



Pathological anatomy

**Disorders of
Circulation**

Thrombosis:

- Intravascular coagulation
- Vessel damage - atheroma, toxins
- Blood changes - stasis, *coagulation factors
- Types: White, Red & Mixed.
- Sites:
 - **Arterial**: Brain, Heart, limbs, eys.
 - **Venous**: Leg
 - **Capillary**: DIC in septicemia

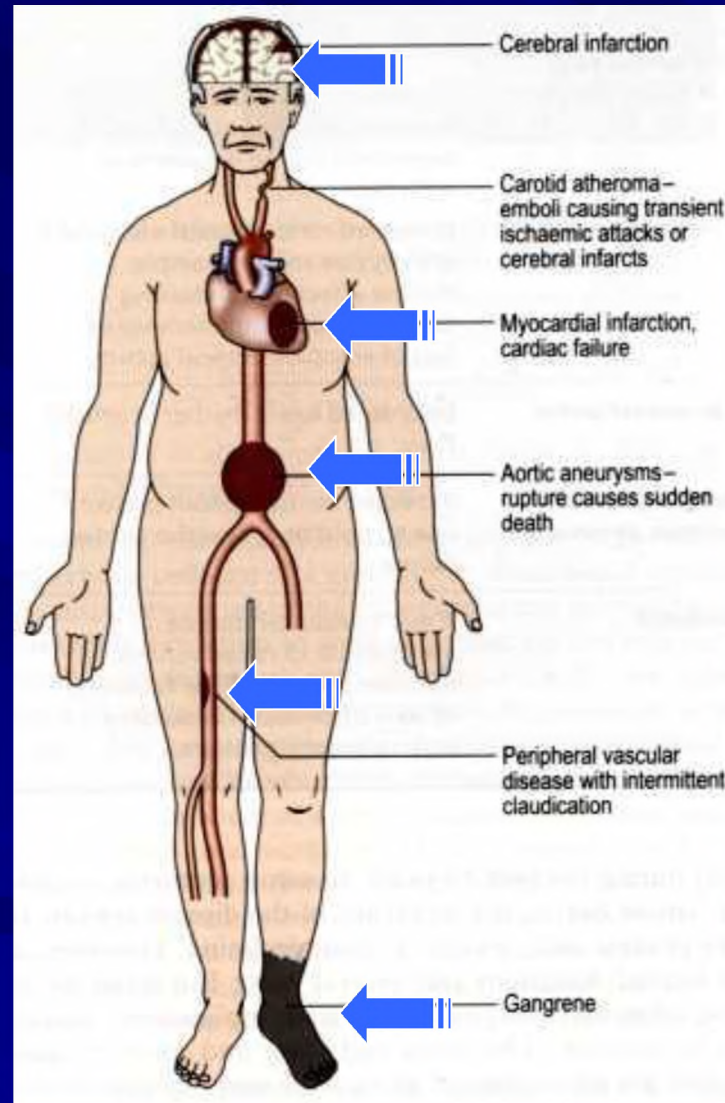
Sequels of Block

- Collateral circulation:
- Ischemia,
- Infarction, Gangrene
- Haemorrhage

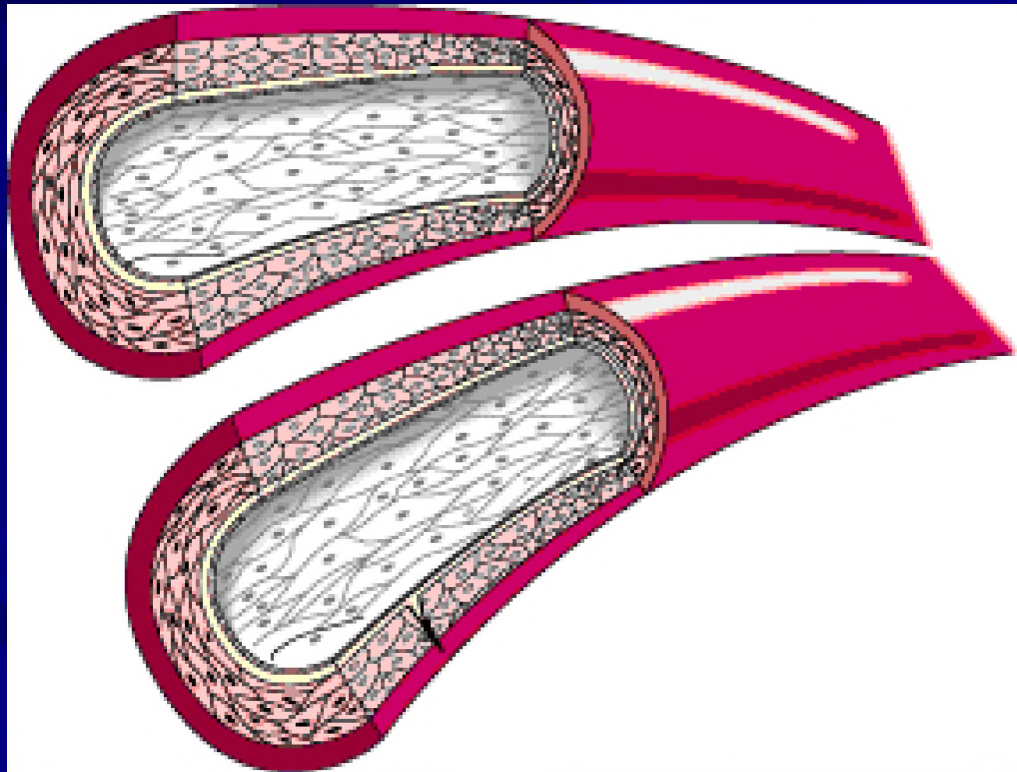
Thrombus

- ***A thrombus is an aggregate of coagulated blood containing platelets, fibrin and entrapped cellular elements, within a vascular lumen.***
- Formation of a thrombus is thrombosis.
- A thrombus by definition adheres to vascular endothelium and should be distinguished from a simple blood clot, which reflects only activation of the coagulation cascade and can form in vitro or even postmortem.

Common Sites of block:



Development of Coronary Atherosclerosis:

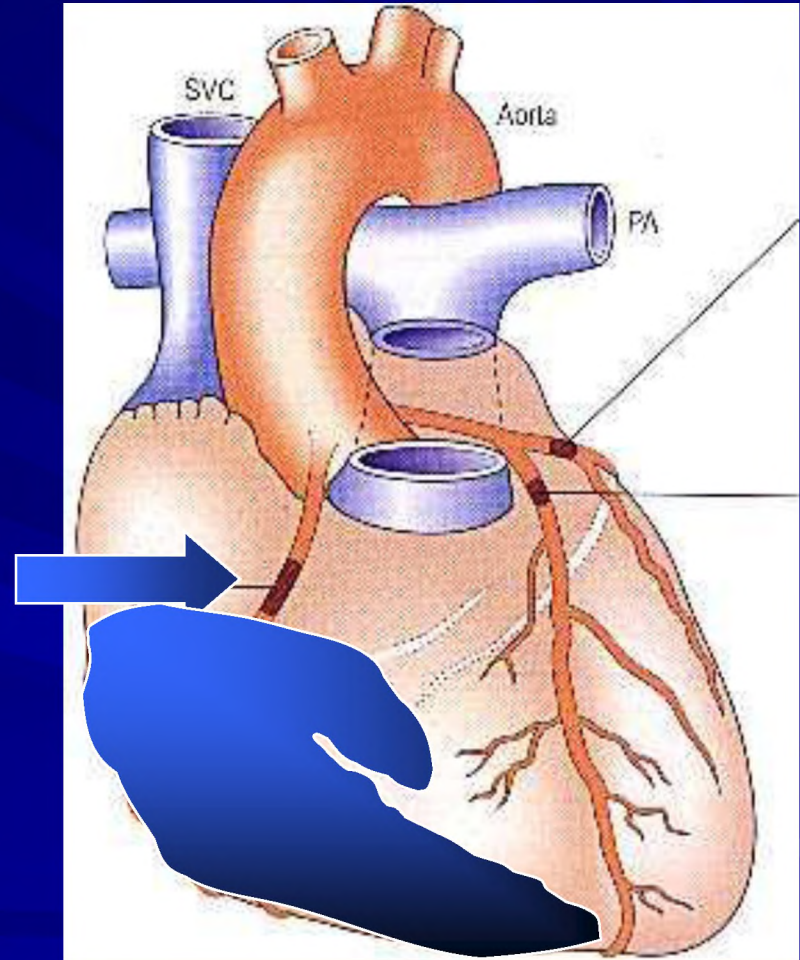
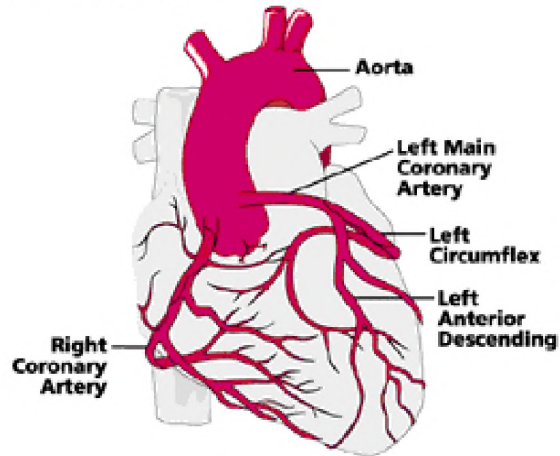


Coronary Atherosclerosis:

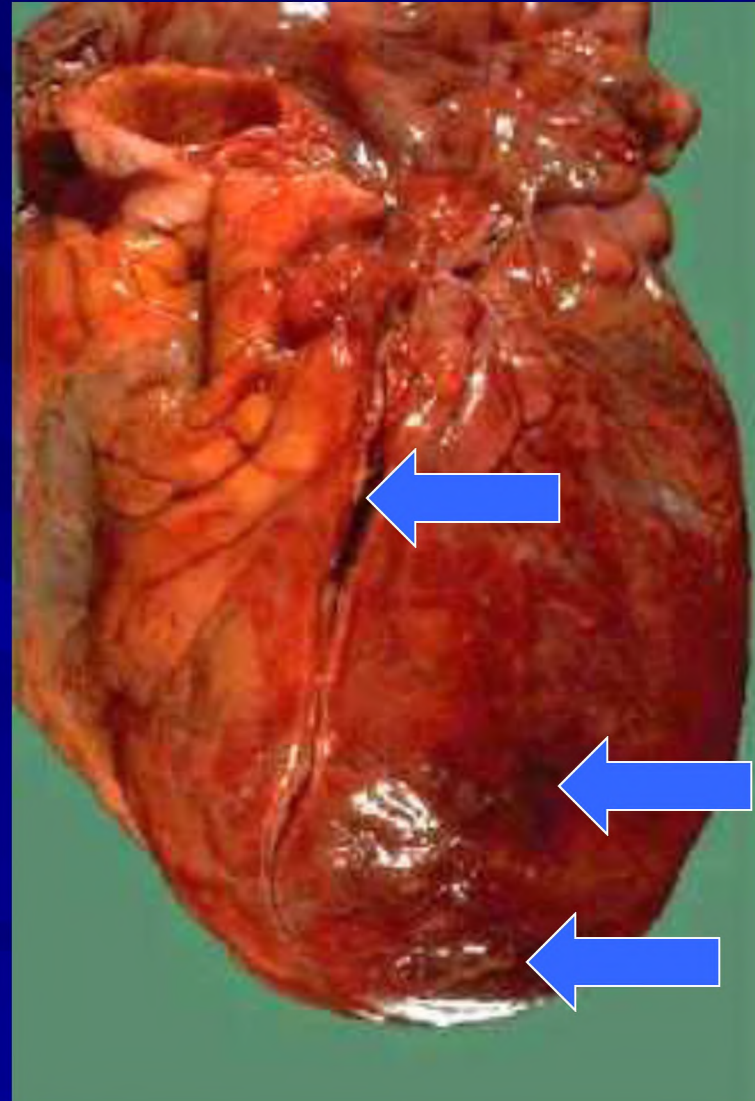


Coronary Atherosclerosis

© 1997 HeartPoint



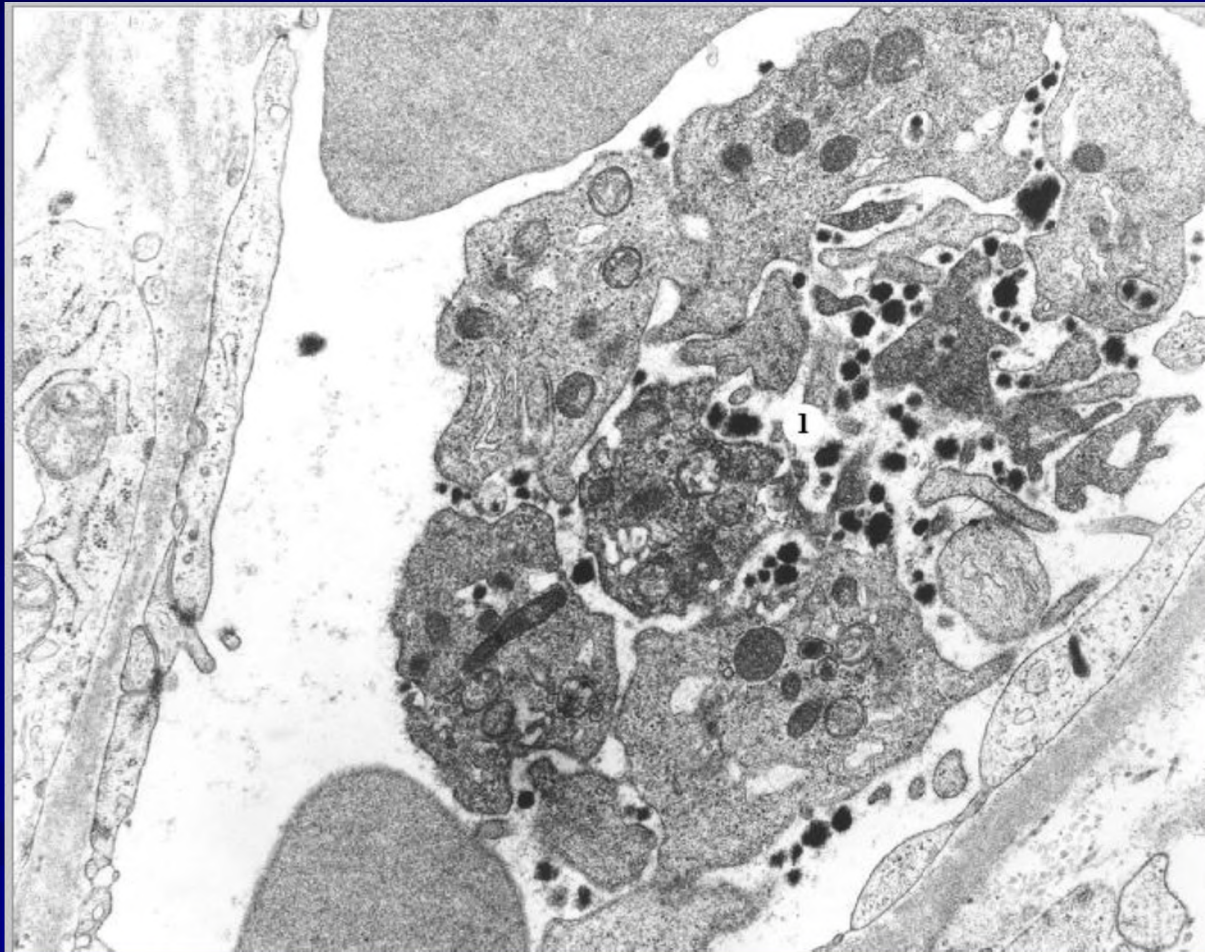
Coronary Thrombosis With Infarction



The pathogenesis of **arterial thrombosis** involves principally three factors:

- **Damage to endothelium**, usually by atherosclerosis, disturbs the anticoagulant properties of the vessel wall and serves as a nidus for platelet aggregation and fibrin formation.
- **Alterations in blood flow**, whether from turbulence in an aneurysm or at sites of arterial bifurcation, is conducive to thrombosis. Slowing of blood flow in narrowed arteries favors thrombosis.
- **Increased coagulability of the blood**, as seen in polycythemia vera or in association with some cancers, leads to an increased risk of thrombosis.

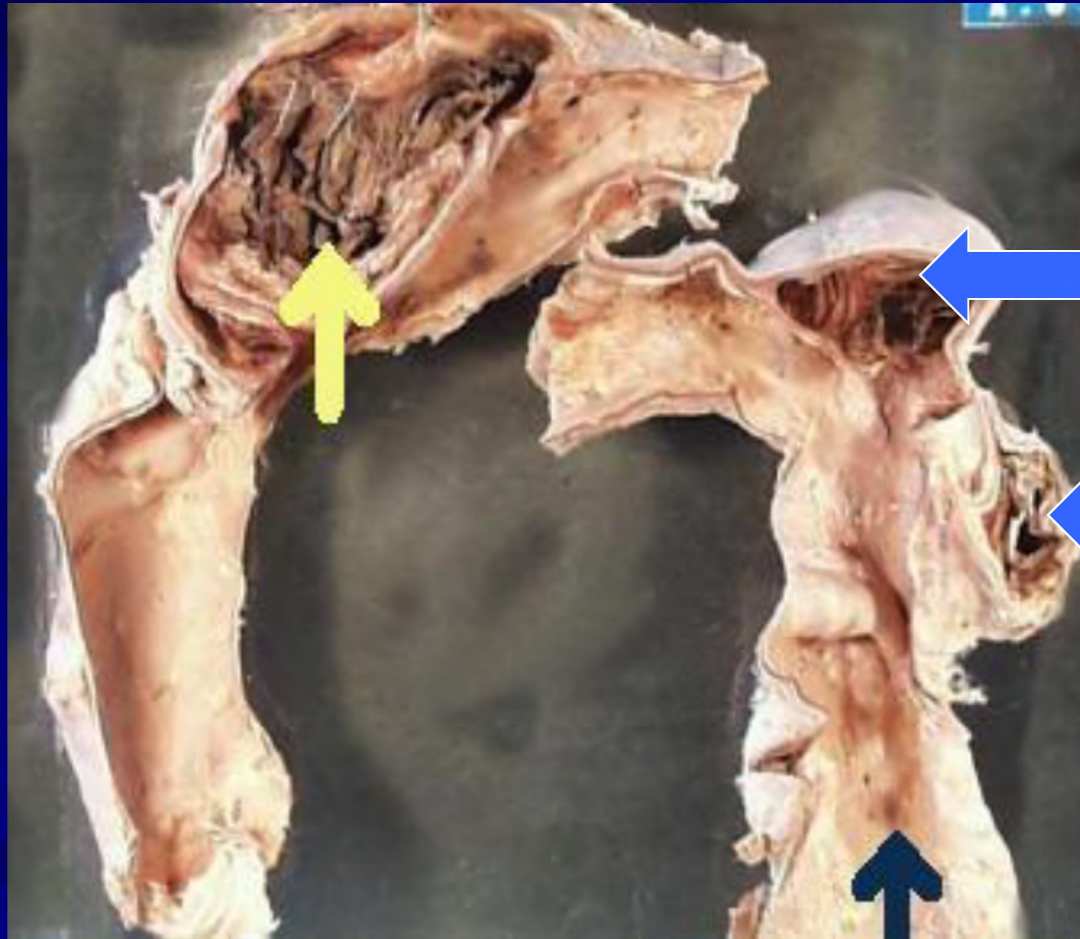
Thrombosis



Atherosclerosis
Aorta
Ruptured aneurism
Nephrosclerosis



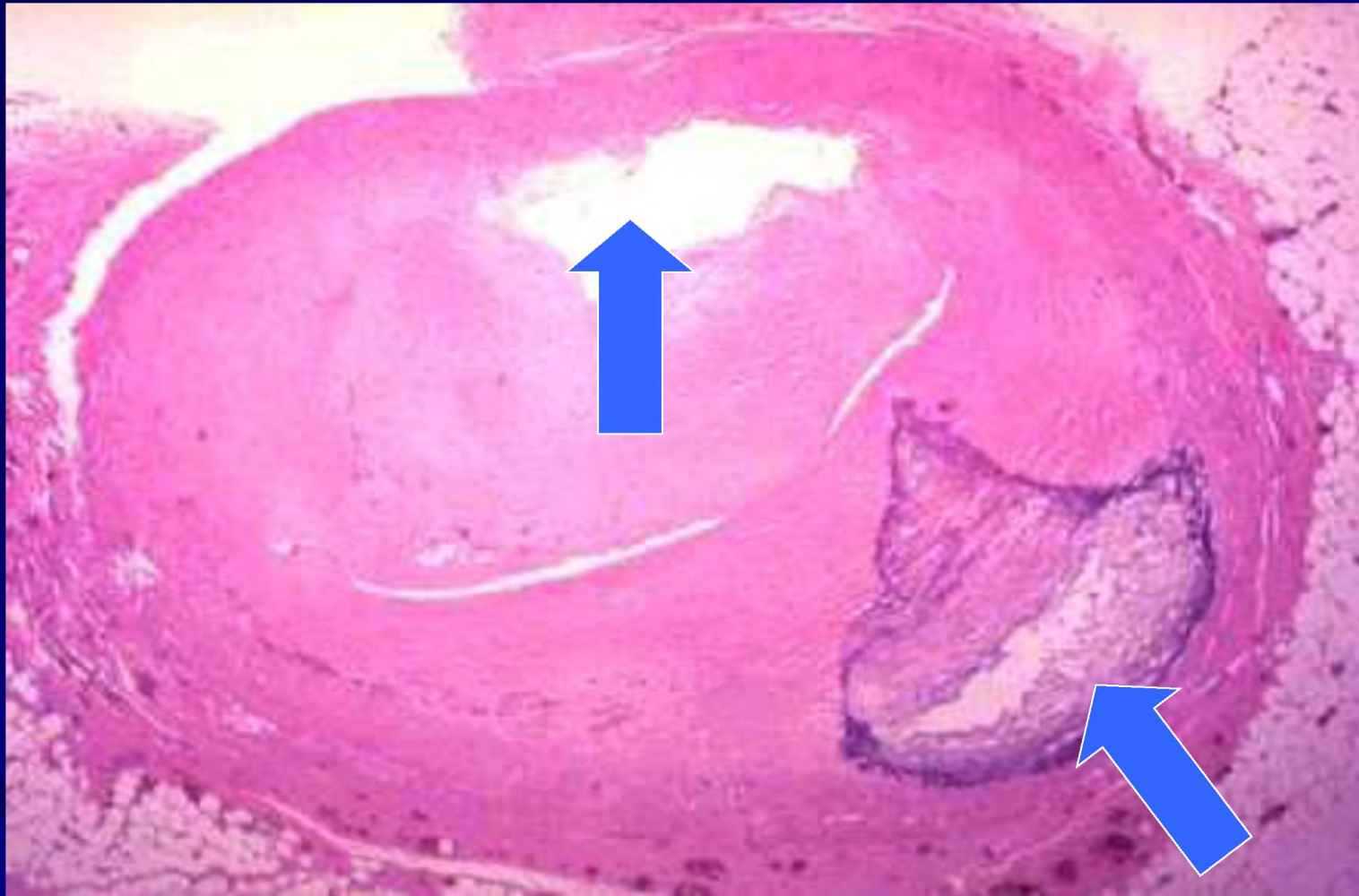
Aorta Dissecting Aneurysms



Coronary Narrowing in Atherosclerosis:



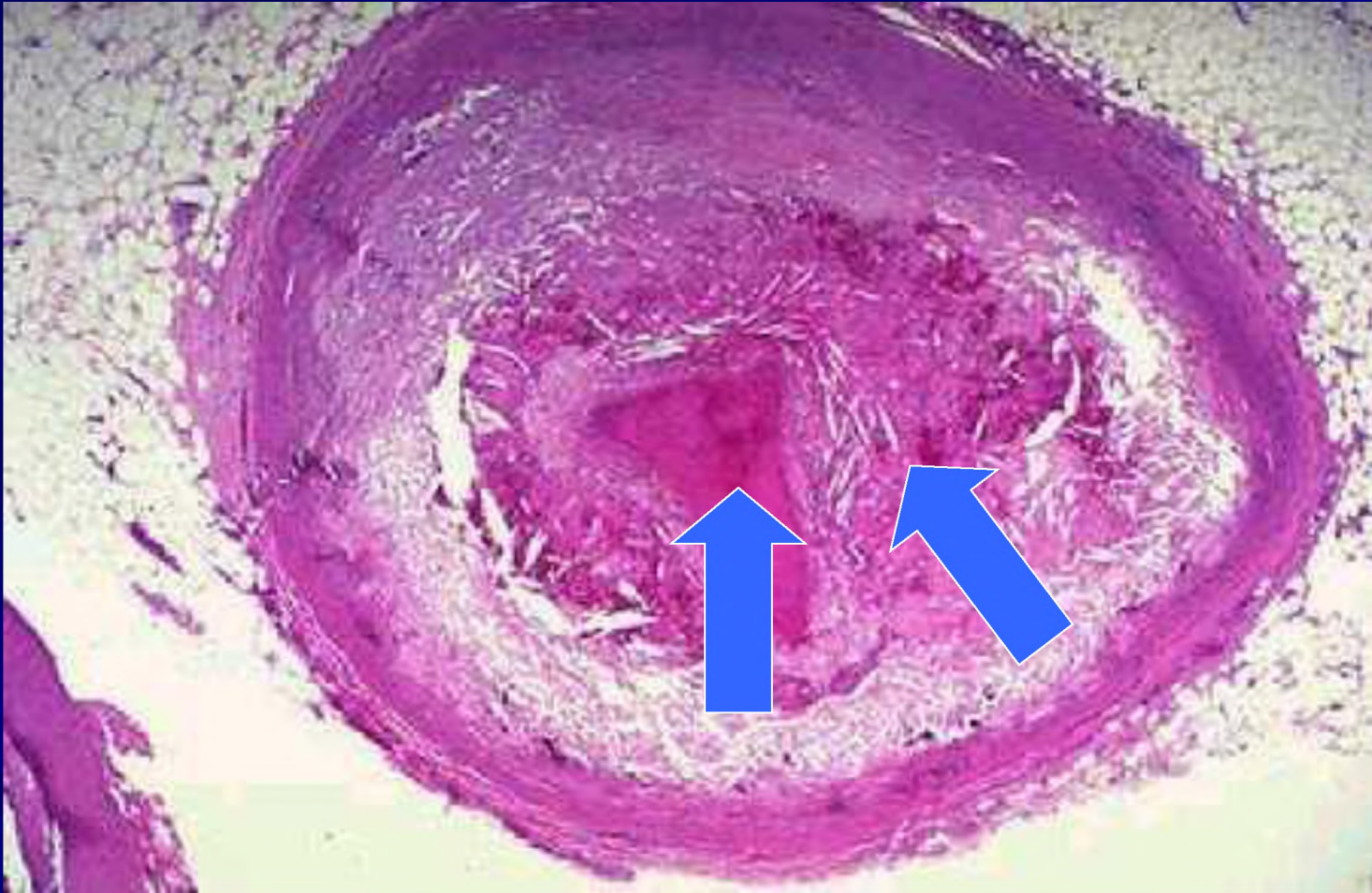
Atheroma Coronary Artery:



Calcification

- An arterial thrombus attached to a vessel wall is initially soft and friable, with fine alternating red bands composed principally of erythrocytes, and yellowish bands composed of platelets and fibrin (the lines of Zahn)

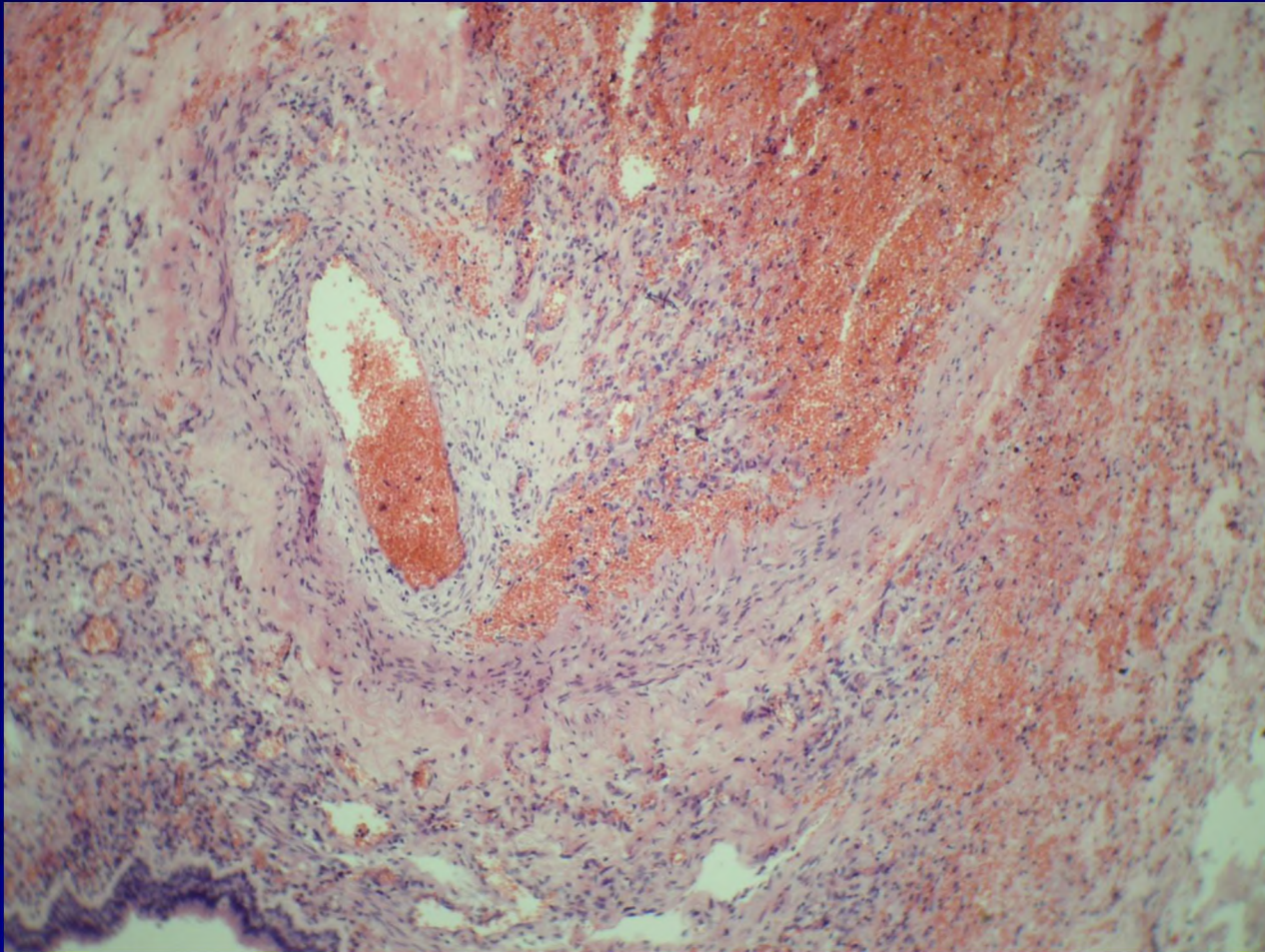
Atheromatous plaque with Thrombosis:



Once formed, arterial thrombi have several possible outcomes.

- **Lysis**, owing to the potent thrombolytic activity of the blood
- **Propagation** (i.e., an increase in its size), because a thrombus serves as a focus for further thrombosis
- **Organization**, the eventual invasion of connective tissue elements, which causes a thrombus to become firm and grayish white
- **Canalization**, by which new lumina lined by endothelial cells form in an organized thrombus
- **Embolization**, when part or all of the thrombus becomes dislodged, travels through the circulation and lodges in a blood vessel at a distance from the site of thrombus formation

Thrombosis



- The term currently used to designate the formation of blood clots in the venous system is **deep venous thrombosis**, which replaces older terminology (phlebothrombosis or, in the absence of inflammation, thrombophlebitis). The most common manifestation of the disorder, namely, thrombosis of the deep venous system of the legs

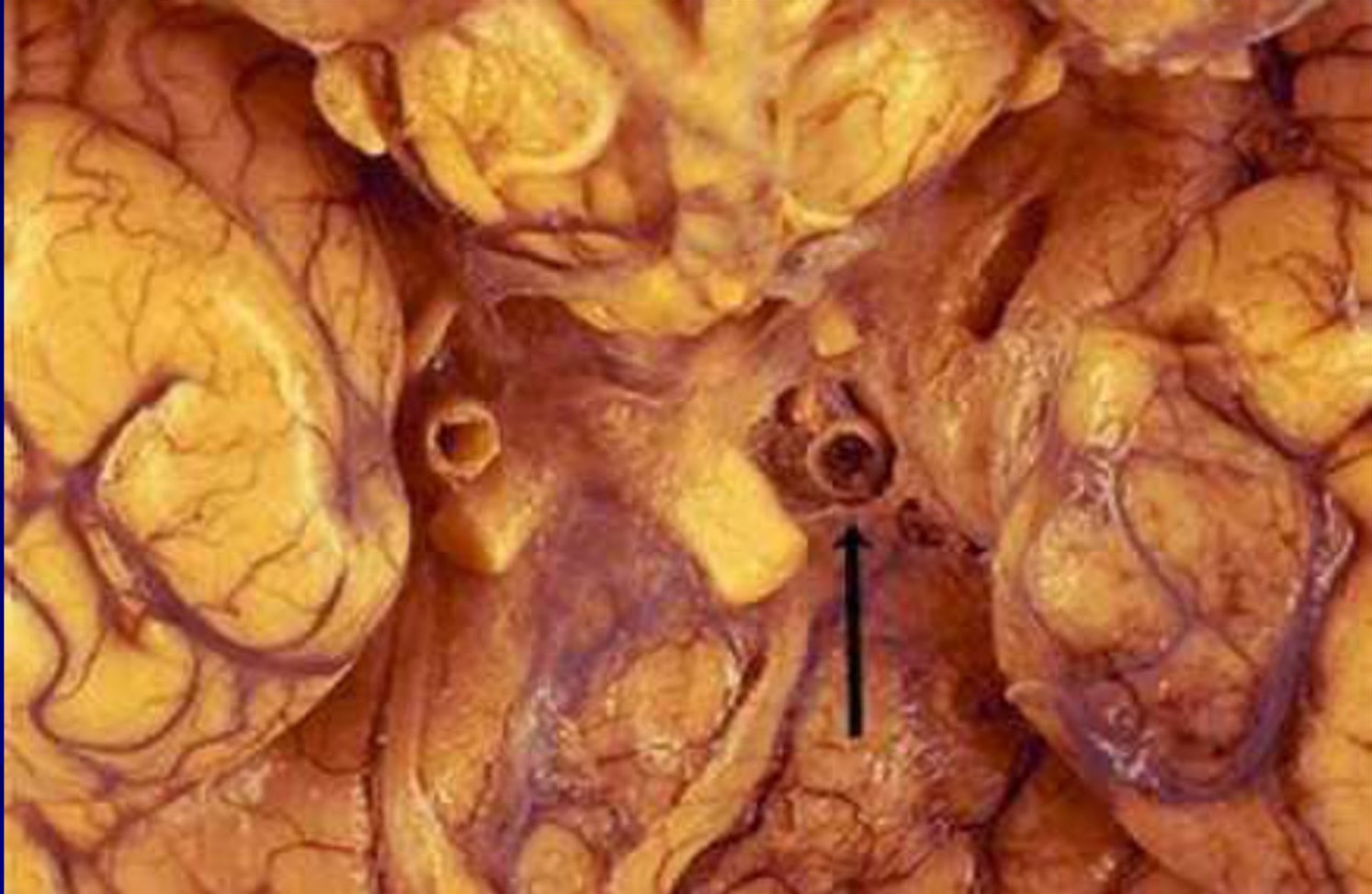
Embolism:

- Abnormal solid mass carried in blood.
- Source – destination
- Types.
 - **Thromboembolism** - atherosclerosis
 - **Fat** - Fractures
 - **Tumor** - cancers
 - **Gas** – ‘Caisson disease’
 - **Liquid** – Amniotic fluid in new born.
- Rapid onset of infarction –vs. Thrombosis

Angiogram - Embolism Infarction

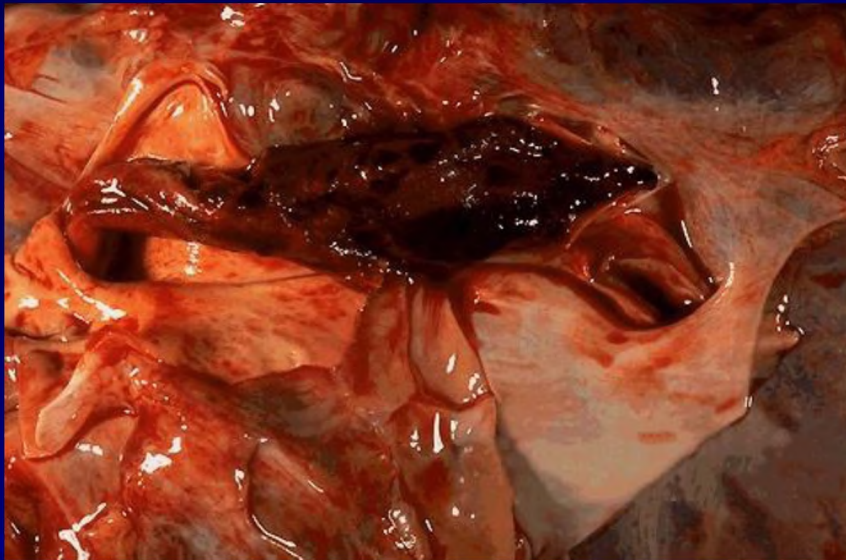


Thrombo-embolism



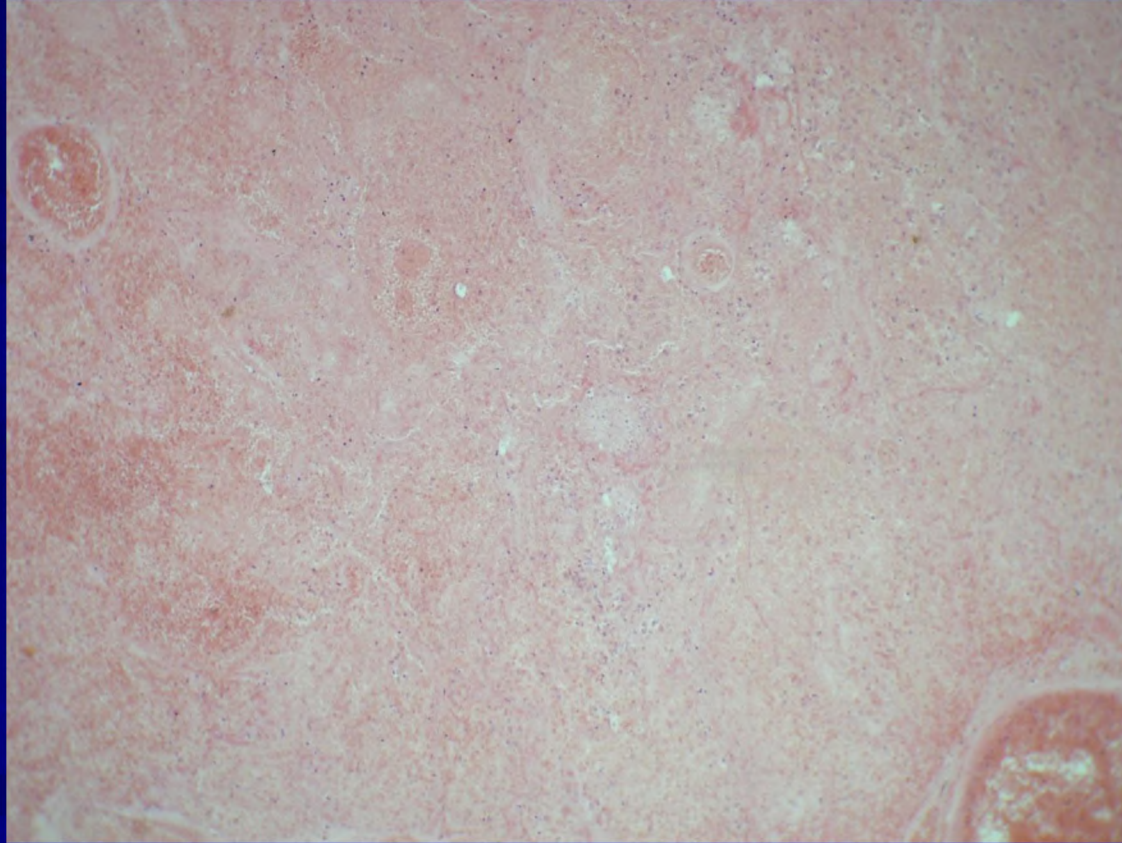
Lung-Thrombo-embolism





- Here is a "saddle embolus" that bridges across the pulmonary artery from the heart as it divides into right and left main pulmonary arteries. Such a saddle embolus is a cause for sudden death. This thromboembolus displays the typical gross appearance. The surface is somewhat irregular, and there are areas of pale tan to white admixed with dark red areas. The thrombus often has the outlines of the vein in which it formed.

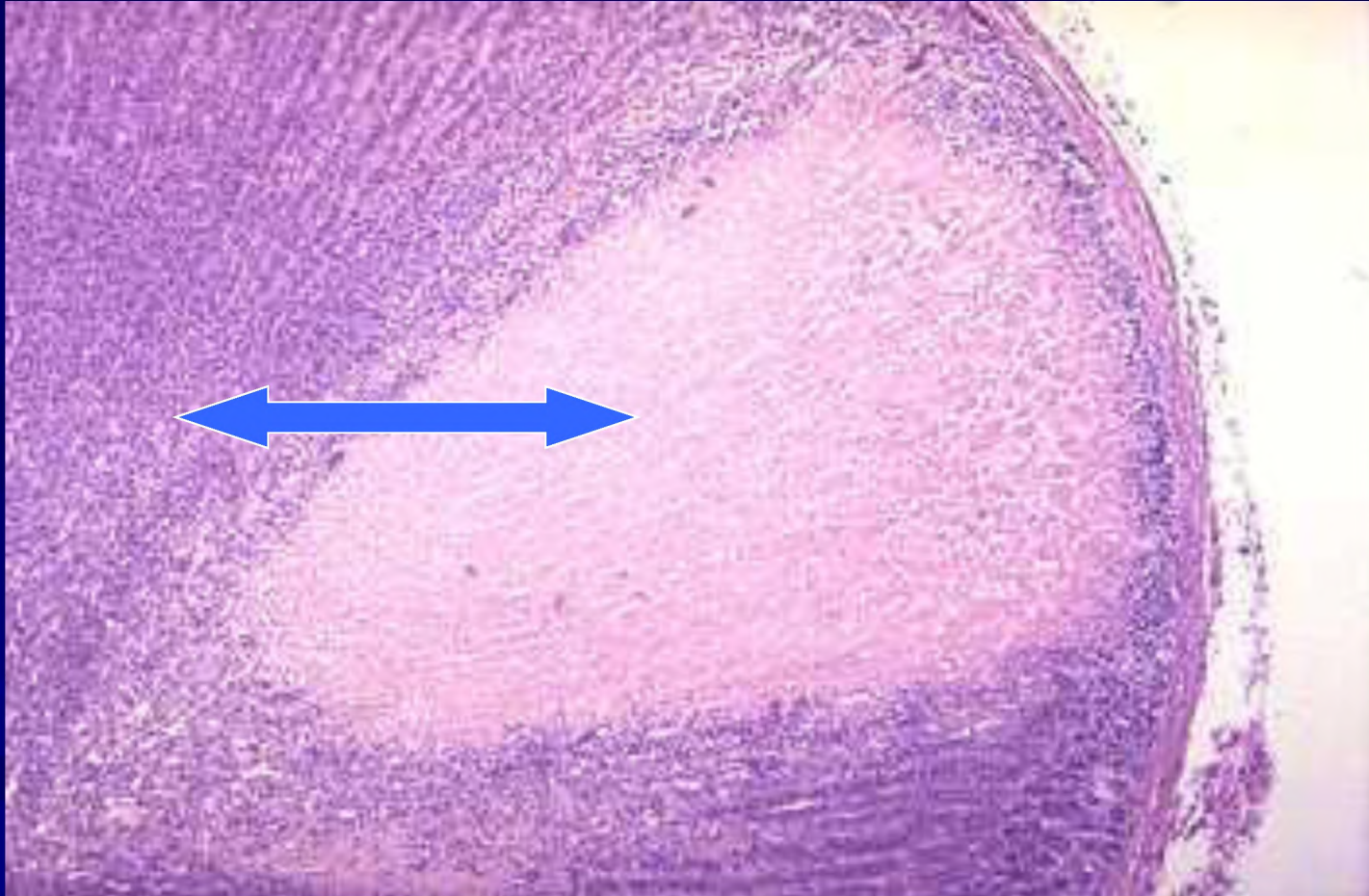
Pulmonary Infarction



Renal Infarction

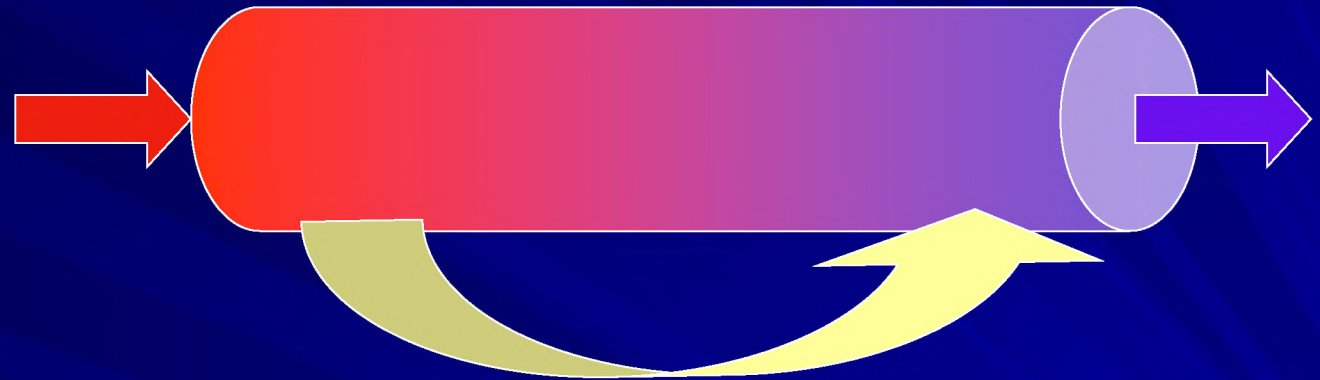


Renal Infarction



Edema & Shock....!

Normal Microcirculation



Capillary	Arterial	Venous
Hydrostatic Pressure	+ 36	+ 16
Oncotic Pressure	- 26	- 26
Net filtration Pressure	+ 10 mmHg (leak-out)	- 9 mm Hg (Reabsorb)

Edema:

- Increased interstitial fluid volume
- Local vs. Systemic (anasarca)
- Mechanism:
 - **Leaky vessels** – inflammation.
 - **Increased capillary hydrostatic pressure**
 - Venous obstructions
 - **Decreased Osmotic pressure**
 - Hypoproteinemia
 - **Lymphatic obstruction**
 - Elephantiasis

Shock:

- *“Depressed vital functions due to decreased circulating blood volume”*
- Types: Hypovolaemic & Cardiogenic
 - Hypovolaemic – Bleeding, diarrhea, vomiting.
 - Cardiogenic – Myocardial infarction.
 - Septic – DIC.
- Compensatory mechanisms:
 - Adrenaline → cold, clammy skin
- Complications: Ischemic damage.

Coagulation Disorders

- **Laboratory findings:**
- **Normal bleeding time & Platelet count**
- **Prolonged prothrombin time (PT)**
 - deficiencies of II, V, VII, X
- **Prolonged time (aPTT)**
 - all factors except VII, XIII
- **Mixing studies - normal plasma corrects PT or aPTT**

Factor VIII Deficiency

- **Classic hemophilia (hemophilia A)**
- **X-linked disorder (affects 1° males)**
- **Most common - severe bleeding**
- **Spontaneous hematomas < 1, 5, 75%**
- **Abnormal aPTT – Intrinsic path.**
- **Diagnosis - factor VIII assay**
- **Treatment - factor VIII concentrate**
- **Cryoprecipitate (less desirable)**

Factor IX Deficiency

- **Christmas disease (Hemophilia B)**
- **X-linked recessive disorder**
- **Indistinguishable from classic hemophilia (F VIII)**
- **Requires evaluation of factor VIII and IX activity levels to diagnose**
- **Treatment - factor IX concentrate**
- **Cryoprecipitate if factor IX unavailable**

Secondary Hemostatic Disorders

Acquired coagulation disorder:

- **Vitamin K deficiency**
 - neonates - decreased intestinal flora and dietary intake
 - oral anticoagulants (coumadin)
 - fat malabsorption syndromes
- **Required for factors II, VII, IX, X**
- **Prolonged PT and aPTT**

Combined Primary and Secondary Hemostatic Disorders (DIC)

Disseminated Intravascular Coagulation

- Major pathologic processes - obstetric complications, neoplasms, infection (sepsis), major trauma
- Primary - platelet consumption
(↑ bleeding time, ↓ platelets)
- Secondary - factor consumption
(↑ PT, aPTT)

Combined Primary and Secondary Hemostatic Disorders

Severe Liver Disease

- **Primary - dysfunctional platelets and/or thrombocytopenia (↑ BT)**
- **Secondary - decrease in all coagulation factors except vWF (↑ PT, aPTT)**
- **Vitamin K will promote synthesis of factors II, VII, IX, X**

Summary Hemostatic Disorders

	<u>BT</u>	<u>Plt</u>	<u>PT</u>	<u>PTT</u>
Vascular Dis	- ↑	-	-	-
PLT Disorder	- ↑	- ↓	-	-
Factor 8/9				
*Congenital	-	-	-	↑
Vit K / Liver				
*Acquired	-	-	↑	- ↑
Combined (DIC)	↑	↓	- ↑	↑

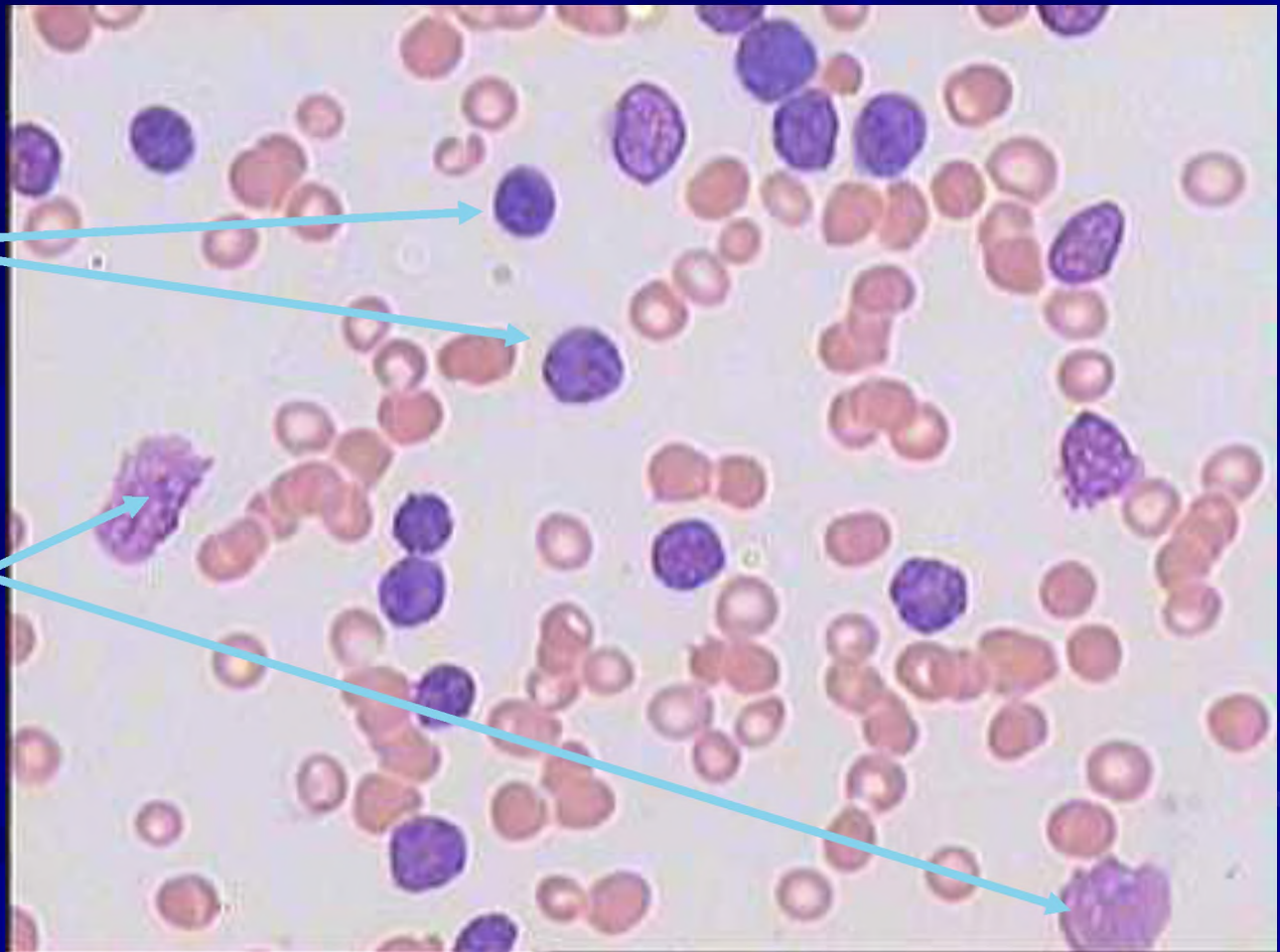
Summary

Symptom	Platelet	Coagulation
Petechiae	Yes	No
Sites	Skin & Mucosa	Deep Tissue
Time	Immediate	Delayed
Ecchymoses /Hematomas	Yes	Yes

CLL-Thrombocytopenia

Lymphoid
cells

Smear cells
(Fragile)



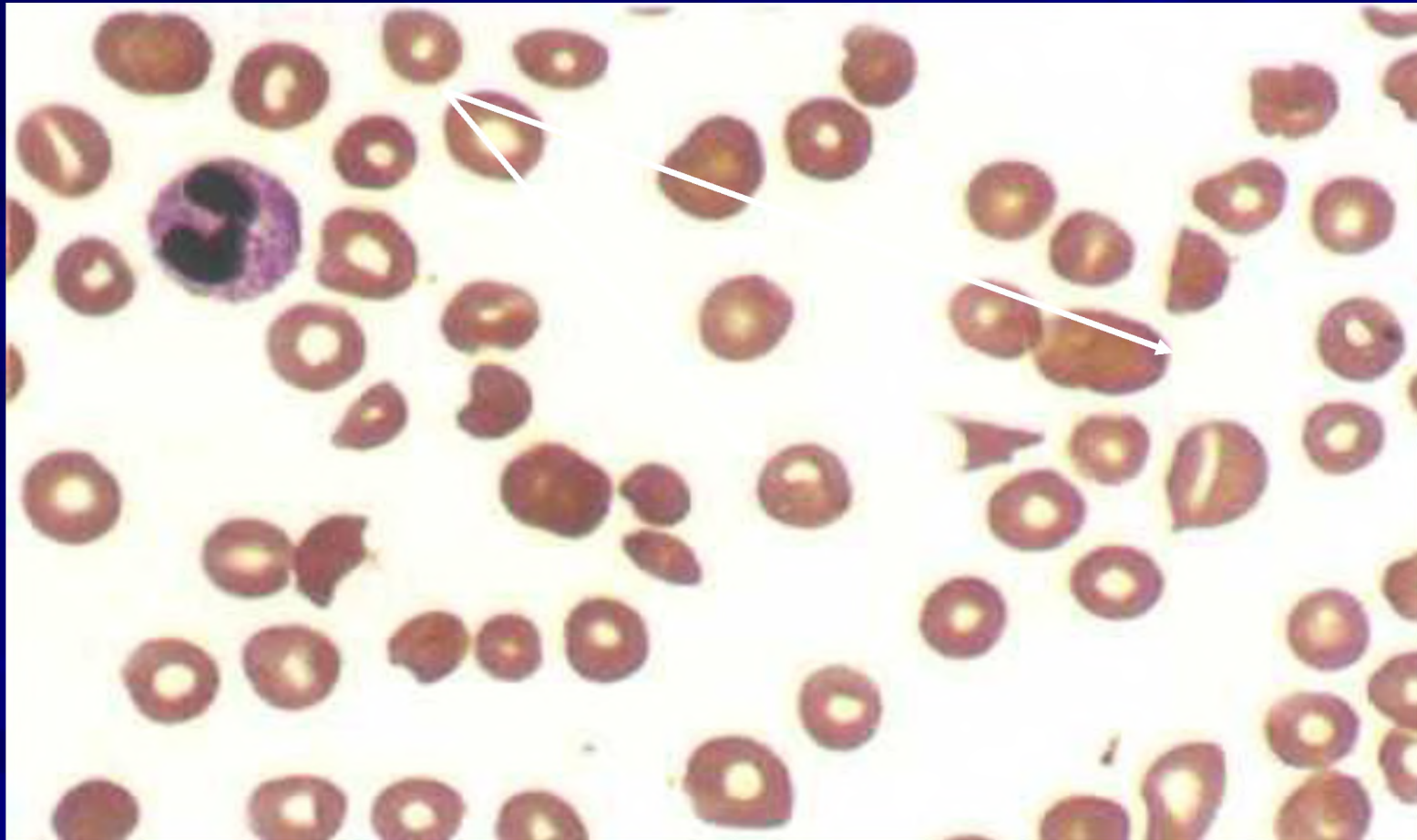
Dengue Hemorrhagic fever



Platelet deficiency..



Thrombocytopenia-TTP



Summary

- Complex system to keep blood fluid
- To block leakage on injury.
- BV, PLT & Coagulation
- Complex inhibitory mechanisms
- Complex thrombolysis mechanisms.
- Screening tests: BT, CT (PT, aPTT)
- Special tests: Factor assay, PLT function etc.

Disorders of Hemostasis

■ Vascular disorders –

- Scurvy, easy bruising, Henoch-Schonlein purpura.

■ Platelet disorders

- Quantitative - Thrombocytopenia
- Qualitative - Platelet function disorders – Glanzmans

■ Coagulation disorders

- Congenital - Haemophilia (A, B), Von-Willebrands
- Acquired - Vitamin-K deficiency, Liver disease

■ Mixed/Consumption: DIC

