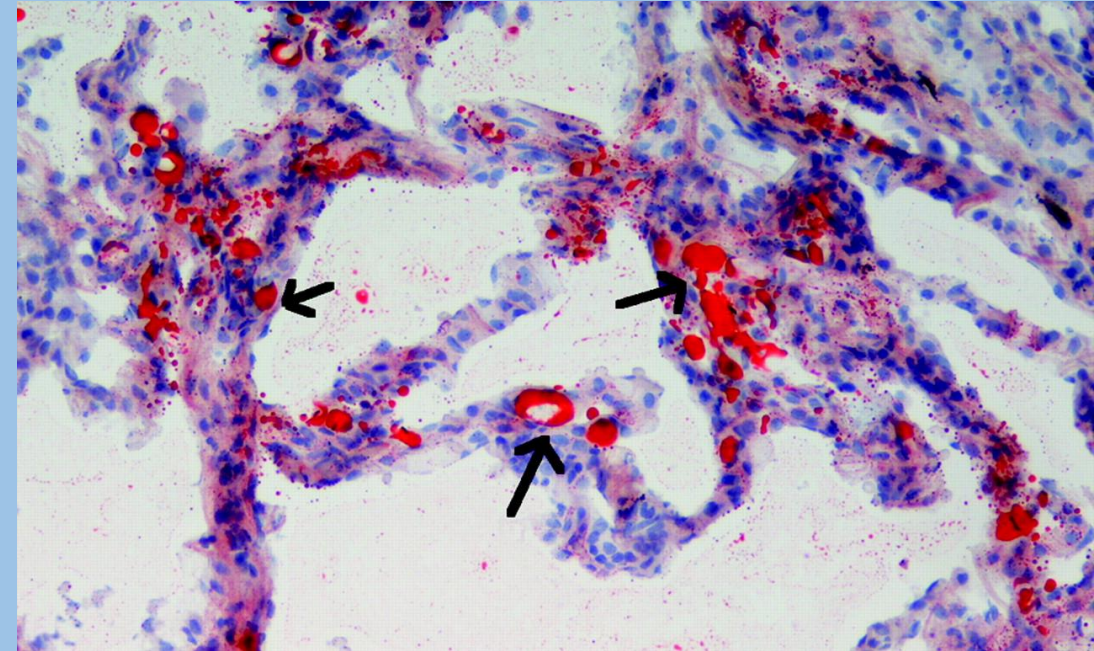
Systemic emboli

Infarction/gangrene



Fat/bone marrow emboli

- Etiology: bone fraction, liposuccion, CPR
- Complications: asymptomatic
 - ARDS
 - Brain microinfarction
 - Petechiae
 - thrombocytopenia

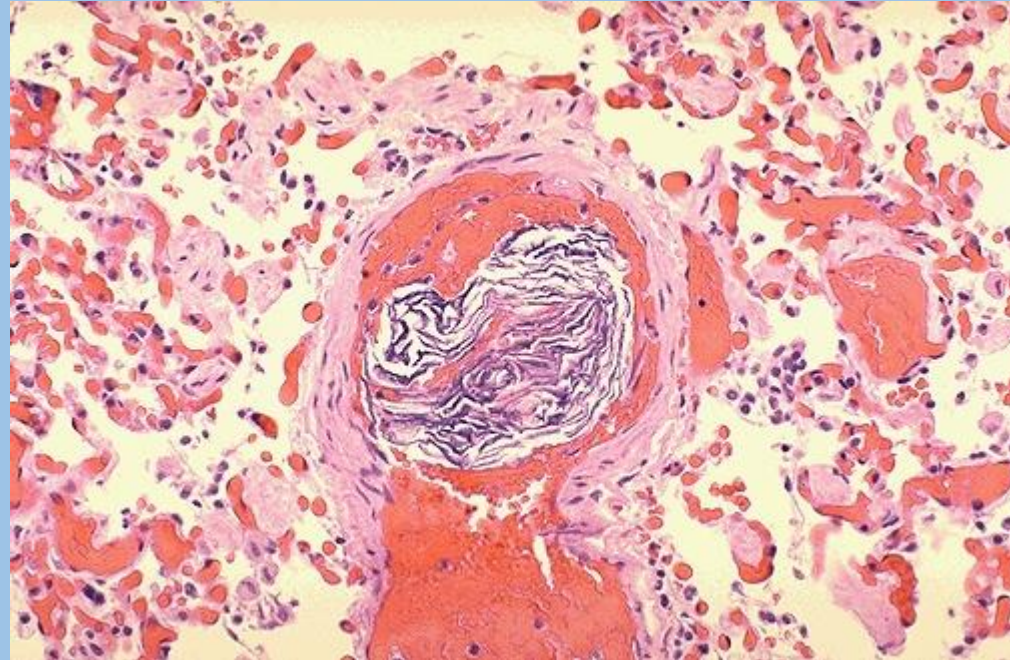


Gas emboli

- Etiology: neck trauma, during labor, Caisson syndrome
- Complications: ARDS
 - Focal brain ischaemia
 - Chronic form ischaemic bone necrosis

Amniotic fluid emboli

- Rare complication of child birth
- ARDS, DIC



Other obstacles of blood flow

- Arterial spasm
 - Coronary spasm (Prinzmetal angina)
 - Cerebral arterial spasm (TIA)
 - Raynaud's phenomenon

Obstruction by external compression

Torsion

Increased pressure (pressure sores)

