

CV pathology summary

THROMBOSIS – PATHOLOGICAL ASPECTS

- **Definition:** Thrombosis is the pathological formation of unnecessary blood clots, which can cause harm to the body.
- **Physiological vs. Pathological:** Normal blood coagulation protects against blood loss (hemostasis). Pathological thrombosis occurs unnecessarily, often due to changes in the environment, injury to endothelial cells, or hypercoagulability.
- **Virchow's Triad:** Pathological thrombosis is caused by one or more of the following:
 1. **Endothelial Injury** (e.g., in heart or arteries).
 2. **Stasis** (abnormal blood flow).
 3. **Hypercoagulability** (genetic or acquired).

ENDOTHELIAL CELLS AND THROMBOSIS

- **Normal Endothelium:** Acts as a barrier to prevent unnecessary thrombosis.
- **Injury or Dysfunction:** Leads to a prothrombotic state, allowing clots to form.
- **Causes of Endothelial Injury:**
 - Valvulitis, myocardial infarction (MI), atherosclerosis, trauma, hypertension, endotoxins (bacterial products), hypercholesterolemia, smoking, radiation, etc.
- **Pathological Healing Response:** Excessive thickening of the tunica intima may result in **luminal stenosis** (narrowing of the vessel) and obstruction (occlusion) of blood flow.

STASIS AND TURBULENT BLOOD FLOW

- **Normal (Laminar) Flow:** Platelets and blood cells flow centrally in the vessel, separated from the endothelium by plasma. This prevents pathological thrombosis.
- **Turbulent Flow:** Seen in conditions like atherosclerosis or varicose veins, turbulence causes endothelial injury and promotes clot formation (turbulence seen more in arteries)
- **Stasis:** A major factor in **venous thrombi** formation. Causes include:
 - Atherosclerosis, aneurysms, MI (non-contractile fibers), mitral valve stenosis, hyperviscosity syndromes (e.g., polycythemia vera, sickle cell anemia).

HYPERCOAGULABILITY

- **Definition:** Increased tendency of blood to clot.
- **Types:**
 - **Genetic (Primary):**
 - Mutations in clotting factors (e.g., Factor V Leiden, prothrombin gene mutations).
 - **Acquired (Secondary):**
 - More common and multifactorial. Causes include immobilization, MI, atrial fibrillation, surgery, fractures, burns, cancer, prosthetic cardiac valves, etc.

MORPHOLOGY OF THROMBI

- **Location:** Thrombi can form anywhere in the cardiovascular system (e.g., **heart chambers**, valves, arteries, veins, capillaries).
- **Types:**
 - **Arterial/Cardiac Thrombi:** Begin at sites of endothelial injury or turbulence, often over atherosclerotic plaques.

- **Venous Thrombi:** Form in areas of stasis, **most commonly in lower extremity (lower limbs) veins (90% of cases)**.
- **Attachment:** Thrombi are attached to the vascular surface. The propagating portion may break off, forming an **embolus**.

LINES OF ZAHN

- **Definition:** Alternating pale platelet and fibrin layers with darker erythrocyte-rich layers in thrombi.
- **Significance:** Distinguishes **antemortem thrombi** (formed before death) from **postmortem clots** (formed after death, non-laminated).
- **Forensic Importance:** Helps determine whether a clot contributed to the cause of death.

TYPES OF THROMBI

1. Mural Thrombi:

- Found in heart chambers or aortic lumen.
- Attached to the wall but do not completely obstruct the lumen.

2. Cardiac Vegetations:

- Thrombi on heart valves.
- Can be:
 - **Infectious** (e.g., bacterial or fungal infections like infective endocarditis).
 - **Non-infectious** (e.g., rheumatic fever, non-bacterial thrombotic endocarditis).

FATES OF A THROMBUS

1. **Propagation:** Accumulation of platelets and fibrin, leading to vessel obstruction.
2. **Embolization:** Dislodgment or fragmentation of thrombi, traveling to other areas and causing **emboli**.
3. **Dissolution:** Fibrinolytic activity removes the thrombus (only in recent thrombi).
4. **Organization and Recanalization:**
 - **Organization:** Ingrowth of endothelial cells, smooth muscle cells, and fibroblasts into the thrombus.
 - **Recanalization:** Formation of new channels within the thrombus, partially restoring blood flow.
5. **Superimposed Infection:**
 - Can lead to a **mycotic aneurysm** (localized infection of the vessel wall).

ADDITIONAL NOTES

- **Mycotic Aneurysm:** A localized infection of a vessel wall caused by a thrombus, weakening the wall and potentially leading to rupture.
- **Embolization Risks:** Fragmented thrombi can obstruct smaller vessels, causing ischemia downstream.
- **Postmortem Clots:**
 - Form after death due to gravity.
 - Lack the lines of Zahn, are gelatinous, and have a "chicken fat" appearance.

