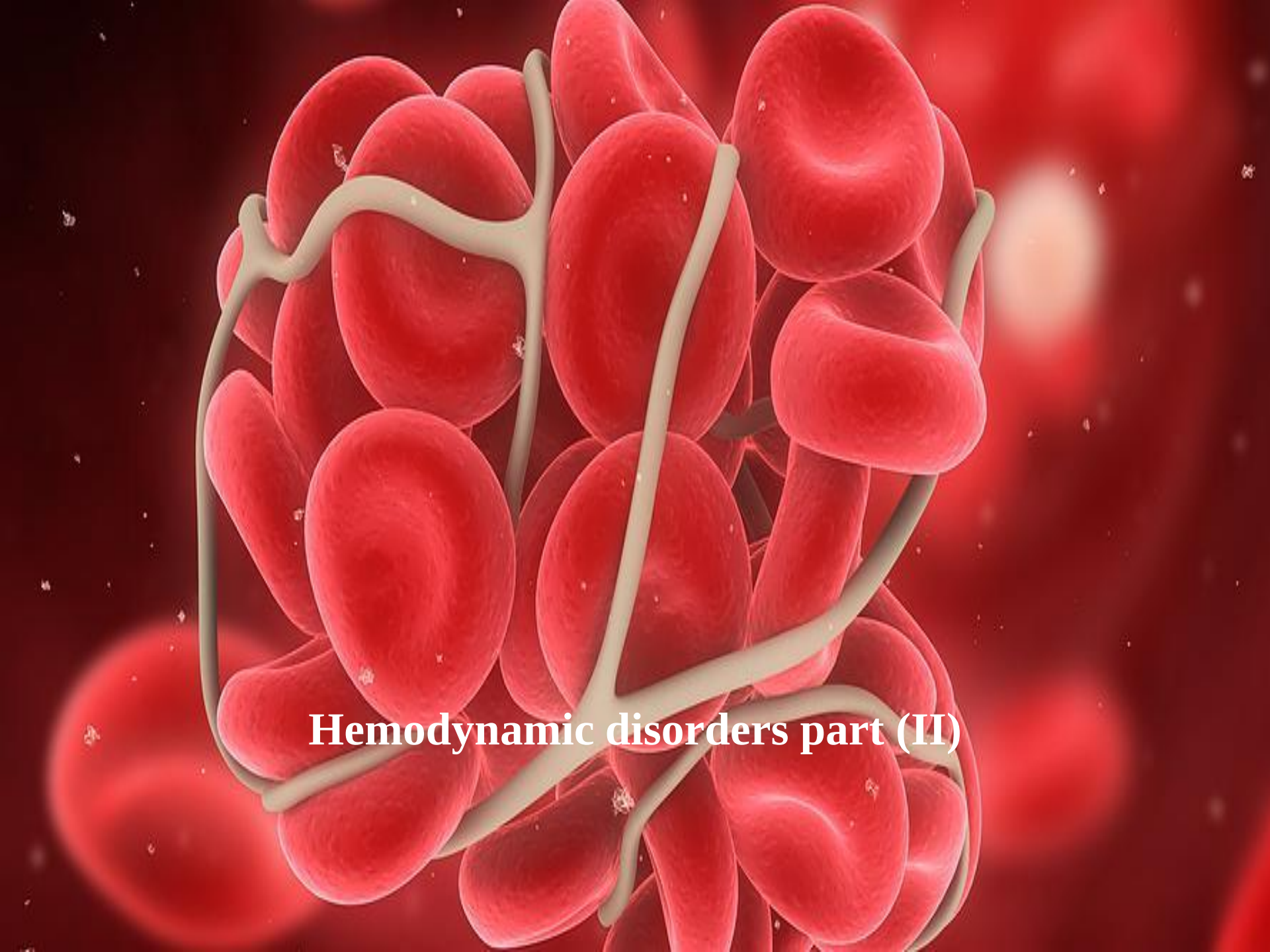


Hemodynamic disorders part (II)

Hemodynamic disorders II

I. Microspecimens:

№ 4. Recent red thrombus in the vein. *(H-E. stain).* **Indications:**

1. Vein wall.
2. Thrombus within the lumen of the vessel:
   a) fibrin strands;
   b) hemolyzed erythrocytes.

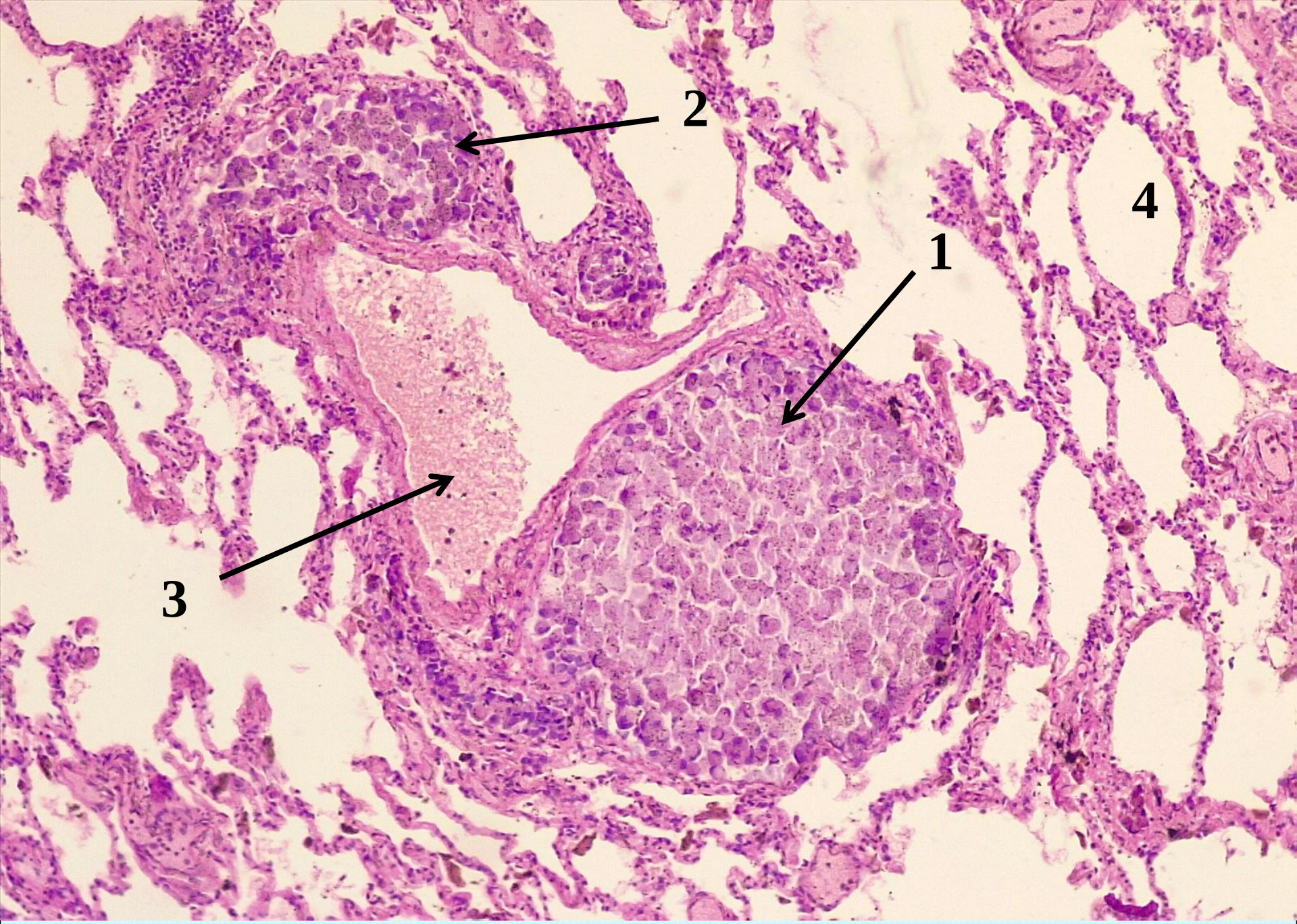
Cross section through the vein, the lumen is obturated by a thrombus, consisting of a network of filaments and homogeneous, eosinophilic masses of fibrin, in which there are figurative elements of the blood, predominantly hemolysed erythrocytes. The thrombus adheres to the vessel intima.

№ 140. Lymphatic vessels celluar (cancerous) embolism. *(H-E. stain).* **Indications:**

1. Dilated lymphatic vessel.
2. Embolus (cancer cells) in the lymph vessel lumen.
3. Vein.
4. Pulmonary alveoli.

Pulmonary lymphatic vessels, which accompany blood vessels, are dilated, in their lumen are present clusters of cancer cells (cell emboli).

№ 4. Recent red thrombus in the vein. *(H-E. stain).*



№ 140. Lymphatic vessels cellular (cancerous) embolism. *(H-E. stain).*

№ 101. Microbial embolism of the renal vessels. *(H-E. stain).* **Indications:**

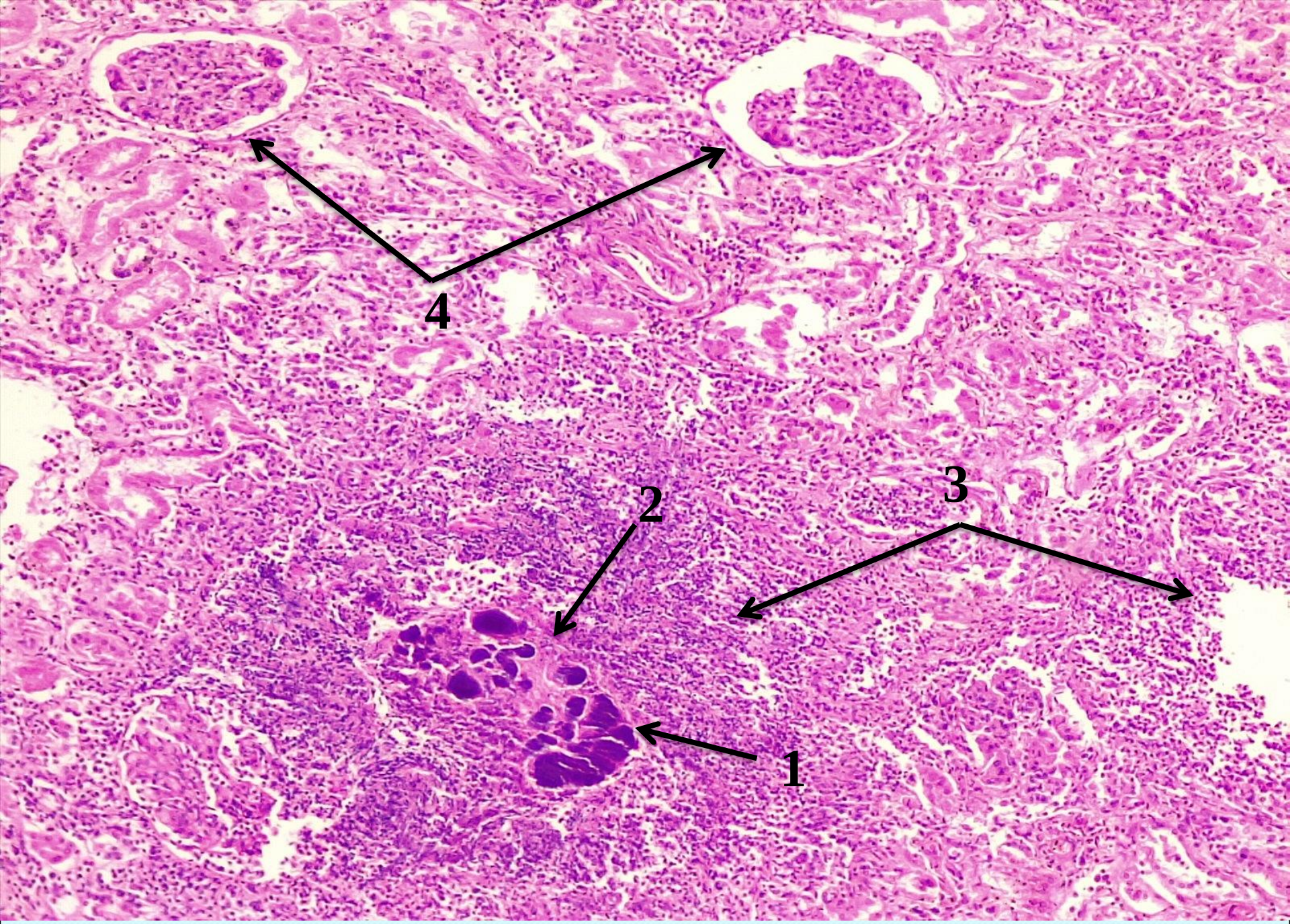
1. Microbial emboli in glomerular capillary lumen.
2. Focus of microbial necrosis around emboli.
3. Clusters of neutrophils (abscess).
4. Unchanged glomerulus.

In some glomeruli there are clusters of microbes (microbial emboli), of intensely basophilic color (look like ink spots), around which necrotic changes (karyolysis) and agglomerations of neutrophilic leukocytes (metastatic abscesses) are determined; microbial emboli are also observed in the lumen of some arterioles and veins; In some microspecimens microbial masses are found in the lumen of the collecting tubules in the medullary layer of the kidney.

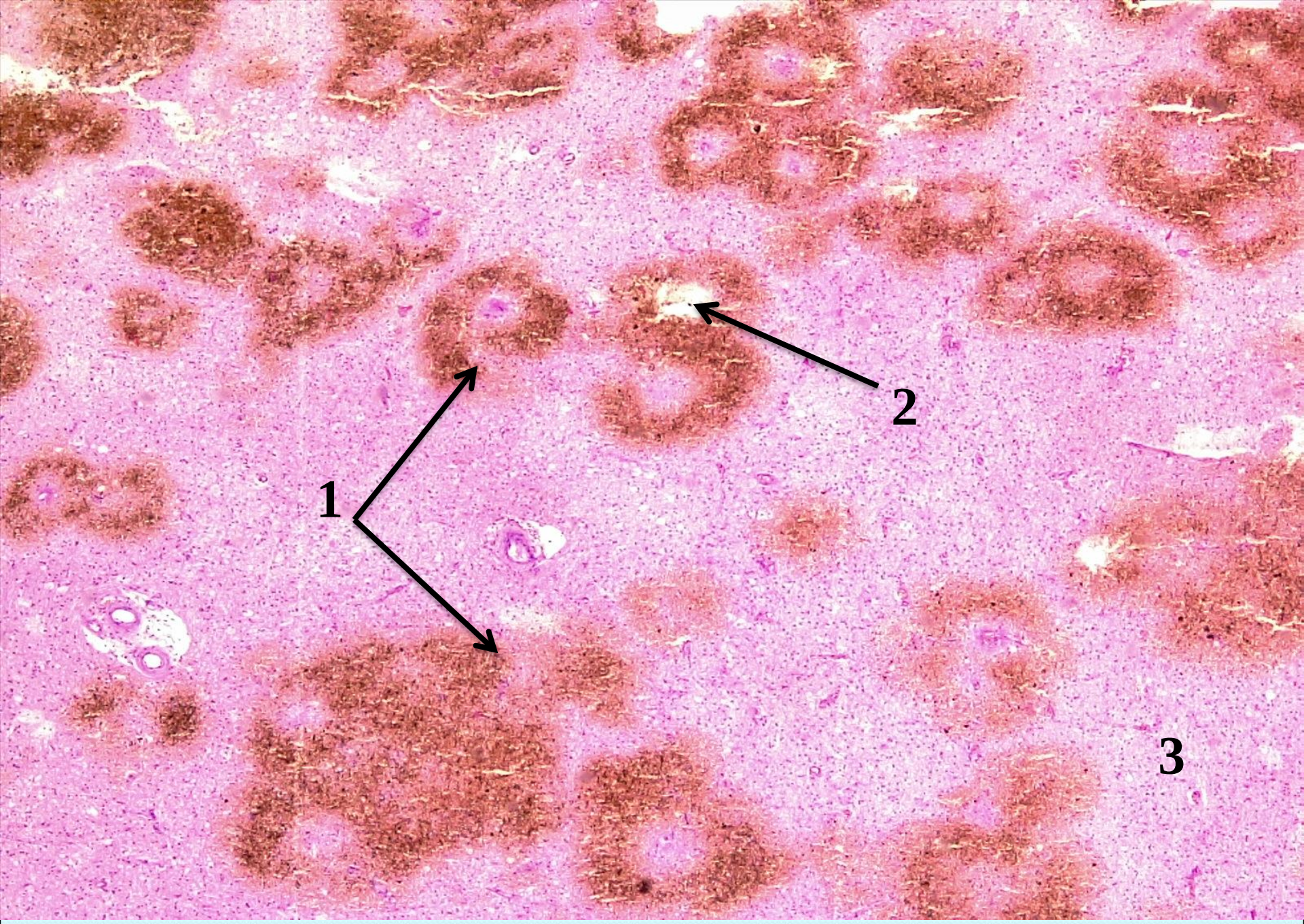
№ 13. Diapedesis hemorrhage in the brain. *(H-E. stain).* **Indications:**

1. Clusters of erythrocytes (hemorrhagic focus).
2. Blood vessel.
3. The brain tissue.

In the cerebral tissue, agglomerations of red blood cells (haemorrhagic foci) are observed, arranged in shape of rings around small blood vessels; the integrity of the blood vessel walls is preserved.



№ 101. Microbial embolism of the renal vessels. *(H-E. stain).*



№ 13. Diapedesis hemorrhage in the brain. *(H-E. stain).*

II. Macrospecimens:

№ 3. Parietal thrombus in the abdominal aorta.

The intima of the aorta is irregular, rough, with multiple protrusions of the wall (atherosclerotic plaques) and ulcerations, covered with atheromatous masses of yellow color; there is a parietal thrombus, adherent to the intima of red-dark color, dense consistency, irregular surface.

№ 37. Thromboembolism of pulmonary artery.

In the common trunk of the pulmonary artery or at the level of the bifurcation, fragments of dark red cylindrical thrombi of 0.5-1.0 cm diameter are observed, which do not adhere to the vessel wall (thromboemboli); at the level of the bifurcation the thrombus obstructs the lumen of both pulmonary arteries, having the appearance of "rider in the saddle".

№ 42. Metastases of cancer into lung.

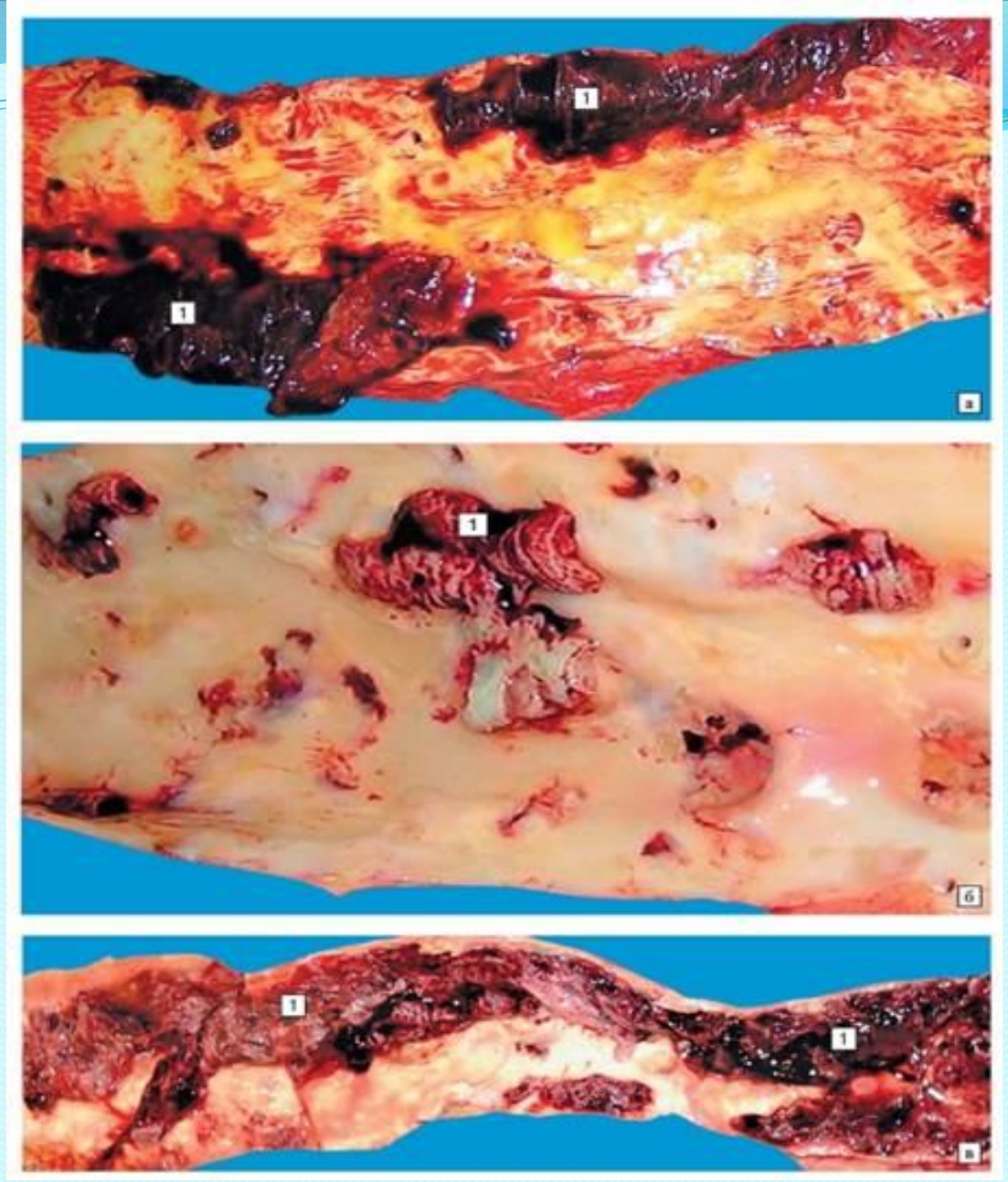
In the lung under the pleura and on the section, there are multiple whitish-gray tumor nodules, round or oval in shape, up to 3-5 cm in diameter, well delimited by the adjacent tissue.

№ 85. Purulent embolic nephritis (metastatic abscess into the kidney).

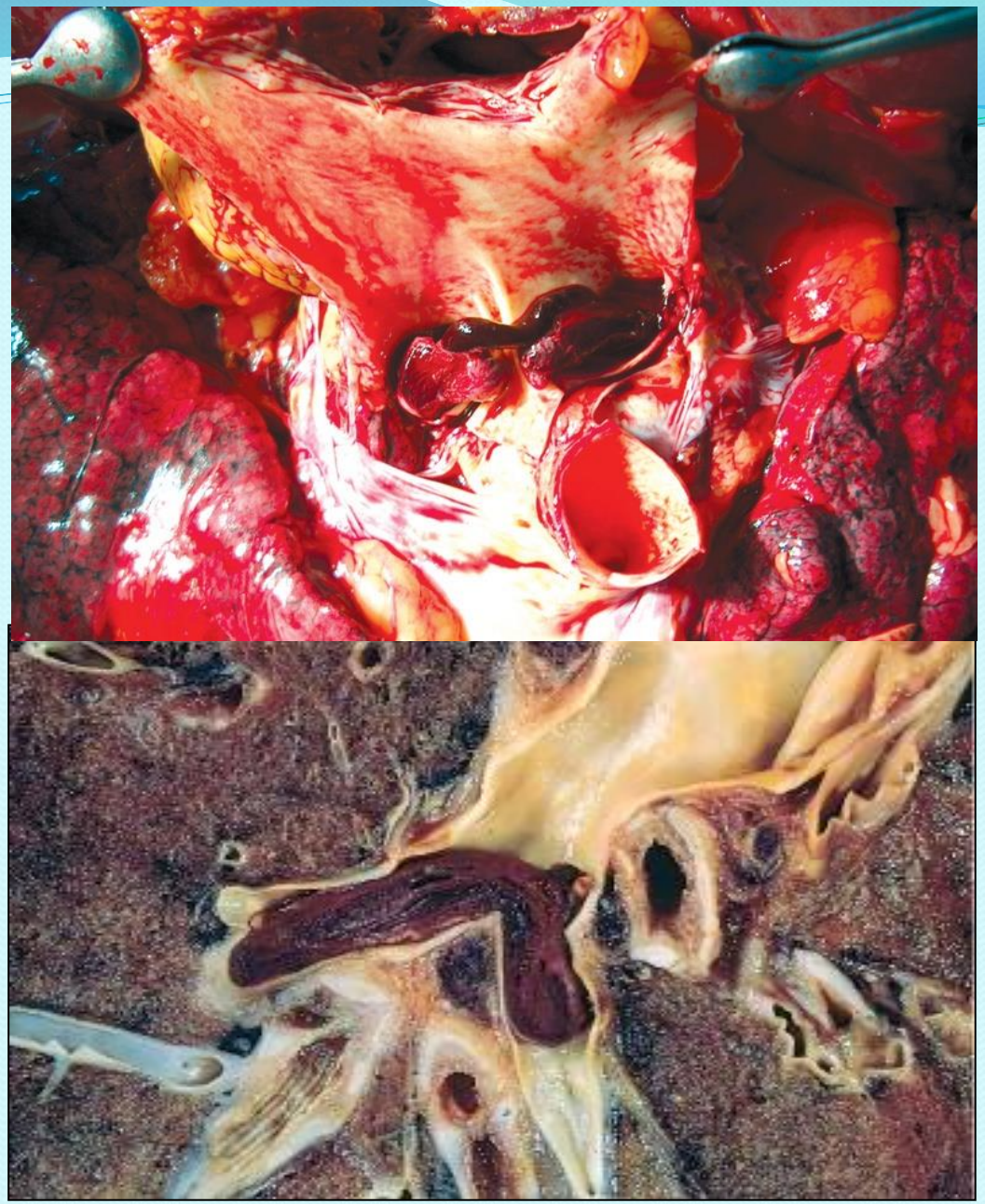
The kidney is enlarged in size, under the capsule there are multiple disseminated foci of purulent inflammation, of yellowish color, with a diameter of 0.5-1.0 cm, which protrude on the surface of the organ - metastatic abscesses.

№ 121. Cerebral hemorrhage (parenchymal hematoma).

In the brain, there is an accumulation of dark red coagulated blood (hematoma), the adjacent brain tissue is softened, of a flaccid consistency.

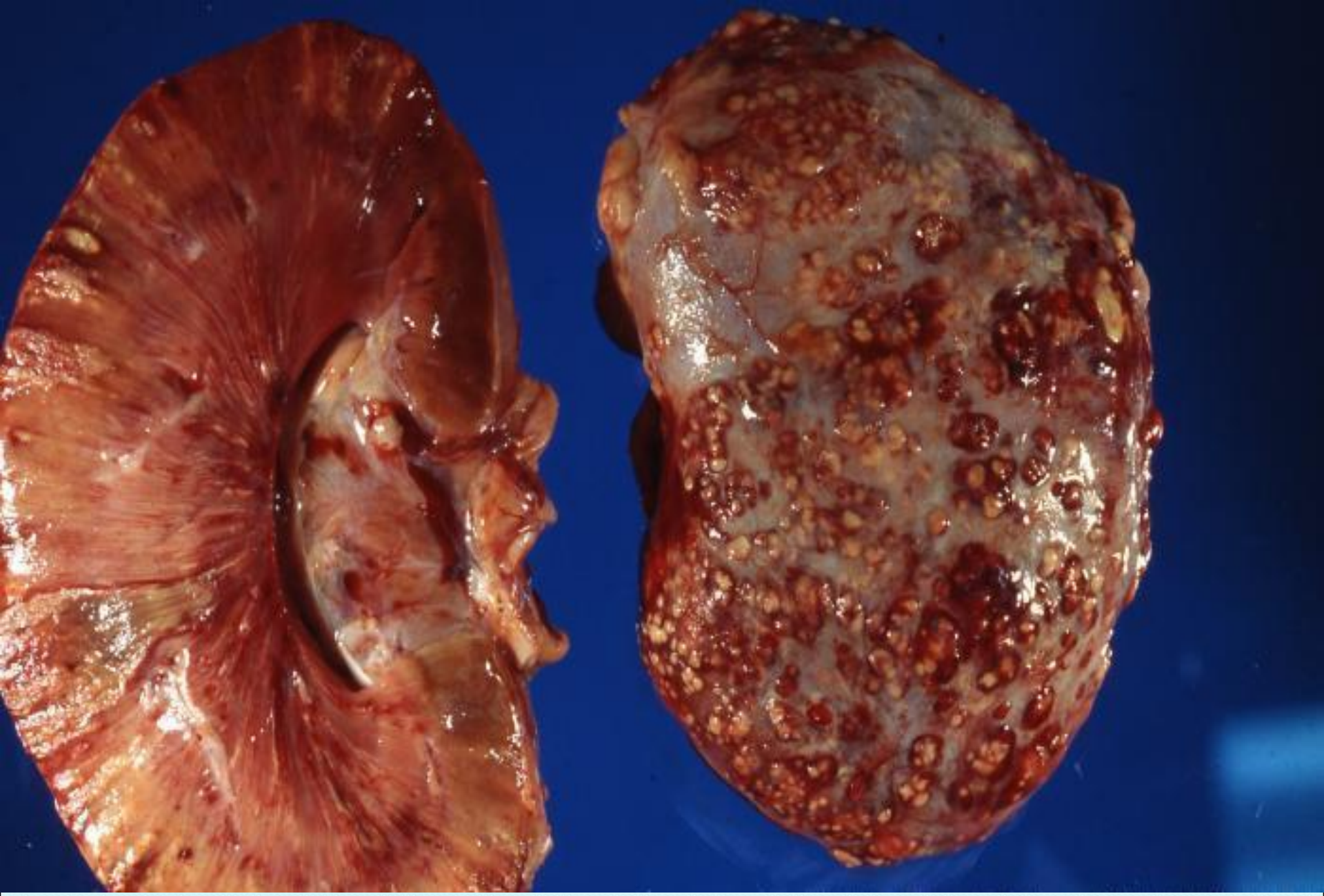


№ 3. Parietal thrombus in the abdominal aorta.

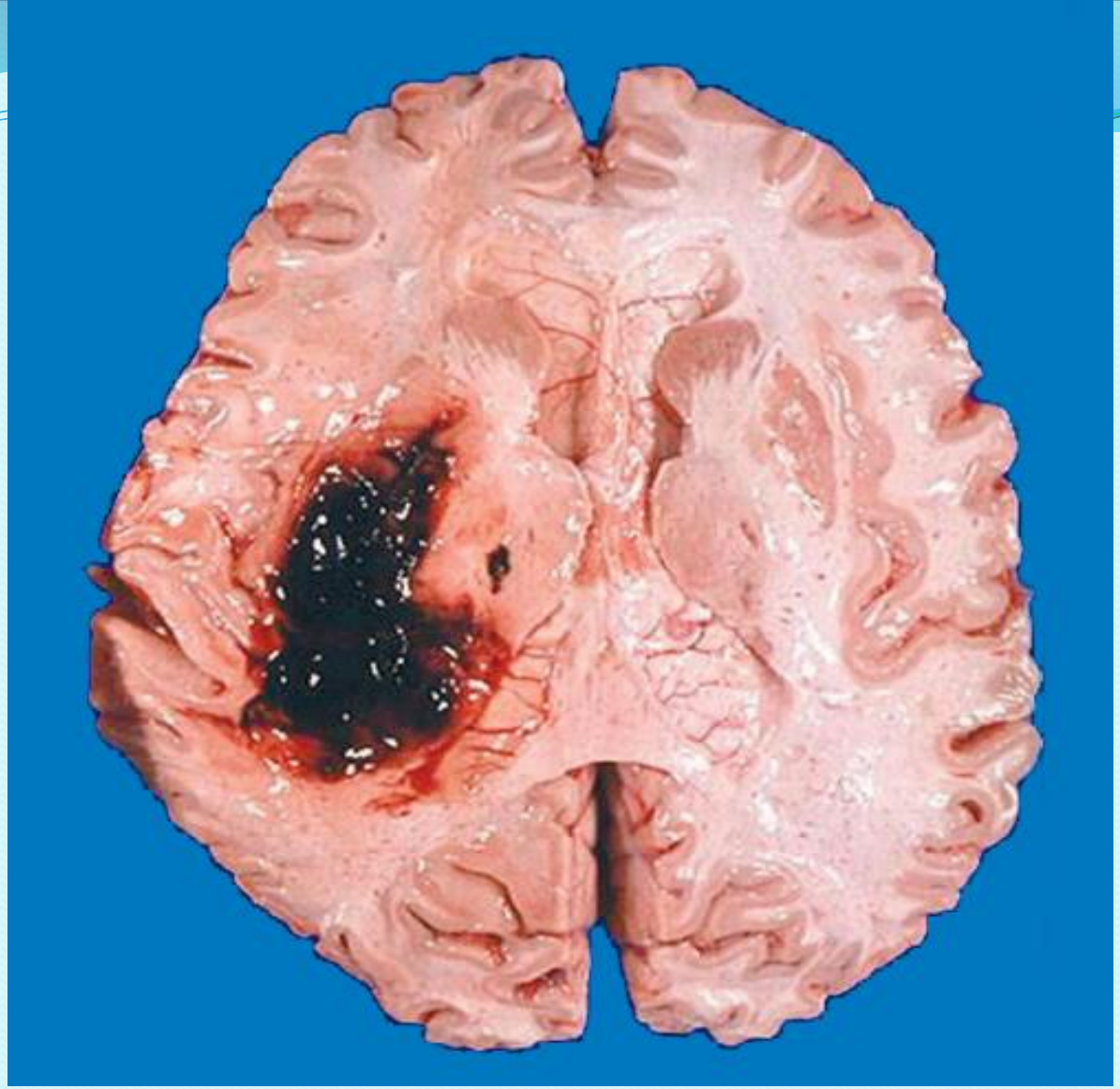


№ 37. Thromboembolism of pulmonary artery.

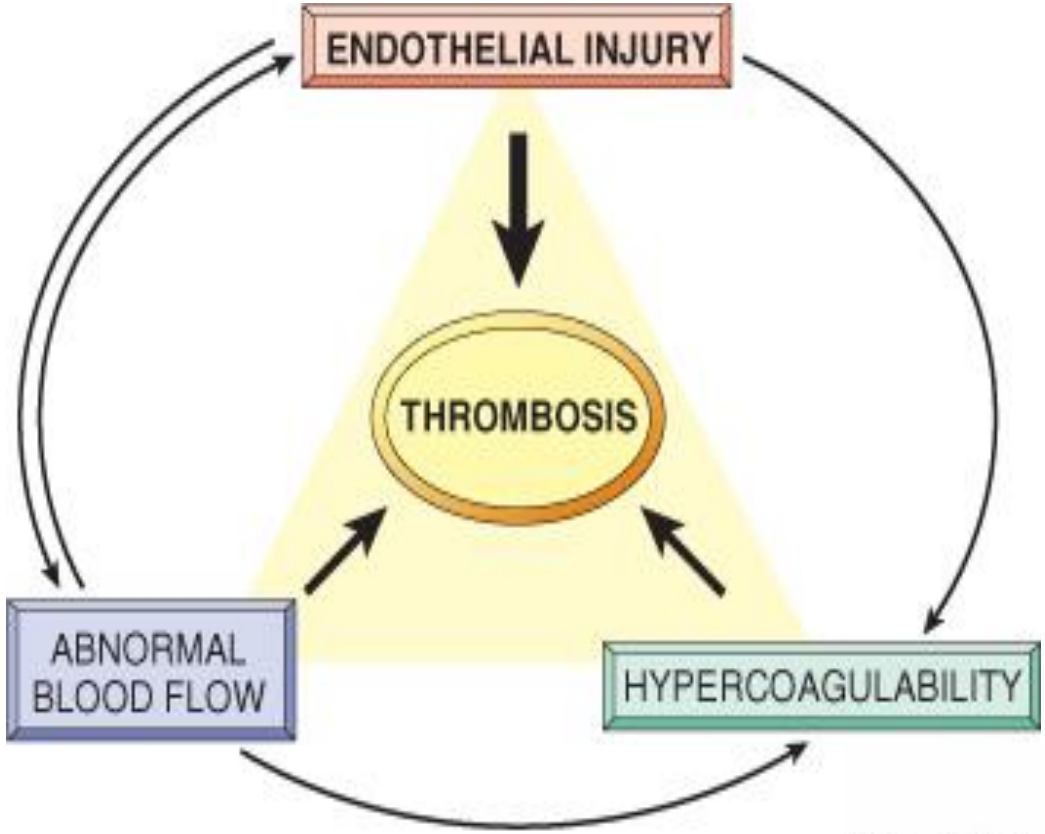
№ 42. Metastases of cancer into lung.



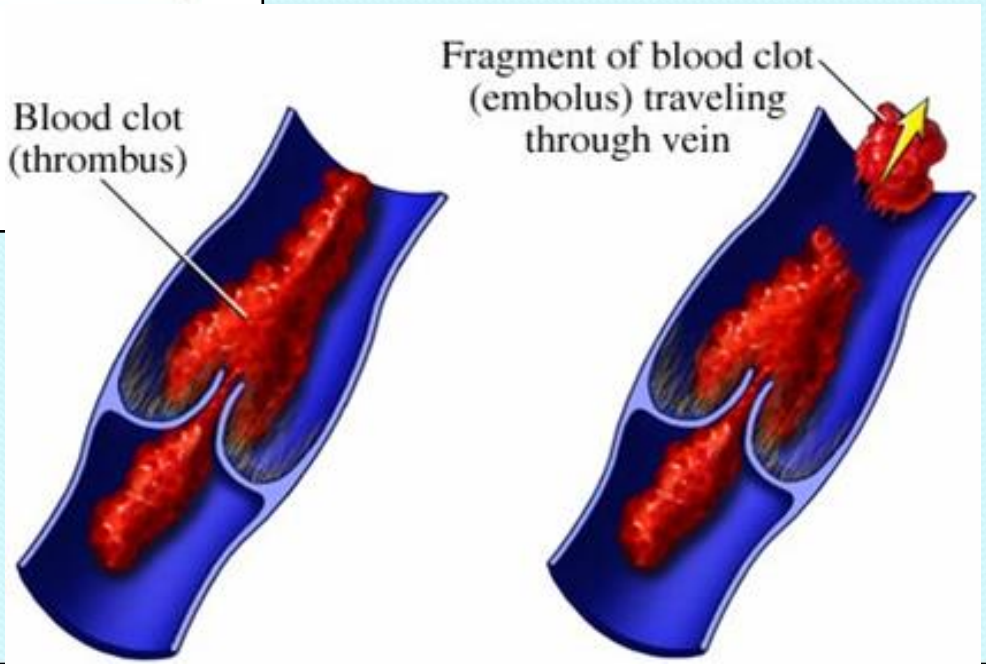
№ 85. Purulent embolic nephritis (metastatic abscess into the kidney).



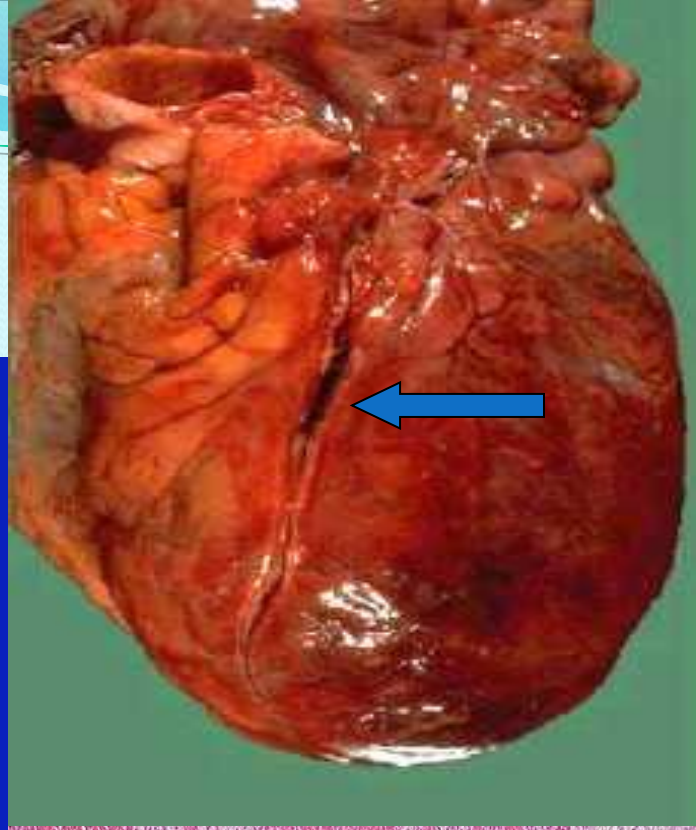
№ 121. Cerebral hemorrhage (parenchymal hematoma).

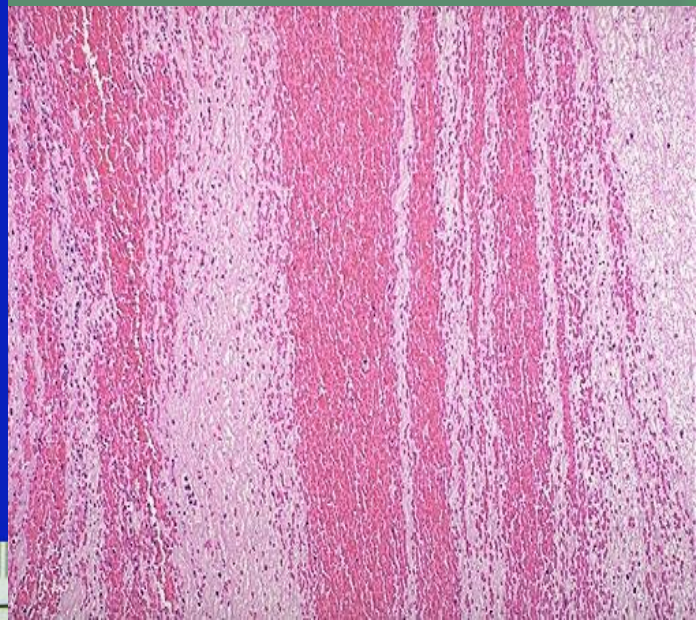


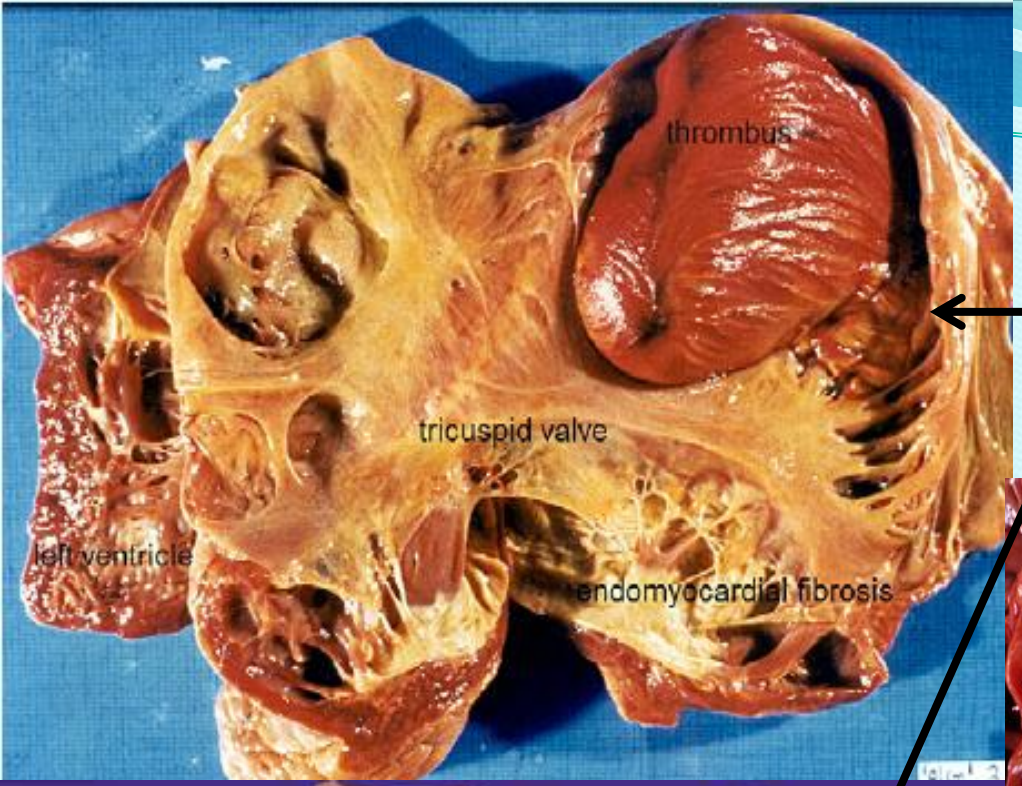
Virchow triad in thrombosis.



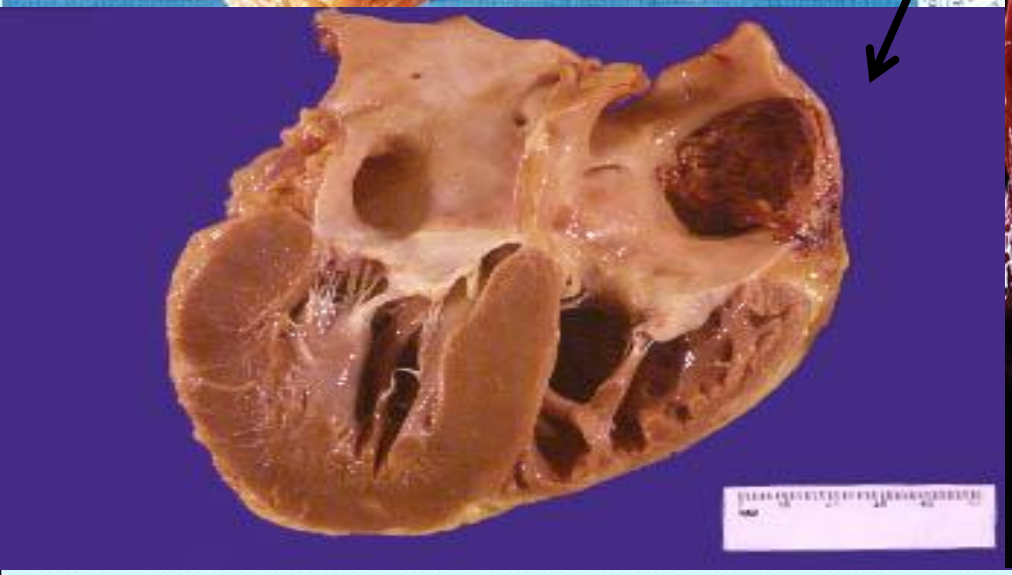
Arterial thrombosis.

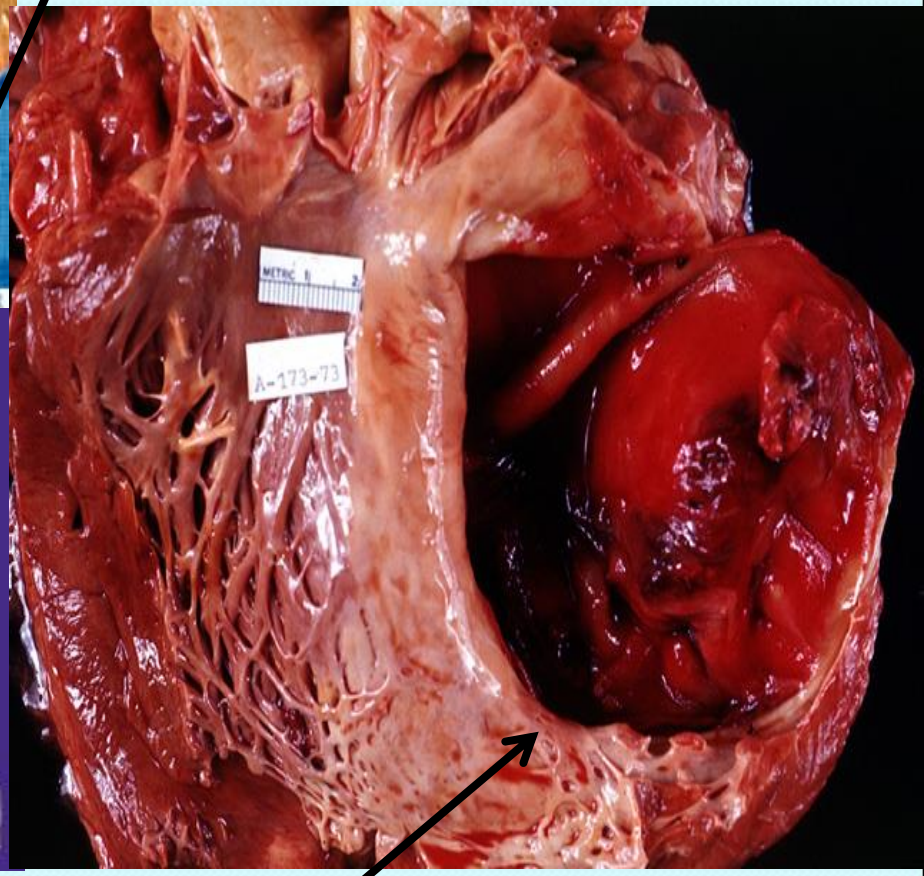




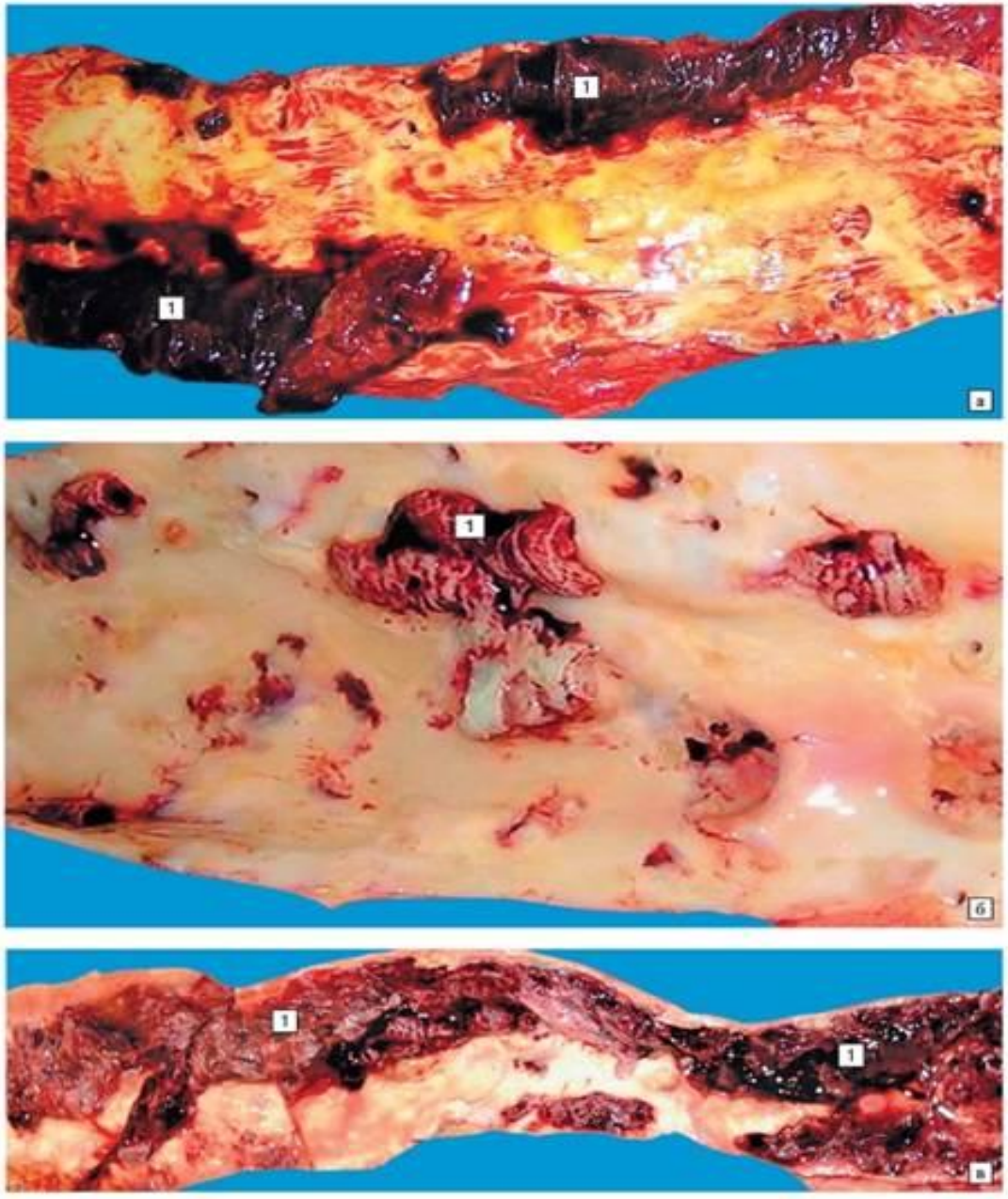


Spherical thrombus in the right atrium.





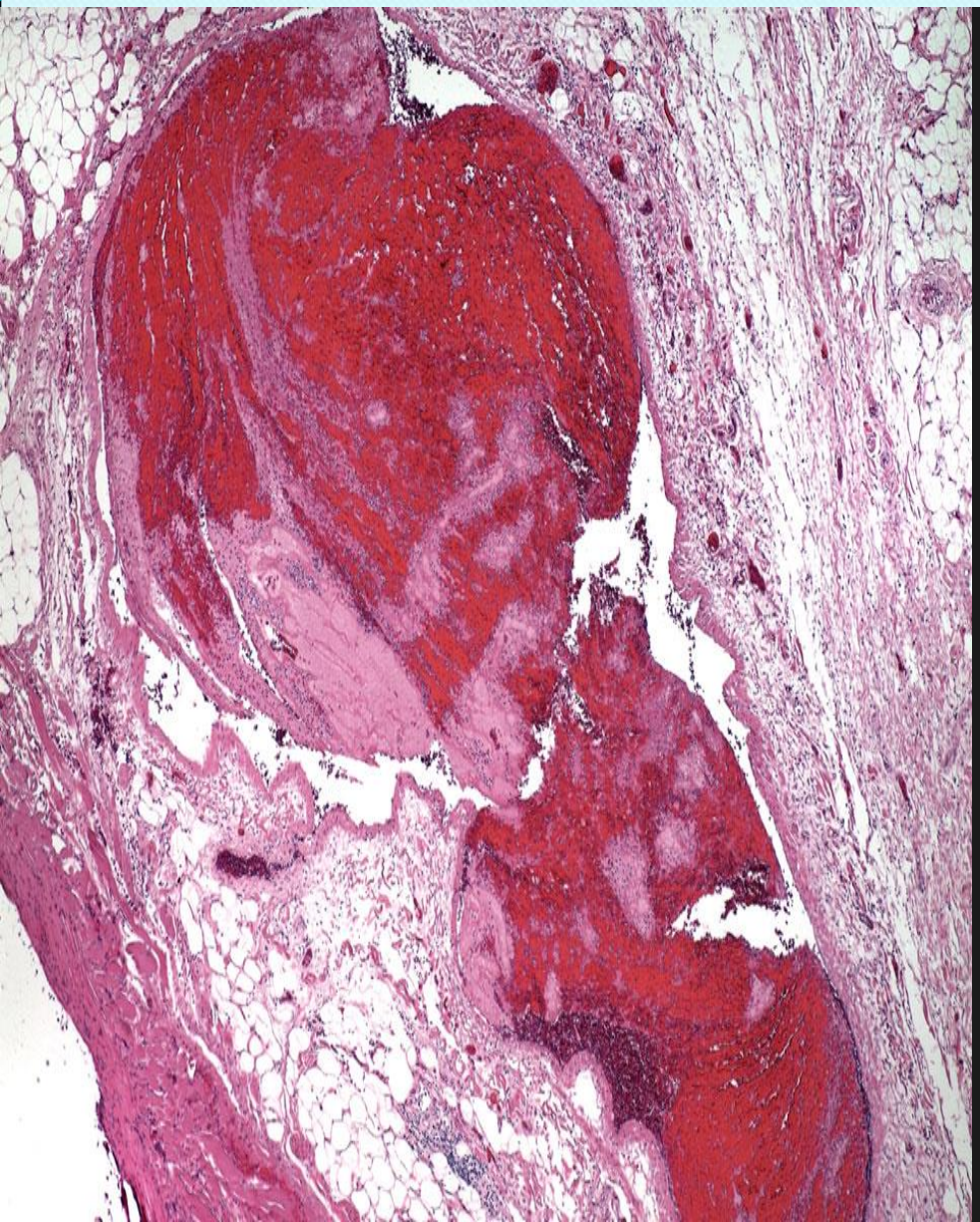
Chronic cardiac aneurysm with thrombosis.

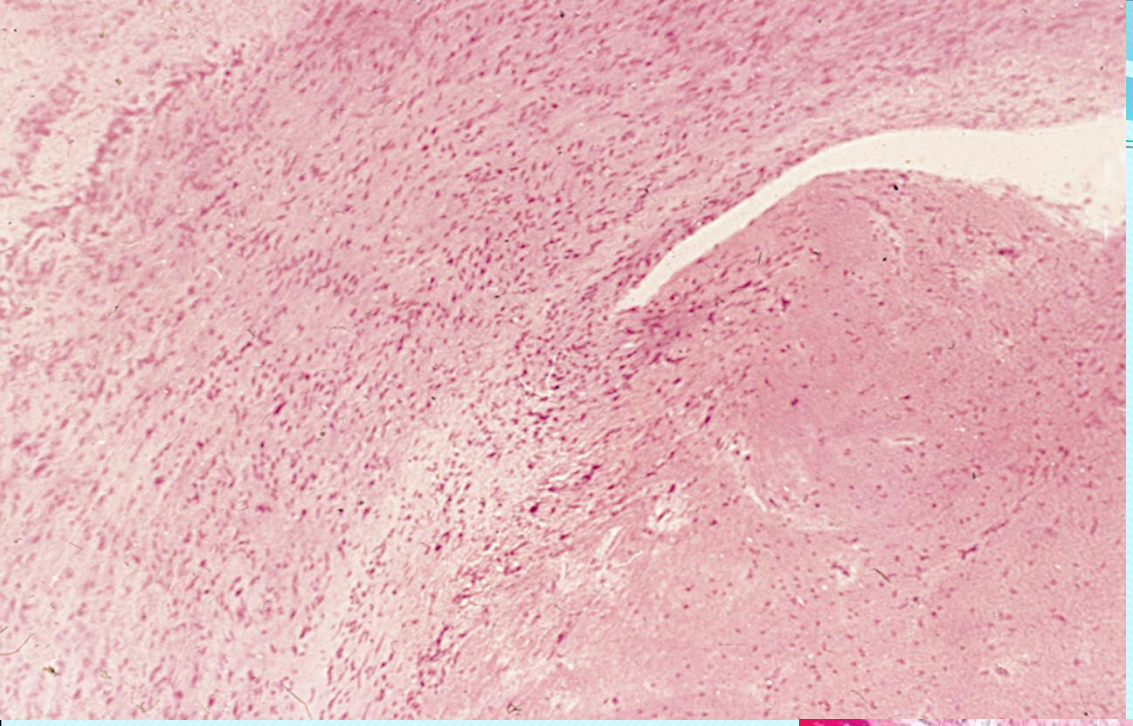


Parietal thrombi in the abdominal aorta in atherosclerosis.

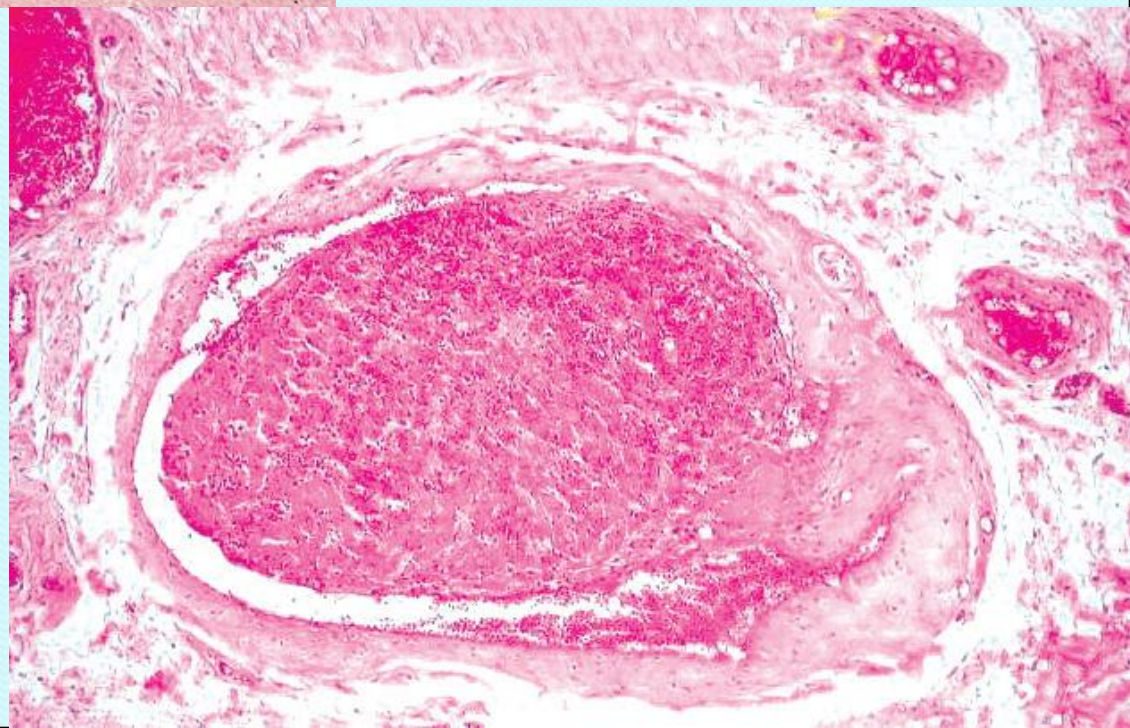
Parietal thrombus in the iliac vein.

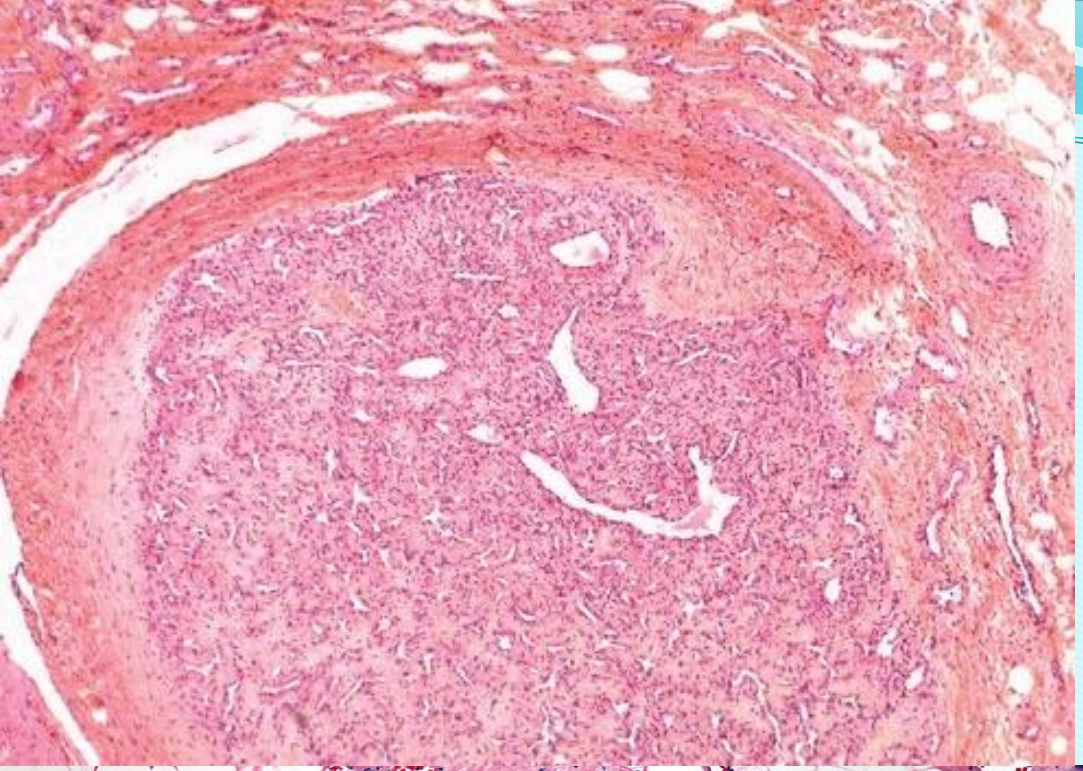
Deep vein thrombosis of the lower limbs.



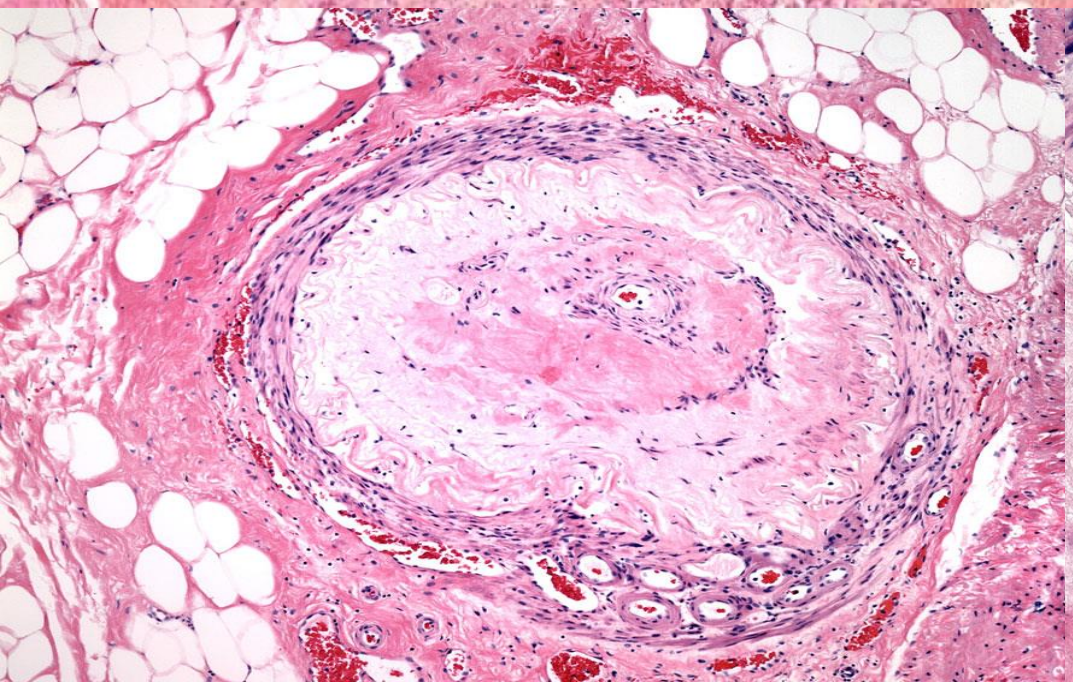


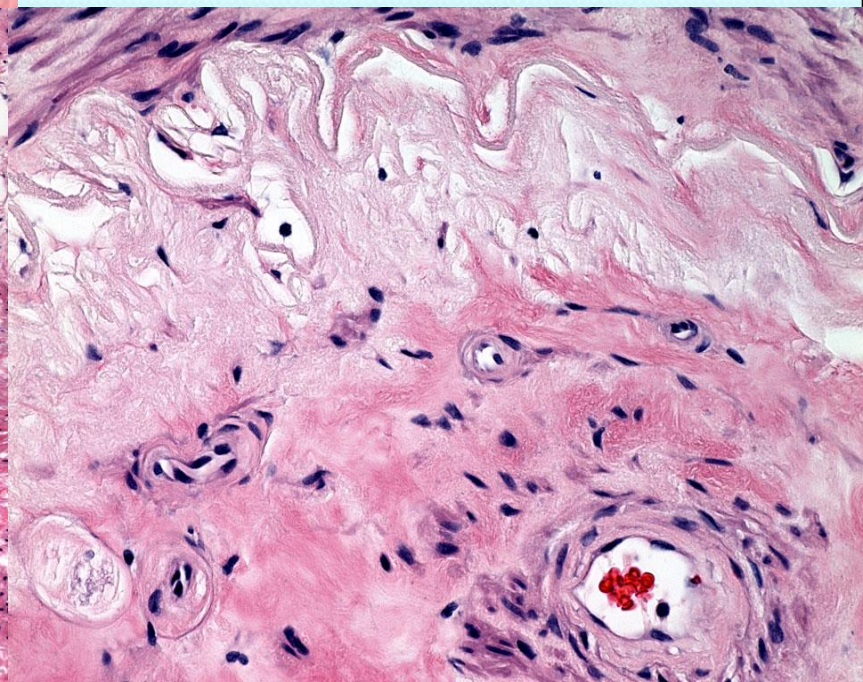
Thrombus in course of organization. (H-E stain).



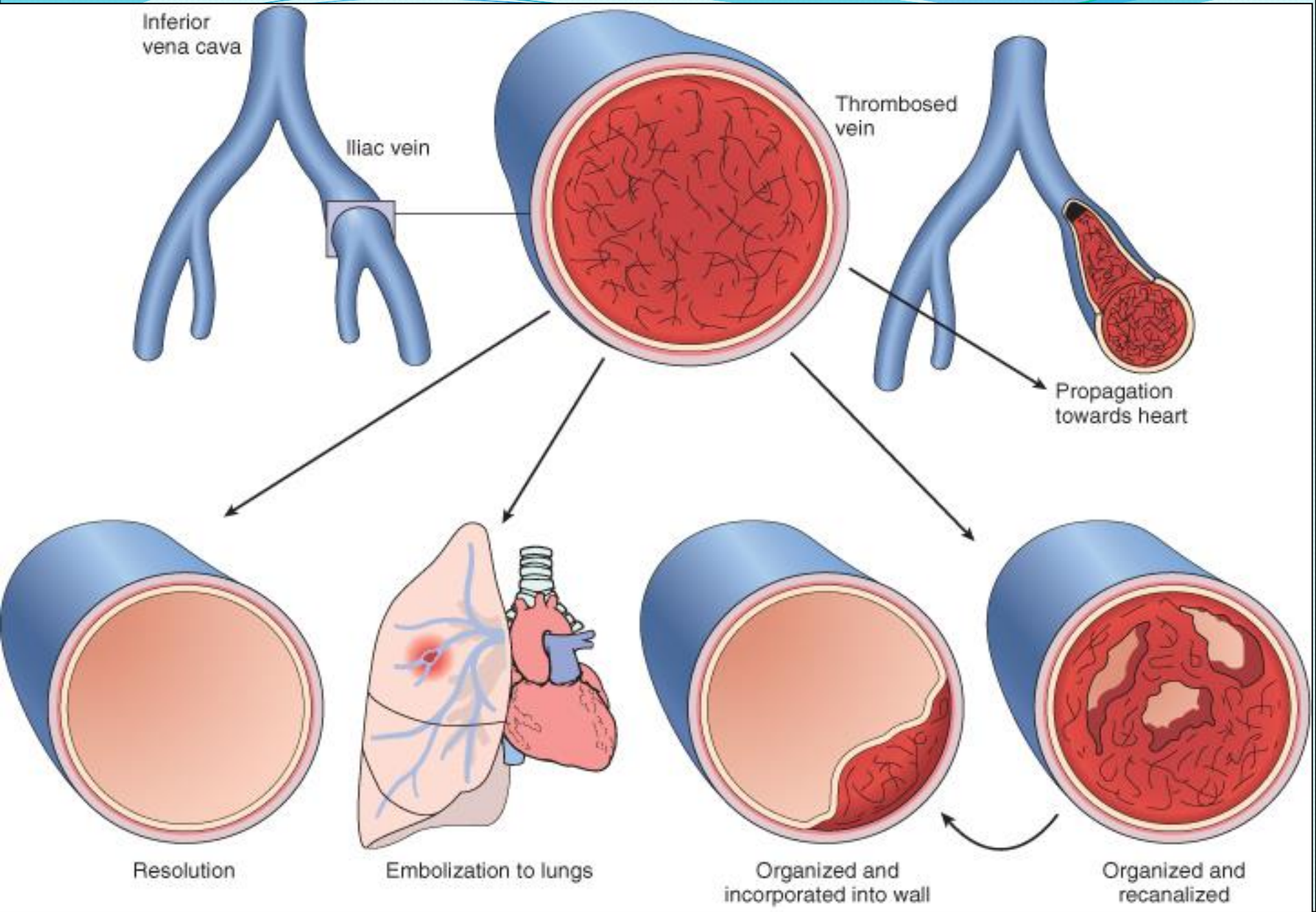


Recanalized thrombus. (H-E stain).

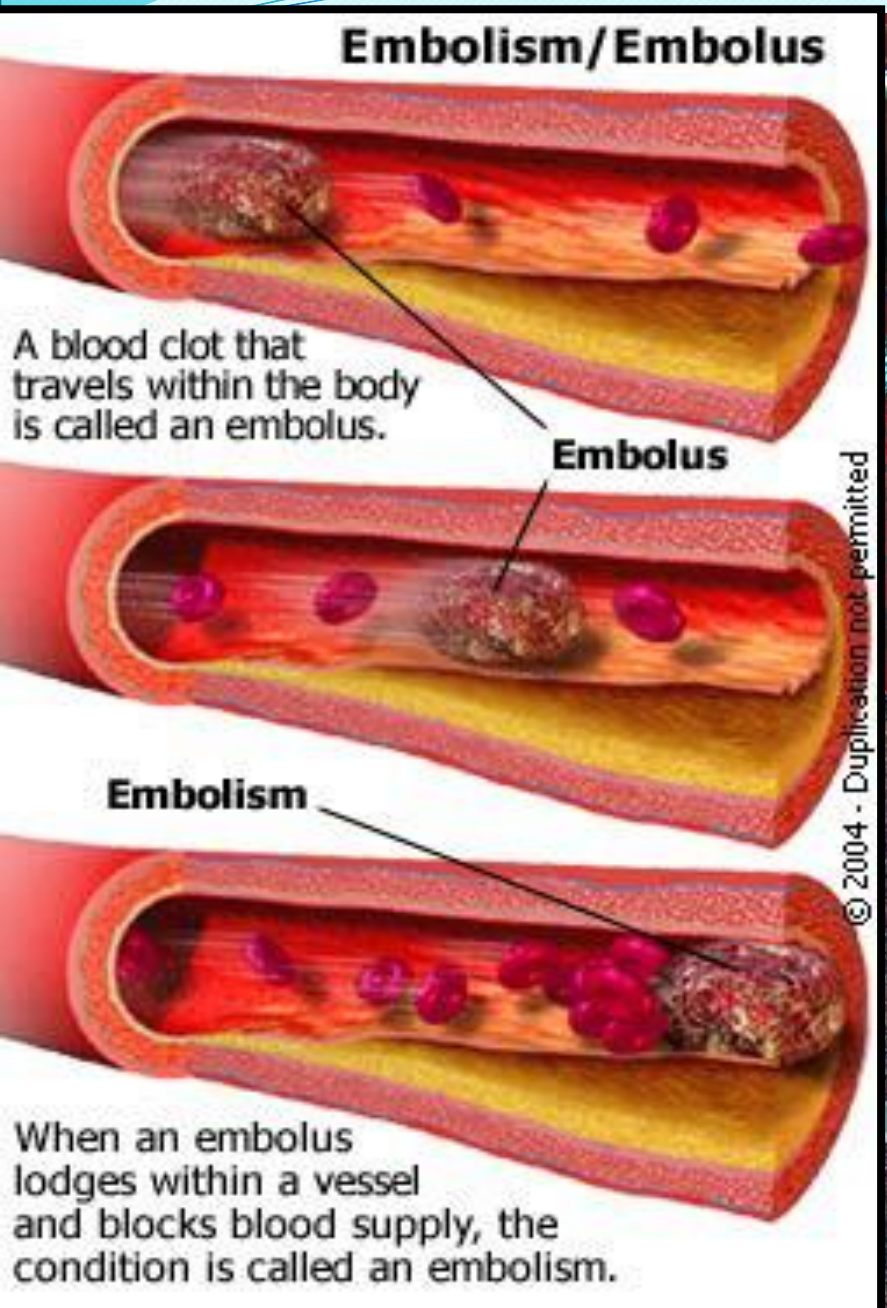


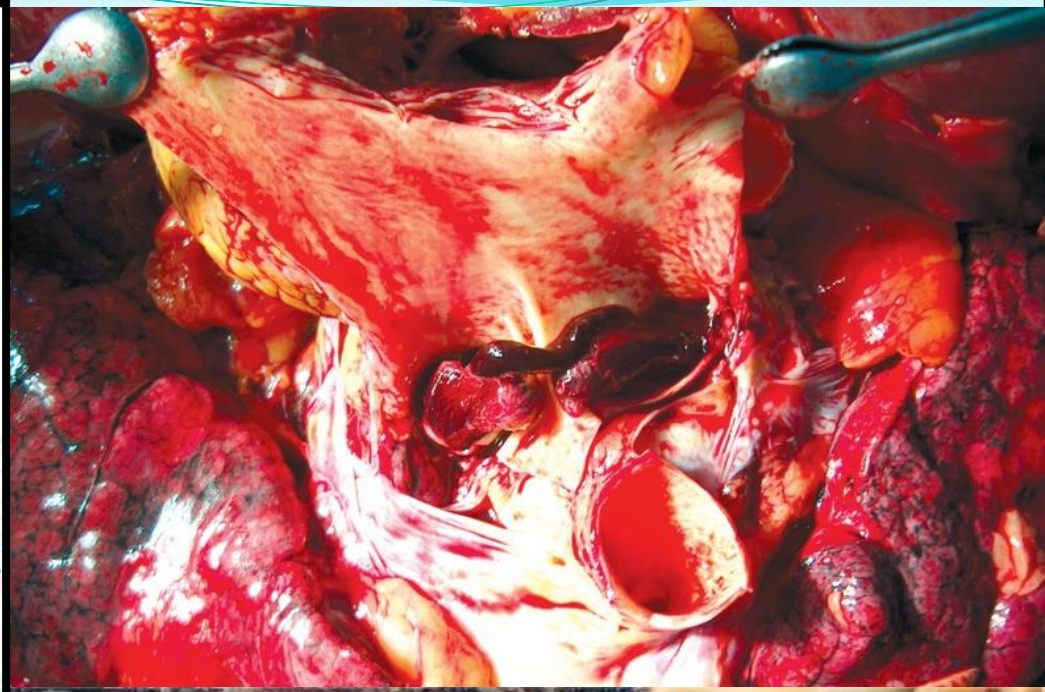


Consequences of thrombosis.

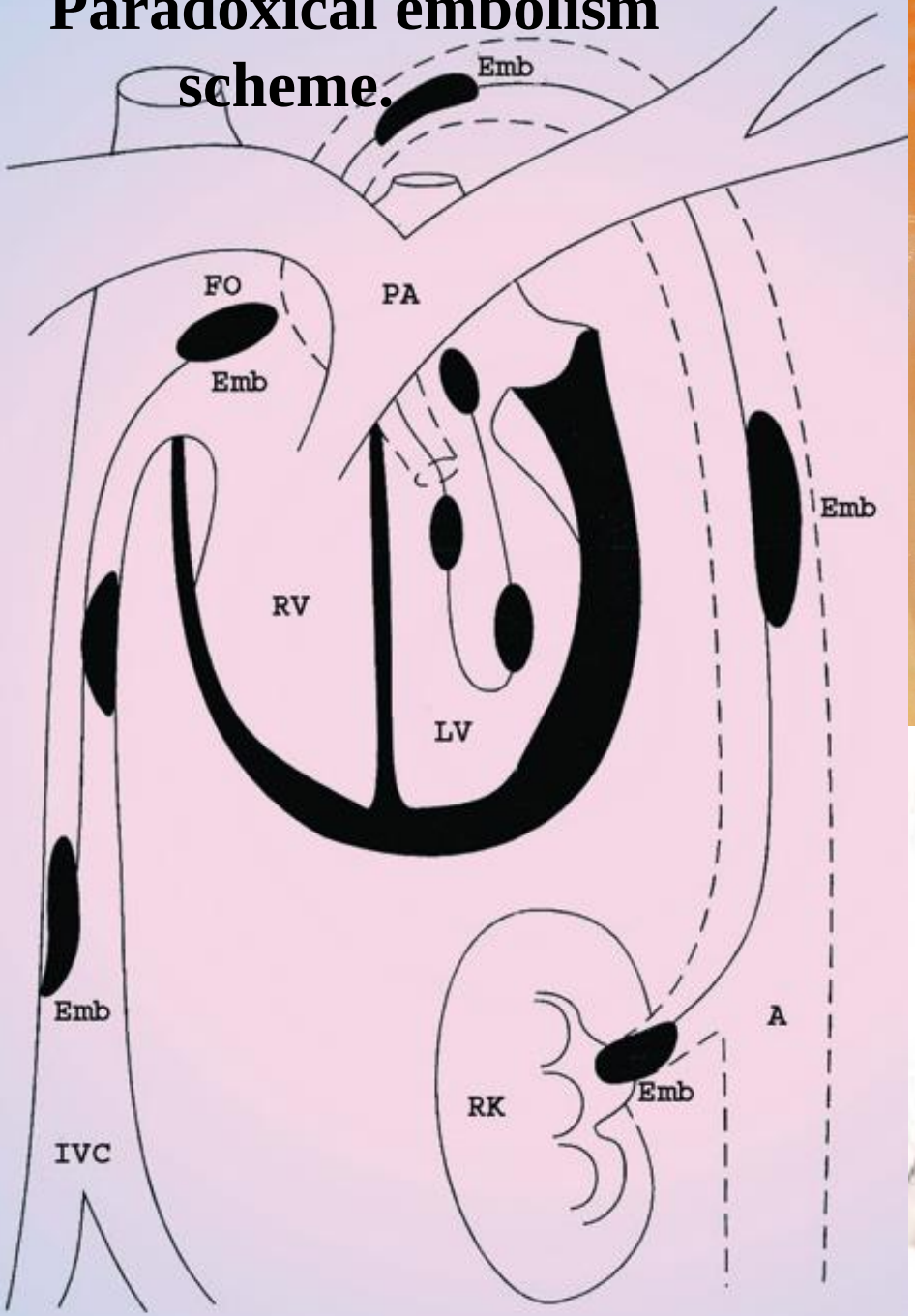


Pulmonary artery thromboembolism.

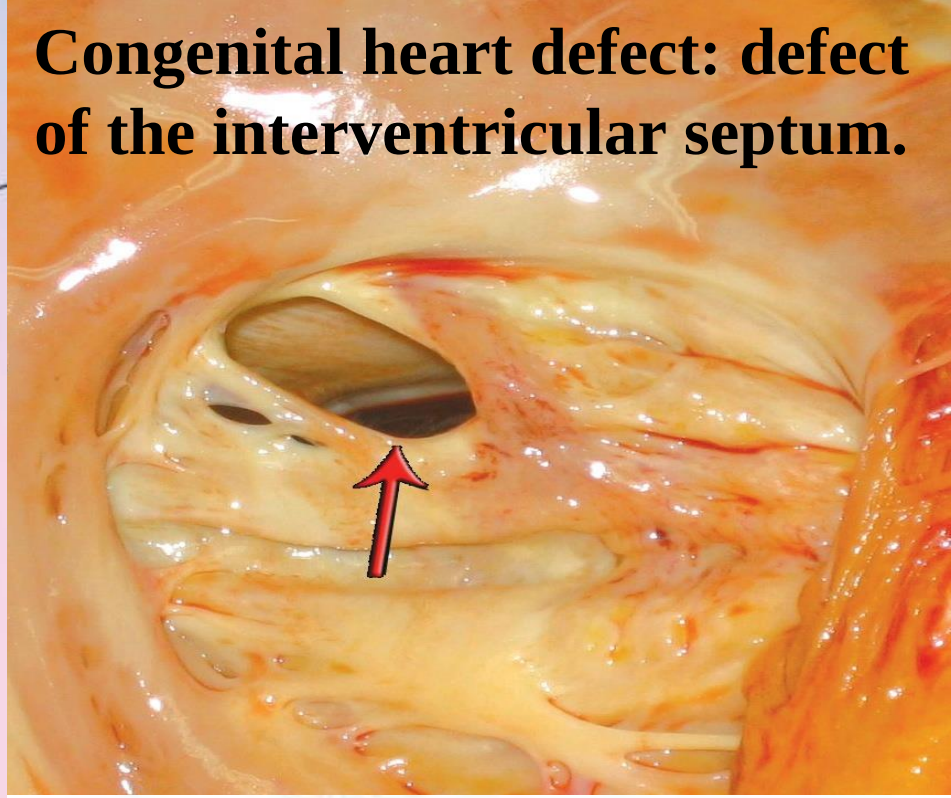


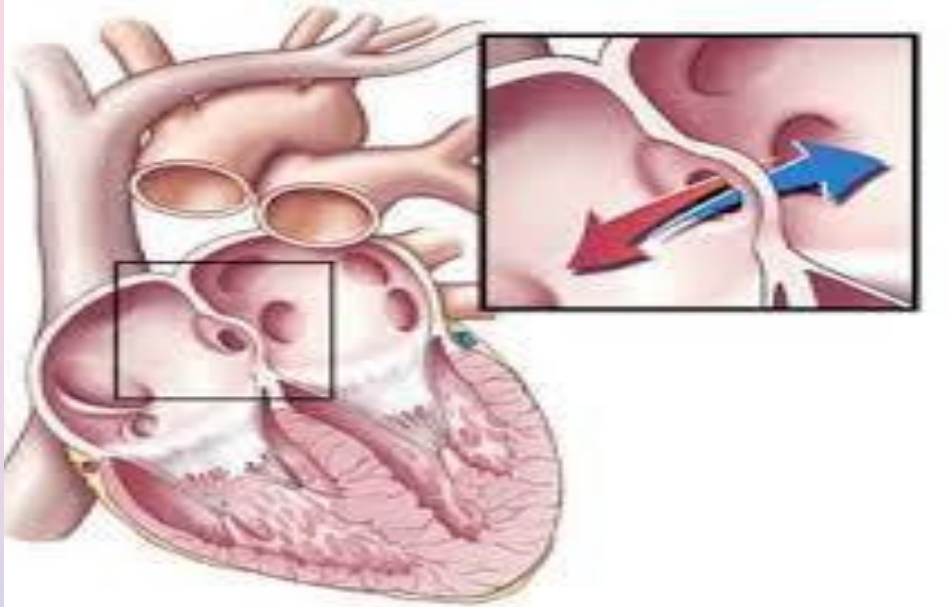


Paradoxical embolism scheme.



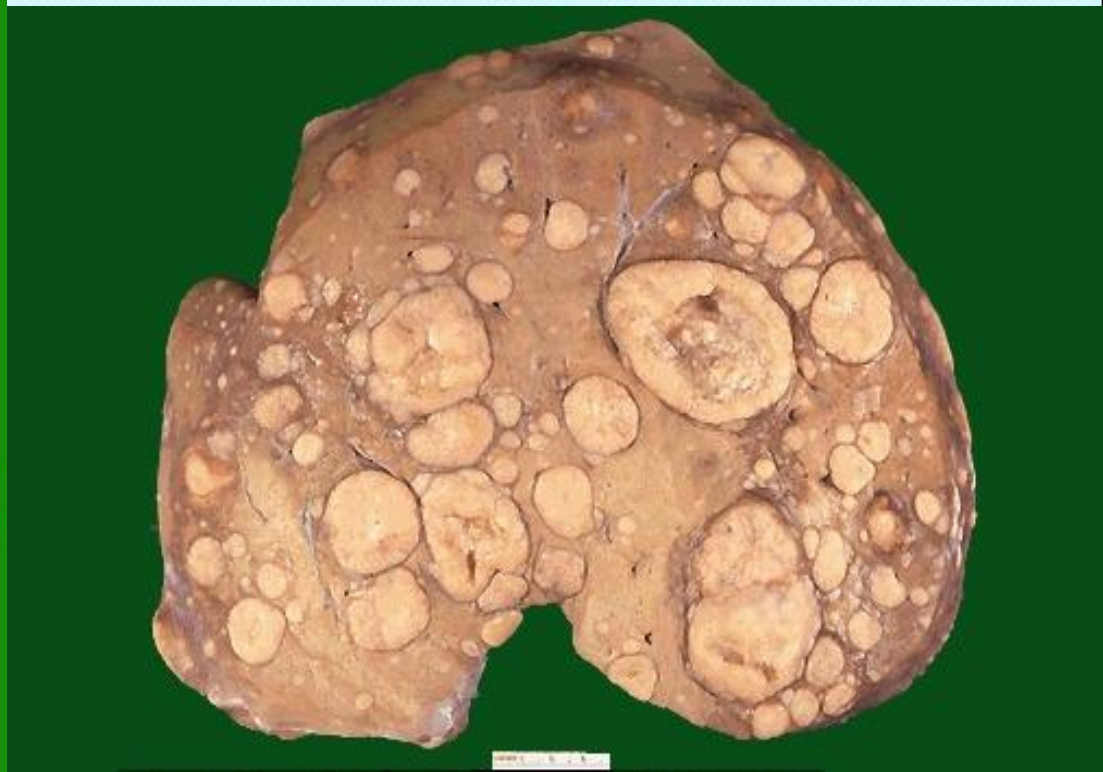
Congenital heart defect: defect of the interventricular septum.





Cancer metastases in the lung.

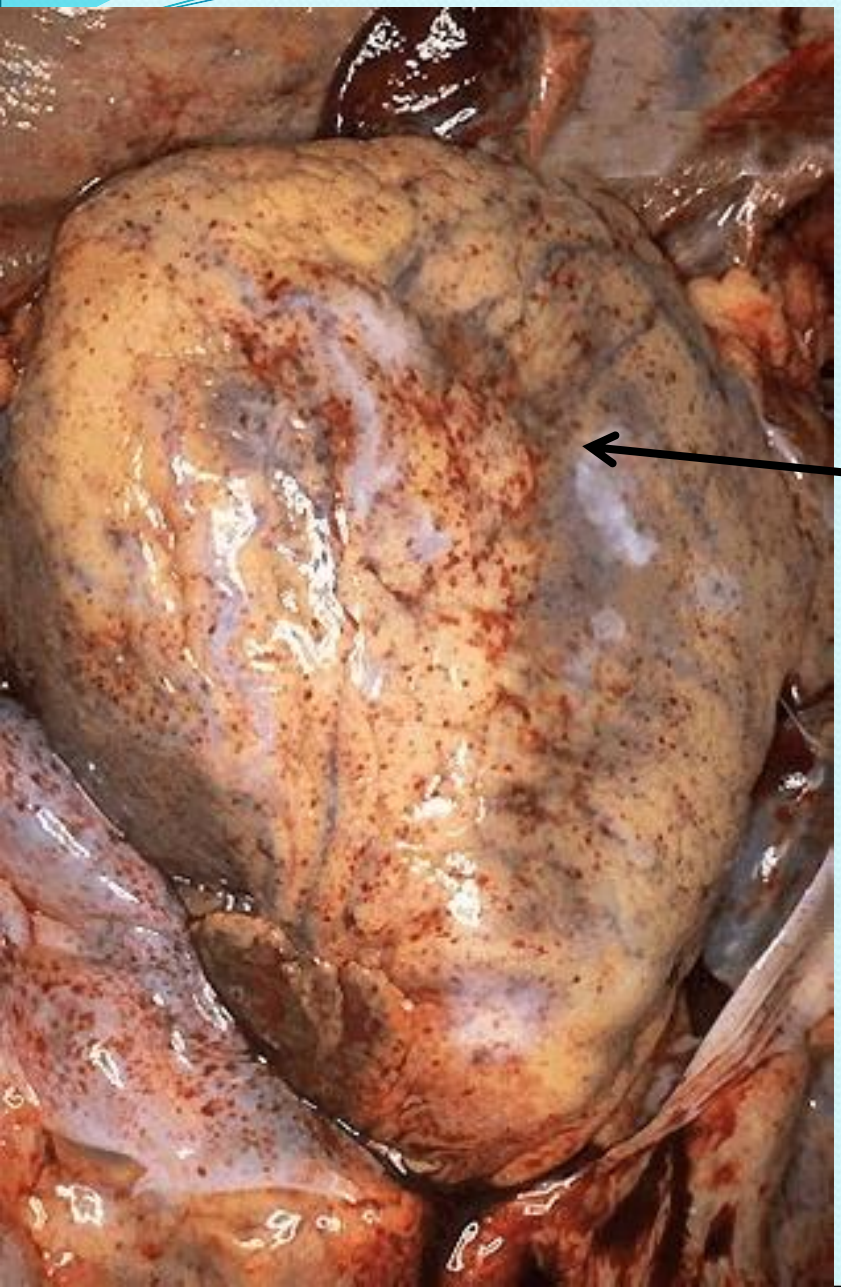
Cancer metastases in the liver.



Hemorrhage (per diabrosin) in tubal pregnancy.

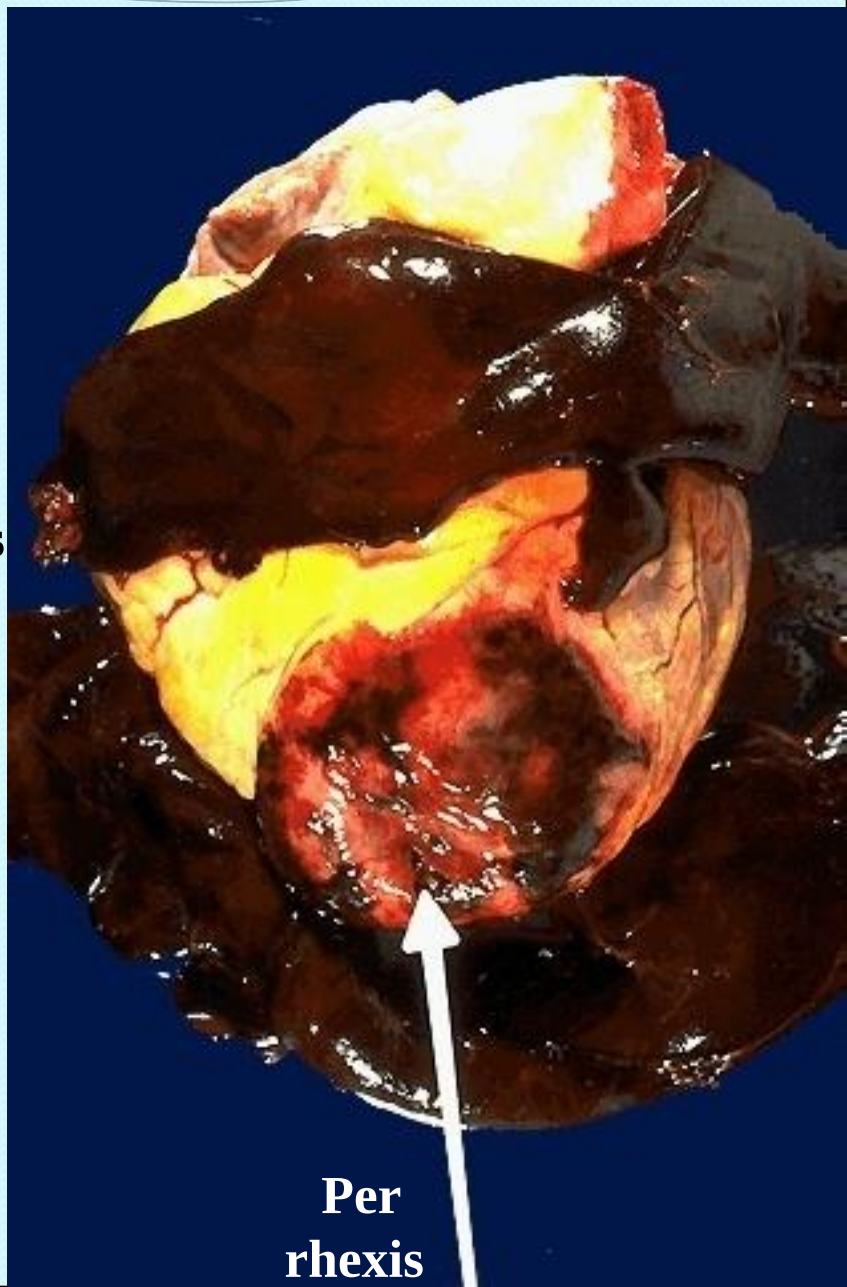
Fatal intracerebral hemorrhage (per rhexis).

Petechial hemorrhages in the epicardium of the heart.



Per diapedesis

Hemopericardium.



Per rhexis

Hemorrhage

Definition:

"Extravasation of blood due to vessel rupture"

Types: (depending on the site, extent and location)

External

Internal

Hematoma: 'Blood within the tissue'

(small; like a Bruise, or sufficiently large as to be fatal)

Causes of hemorrhage:

- vascular diseases with rupture (atherosclerosis, arteritis, aneurysms, etc.).

- low platelets (below 10-15,000/cu mm); coagulopathy (factors less than 10% activity);

- ulcers, tumors, coagulation factors, infarcts, trauma.

Types of hemorrhage: acute *vs*. chronic

petechia (-ae) - 1 to 2 mm. hemorrhages, usually indicating either platelet disorder or capillary fragility

ecchymosis (-es) - hemorrhages measuring > 1 cm., often indicating coagulation factor abnormality

purpura - ecchymotic and petechial hemorrhages into skin

hemopericardium - blood into pericardium

hemothorax - blood into thoracic cavity (ies)

hemoperitoneum - blood into peritoneal cavity

hematochezia - bright red blood per rectum

melena - dark black blood per rectum

hematuria - blood, gross or microscopic, in urine

hemoptysis - coughing up of blood

hematemesis - vomiting up of blood

Hemorrhage

Petechiae:

- **Minute 1-2 mm**
- **Into skin, mucous membrane, or serosal surfaces**
- **Causes: Locally increased intravascular pressure, low platelet count, defect in platelet function, and deficiency of clotting factors.**

Petechial hemorrhages of colonic mucosa as a consequence of thrombocytopenia

Hemorrhage

Purpura:

- **Slightly larger ≥ 3mm**
- **All causes of Petechiae, plus**
- **Secondary to trauma, vascular inflammation, and increased vascular fragility**

Hemorrhage

Ecchymoses:

(Subcutaneous hematoma; Bruises)

- **Larger > 1-2 cm**
- **Characteristically seen after trauma**
- **Exacerbation of any of the aforementioned conditions**

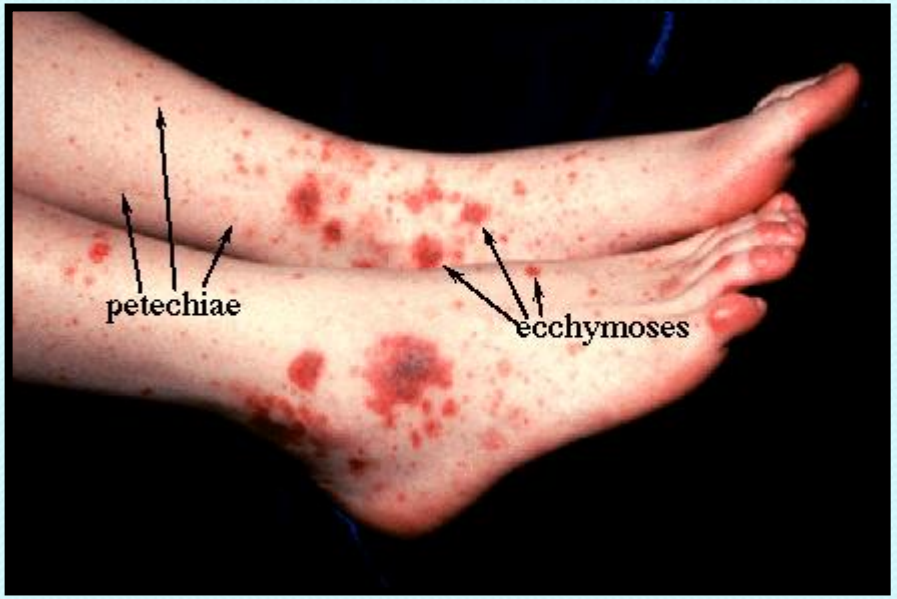
Hemorrhage

Ecchymoses:

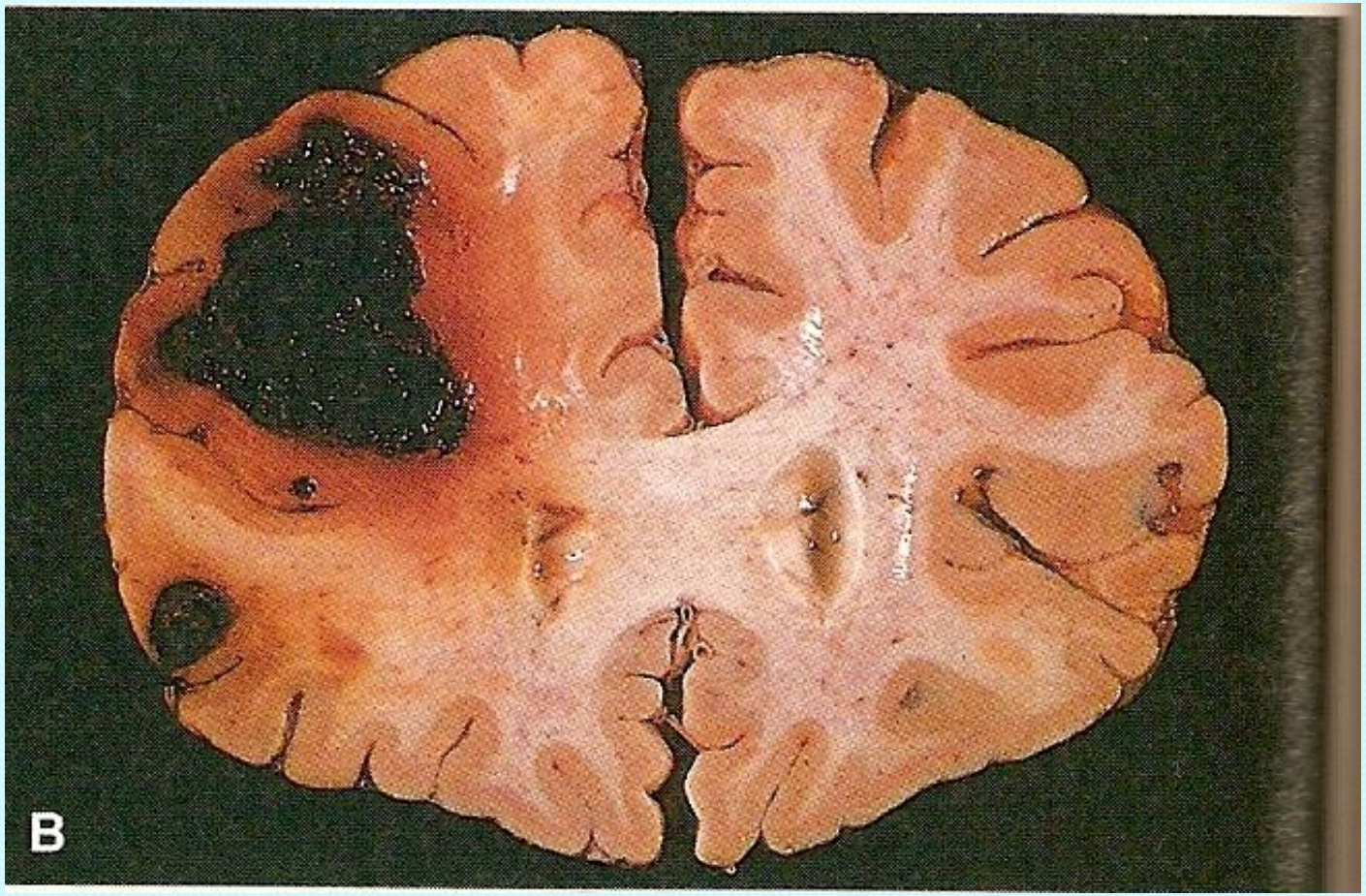
(Colours changes in hematoma)

- **Hemoglobin (Red-blue)**
- **Bilirubin (Blue-green)**
- **Hemosiderin (Gold-brown)**

Petechiae & Ecchymoses



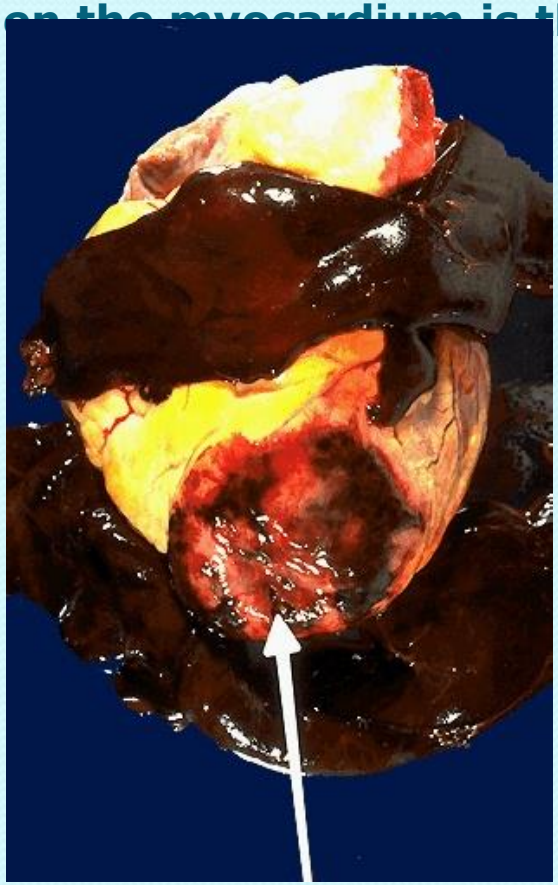
Fatal intracerebral hemorrhage



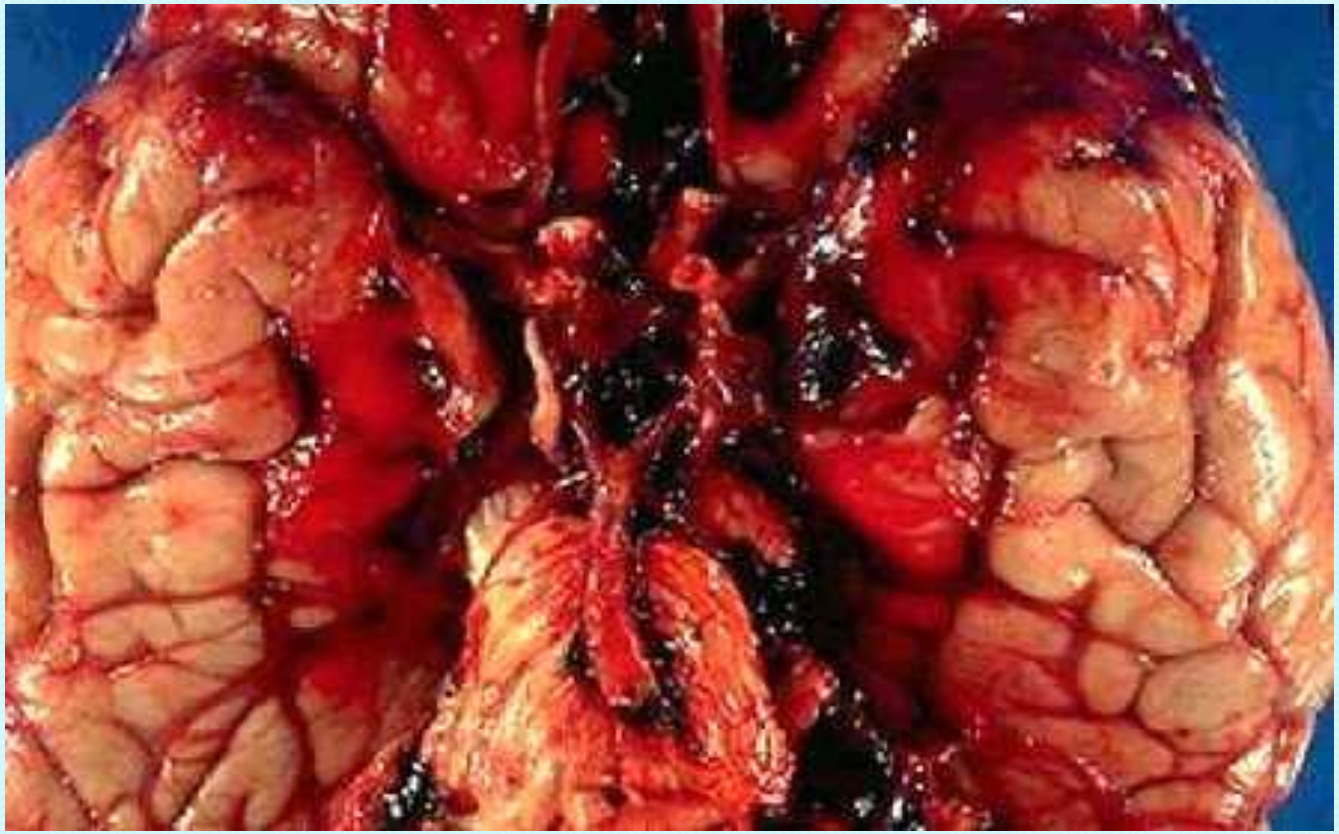
Hemorrhage:
Ectopic pregnancy

One complication of a transmural myocardial infarction is rupture of the myocardium. This is most likely to occur in the first week between 3 to 5 days following the initial event, when the myocardium is the softest.

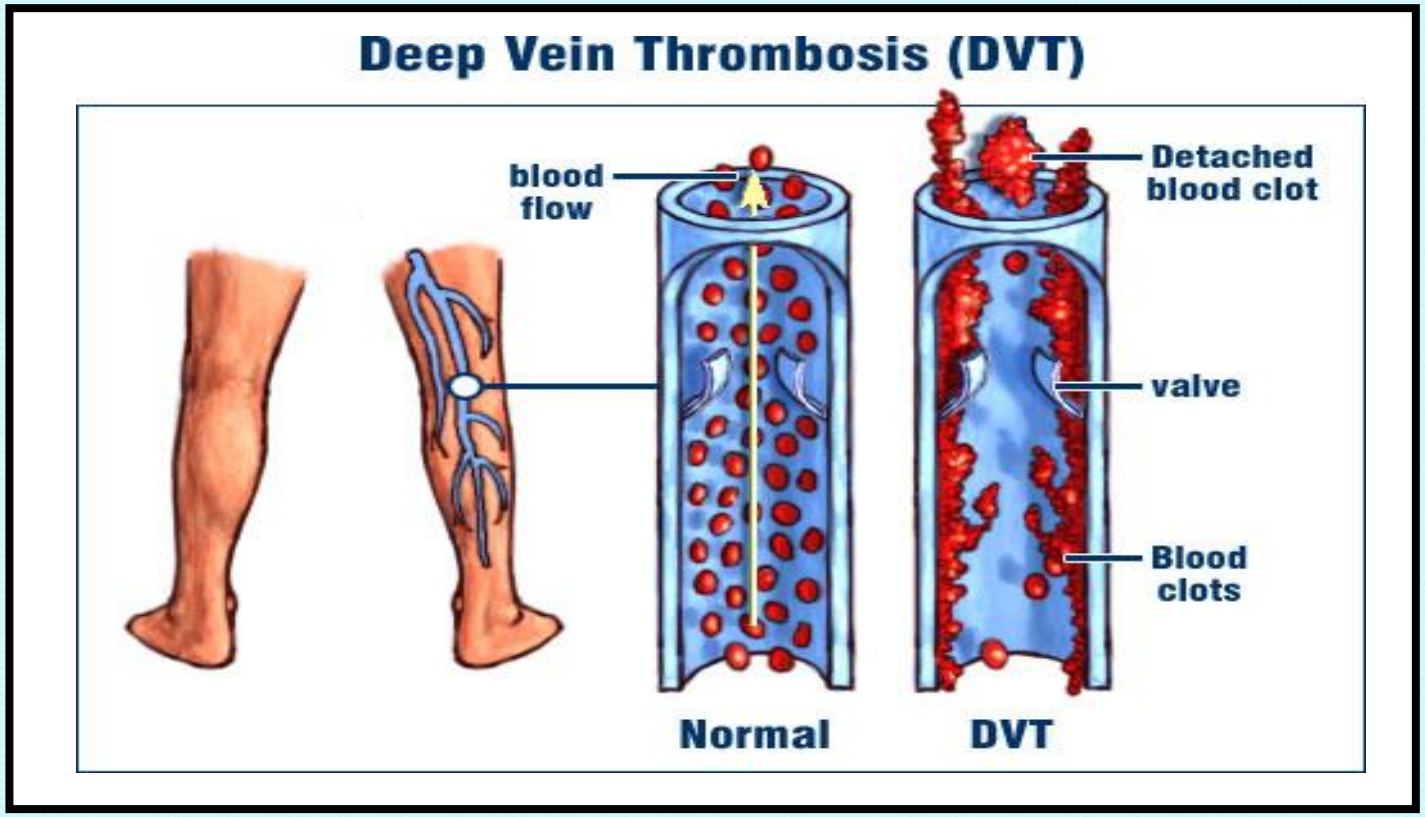
Here are petechial hemorrhages seen on the epicardium of the heart.



Subarachnoid Haemorrhage:



Thrombosis: Intravascular coagulation



THROMBUS solidified blood inside the vascular space in a living organism.

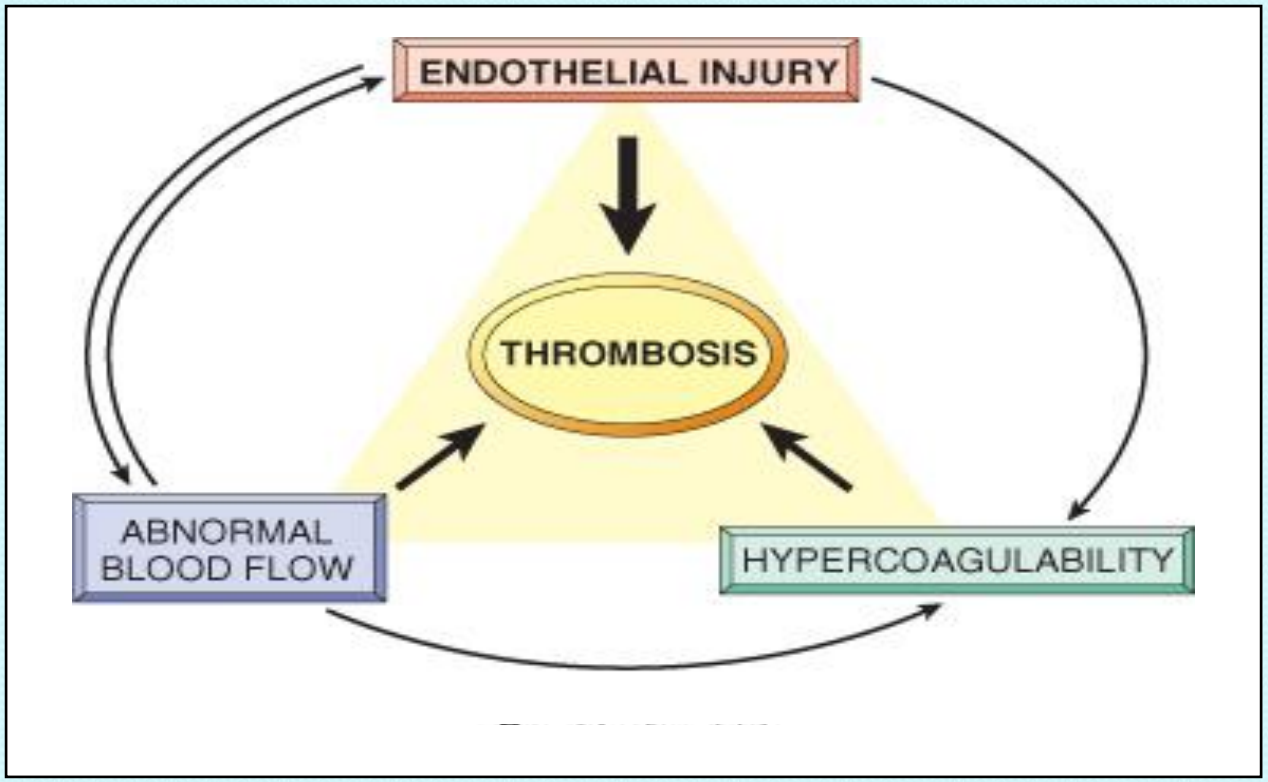
Composed of fibrin, platelets, and rbc's
Hemostatic plug formation
endothelial injury
platelet aggregation
fibrin meshwork

Location of thrombi: Arteries, veins, heart chambers, heart valves

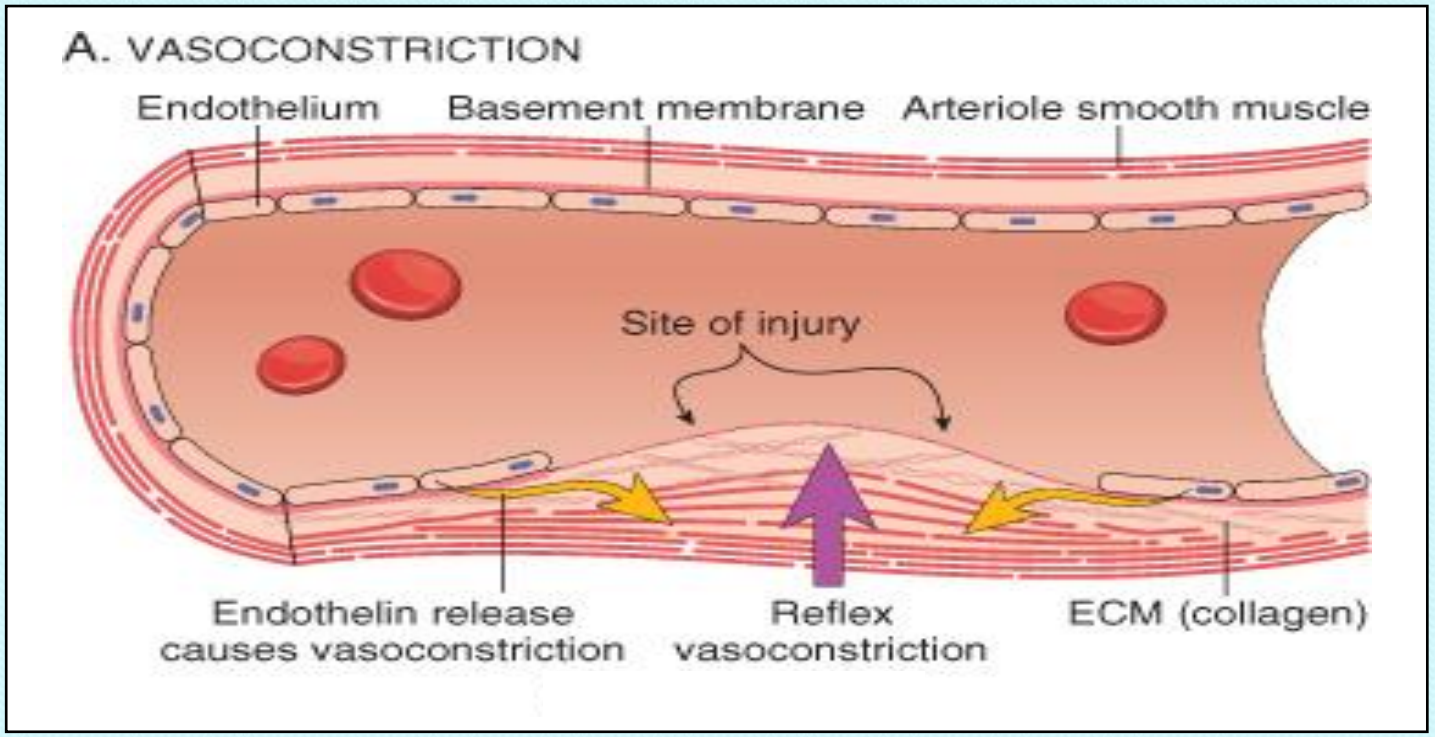
Types of thrombi: Arterial *vs*. venous; bland *vs*. septic

Virchow triad in thrombosis.

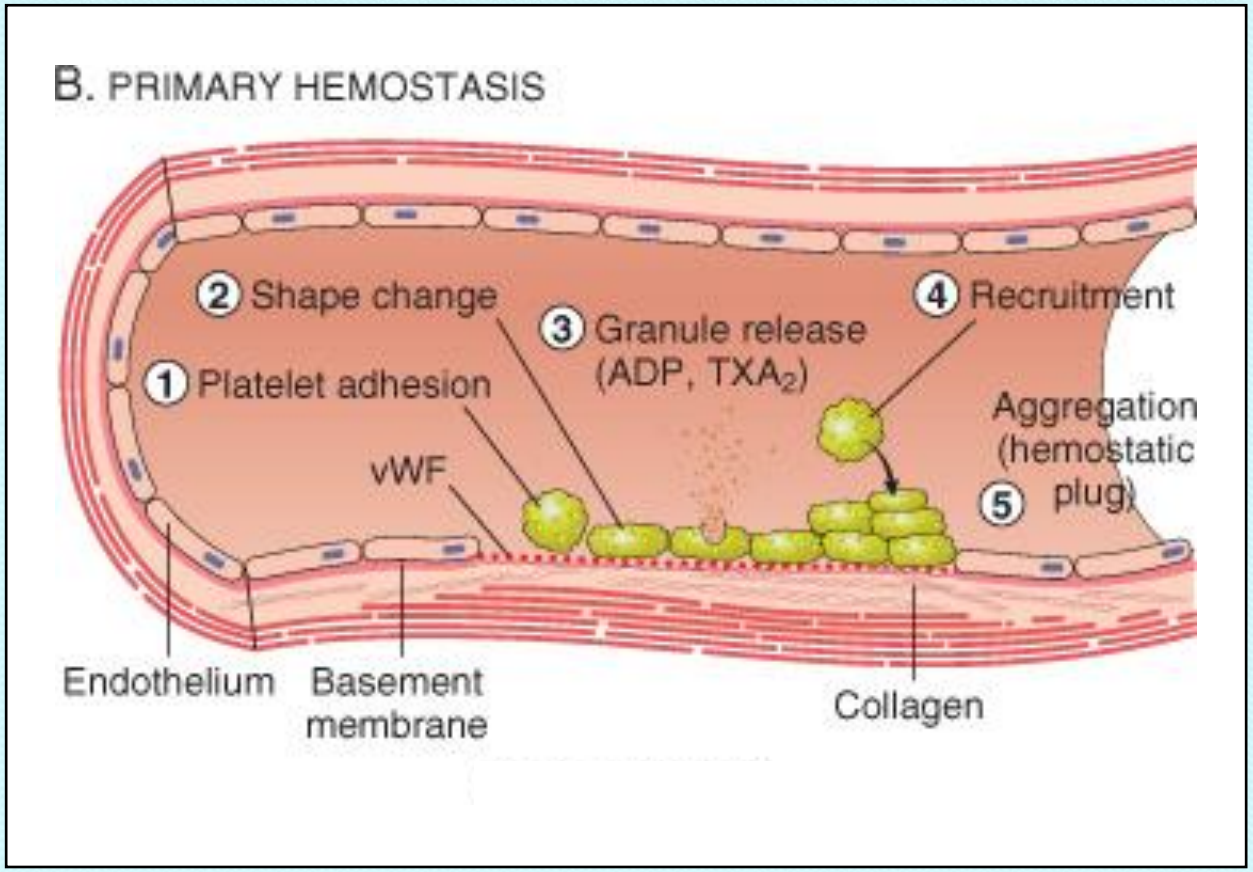
Endothelial integrity is the single most important factor. Note that injury to endothelial cells can affect local blood flow and/or coagulability; abnormal blood flow (stasis or turbulence) can, in turn, cause endothelial injury. The elements of the triad may act independently or may combine to cause thrombus formation.



Diagrammatic representation of the normal hemostatic process

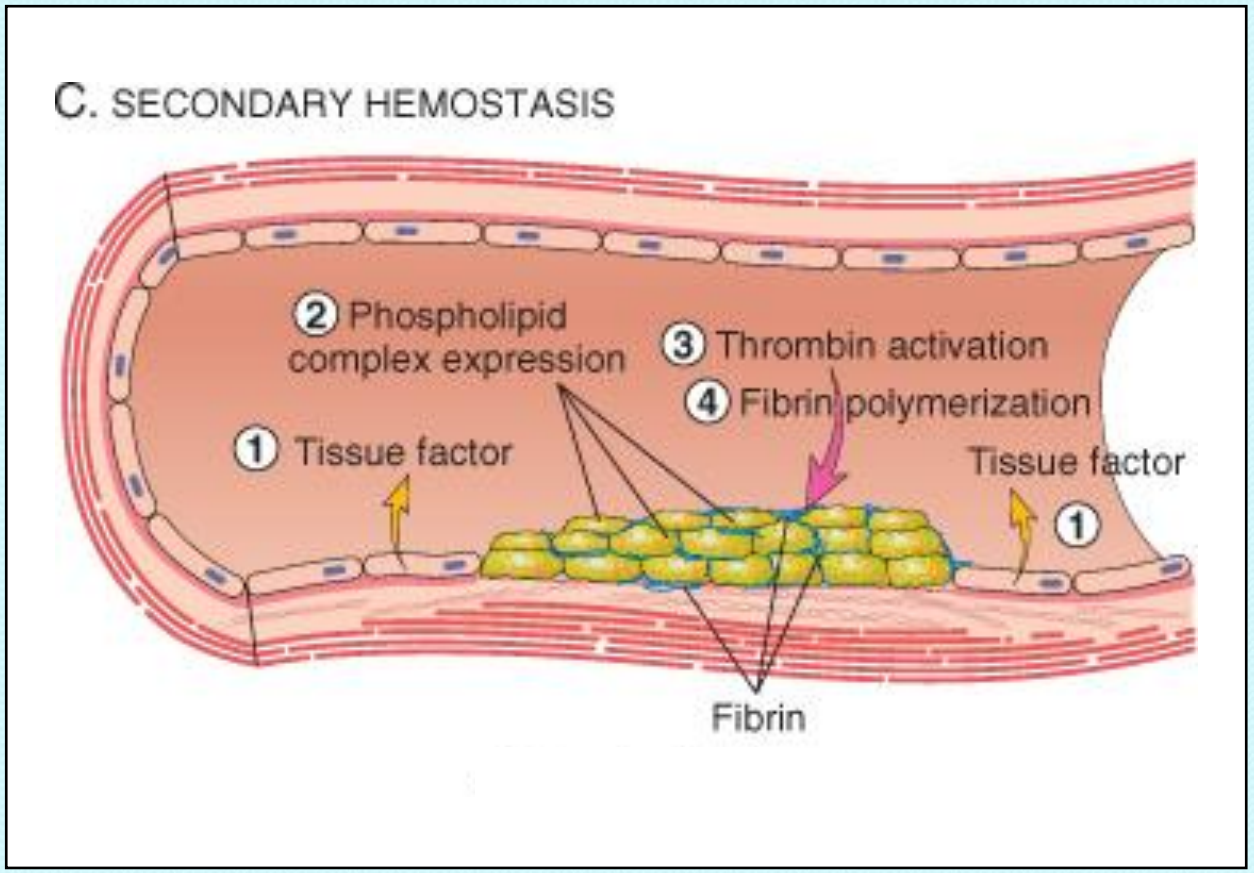


Diagrammatic representation of the normal hemostatic process



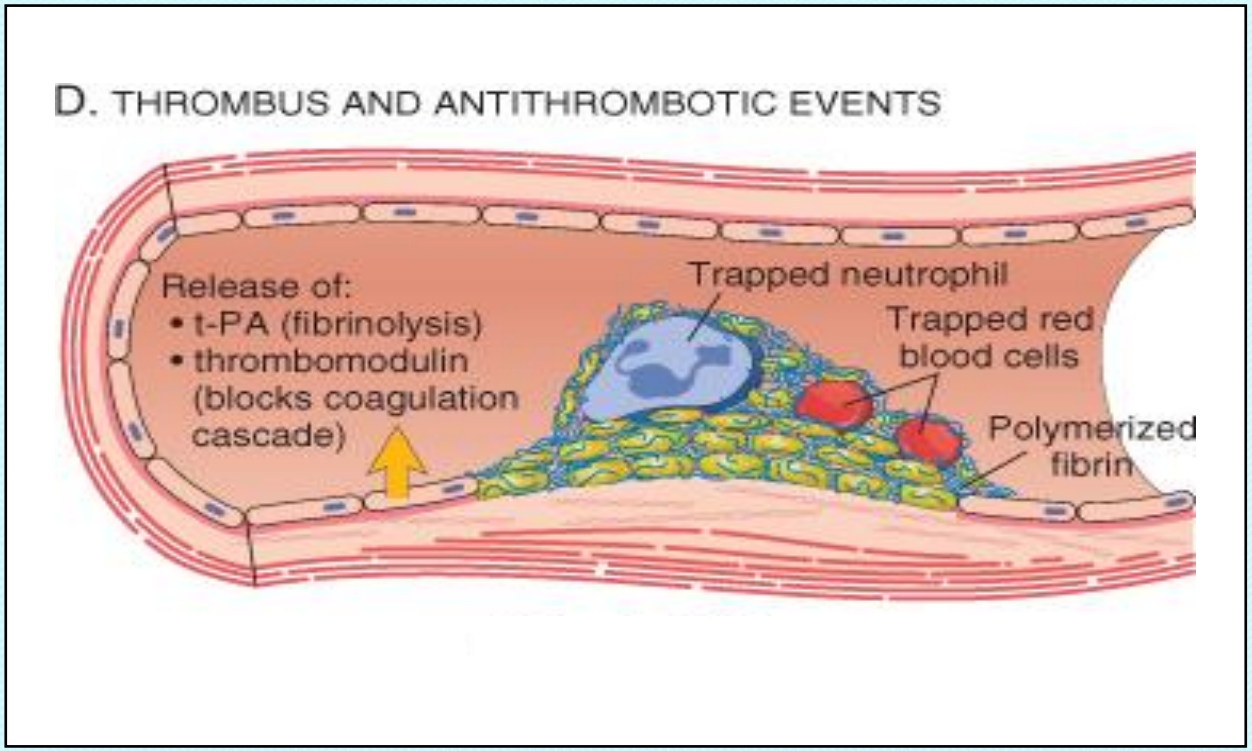
Platelets adhere to exposed extracellular matrix (ECM) via von Willebrand factor (vWF) and are activated, undergoing a shape change and granule release; released adenosine diphosphate (ADP) and thromboxane A2 (TxA2) lead to further platelet aggregation to form the primary hemostatic plug.

Diagrammatic representation of the normal hemostatic process



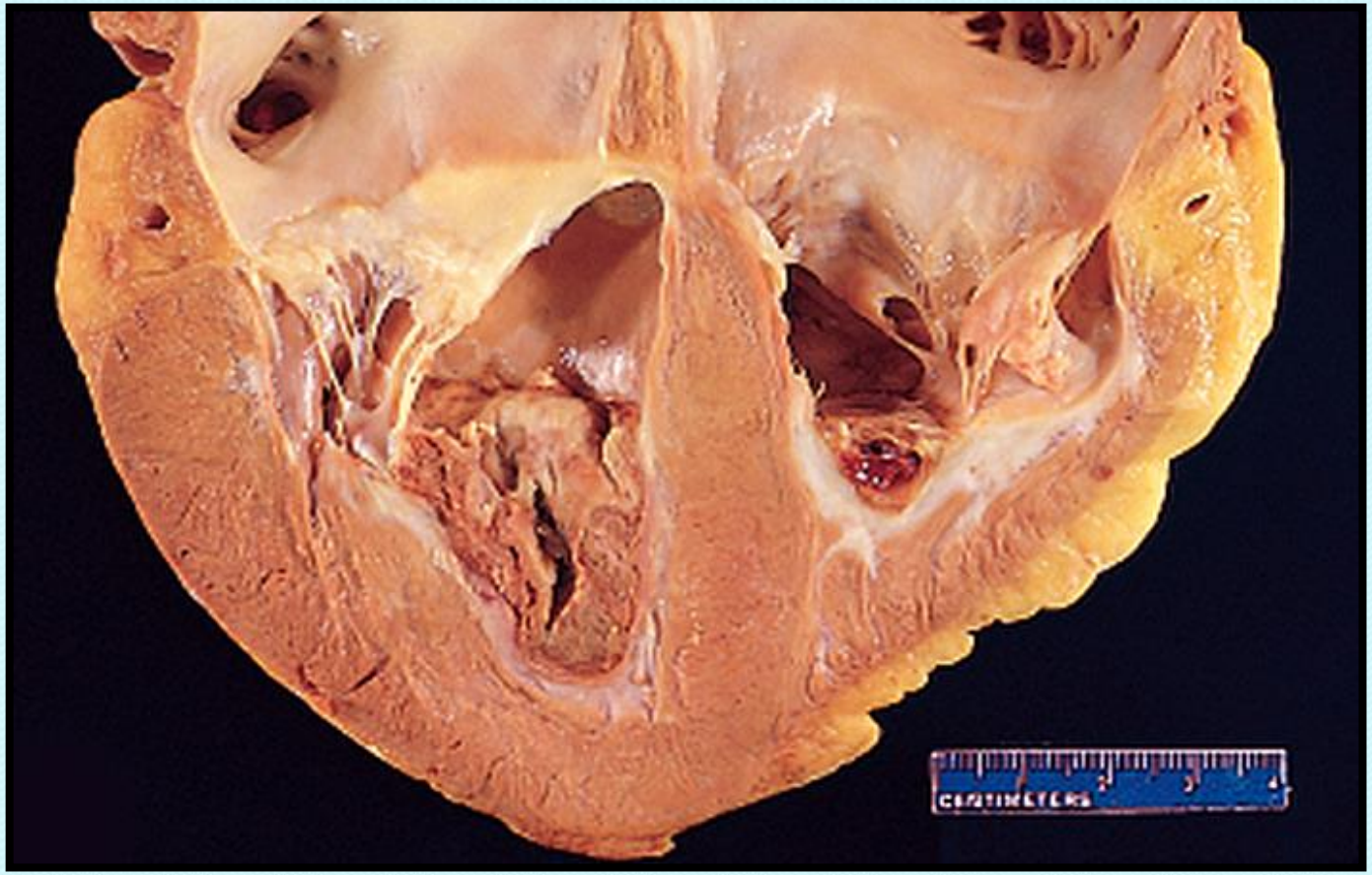
Local activation of the coagulation cascade (involving tissue factor and platelet phospholipids) results in fibrin polymerization, "cementing" the platelets into a definitive secondary hemostatic plug.

Diagrammatic representation of the normal hemostatic process



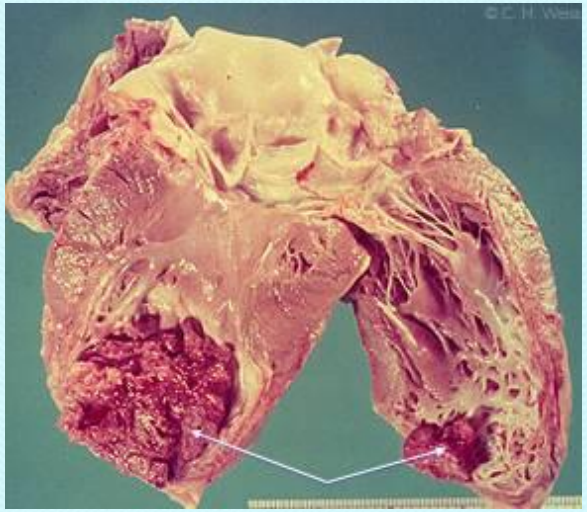
Counter - regulatory mechanisms, such as release of tissue type plasminogen activator (t-PA) (fibrinolytic) and thrombomodulin (interfering with the coagulation cascade), limit the hemostatic process to the site of injury.

Mural thrombi.

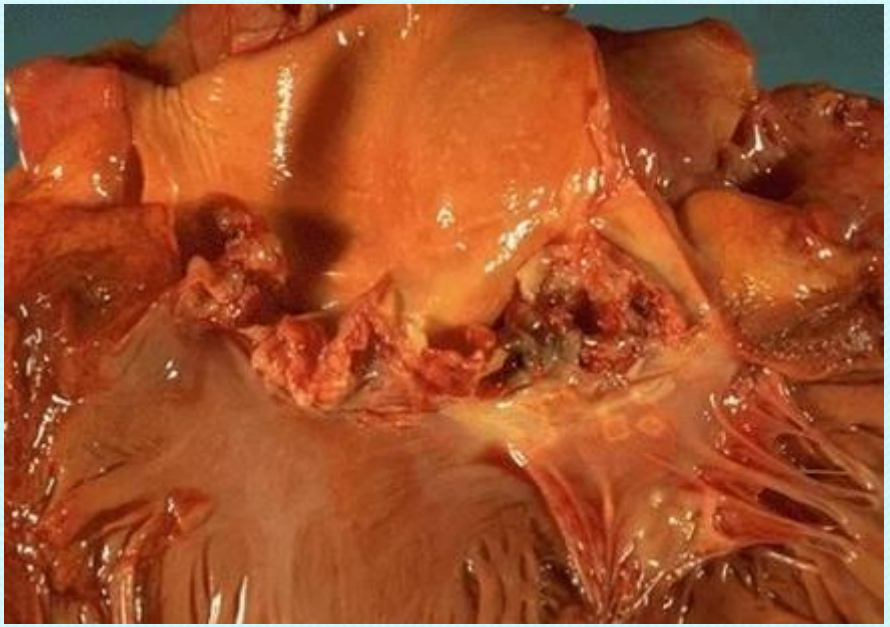


Sites of Thrombosis

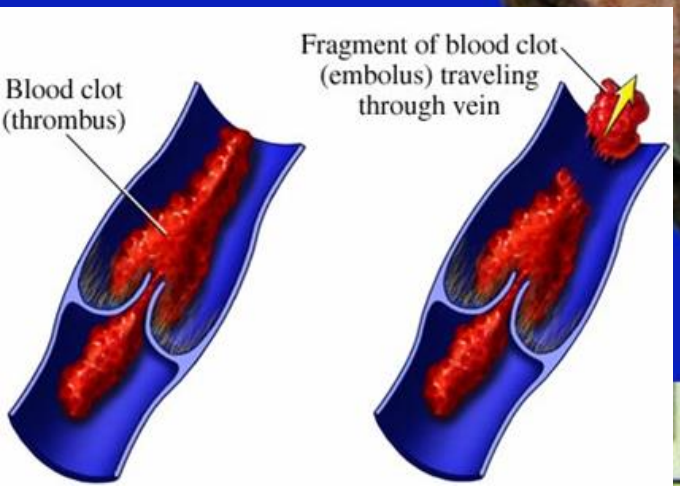
in heart (atria , ventricles & on valves); in arteries ; in veins ; and in capillaries.

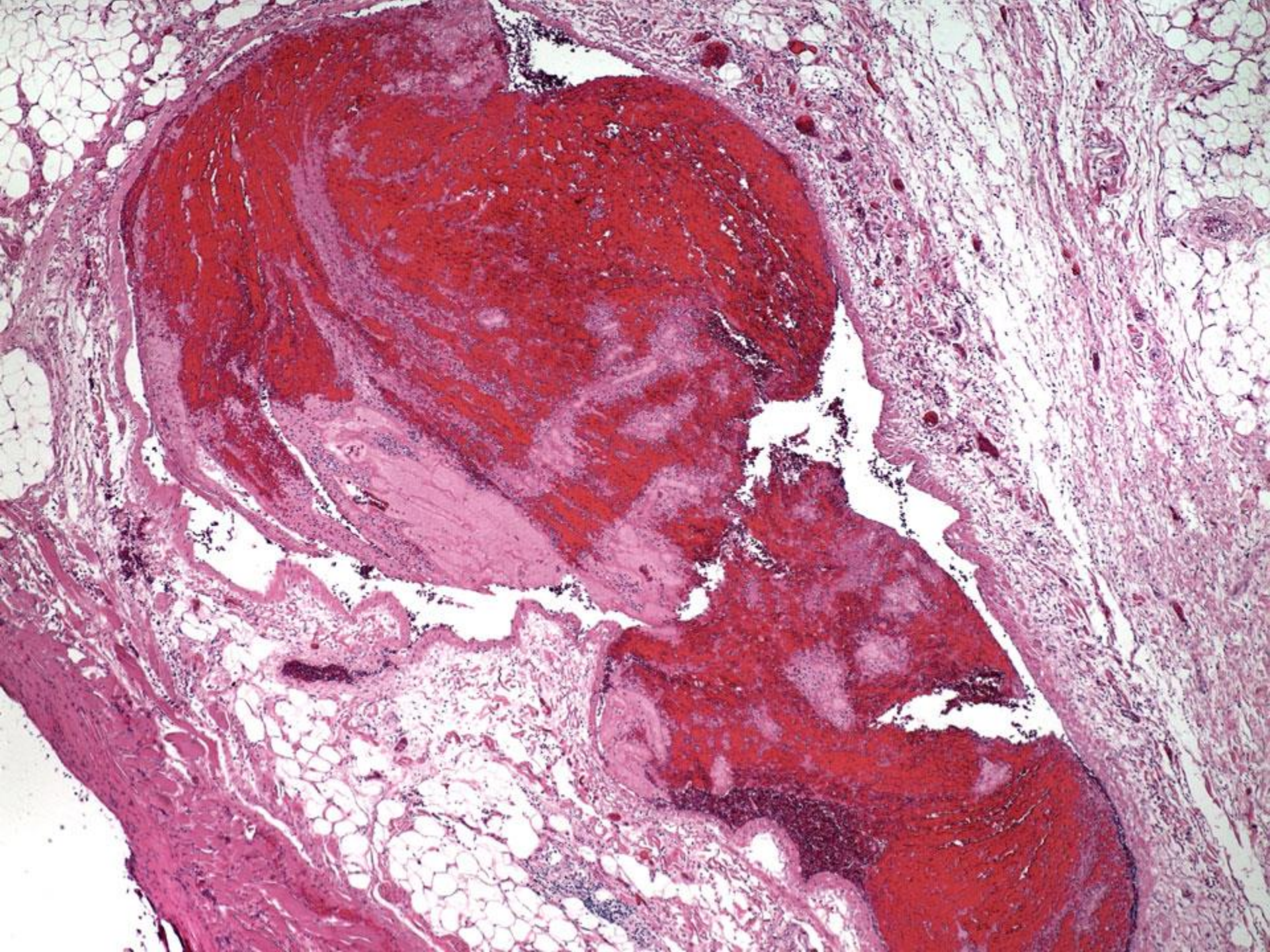


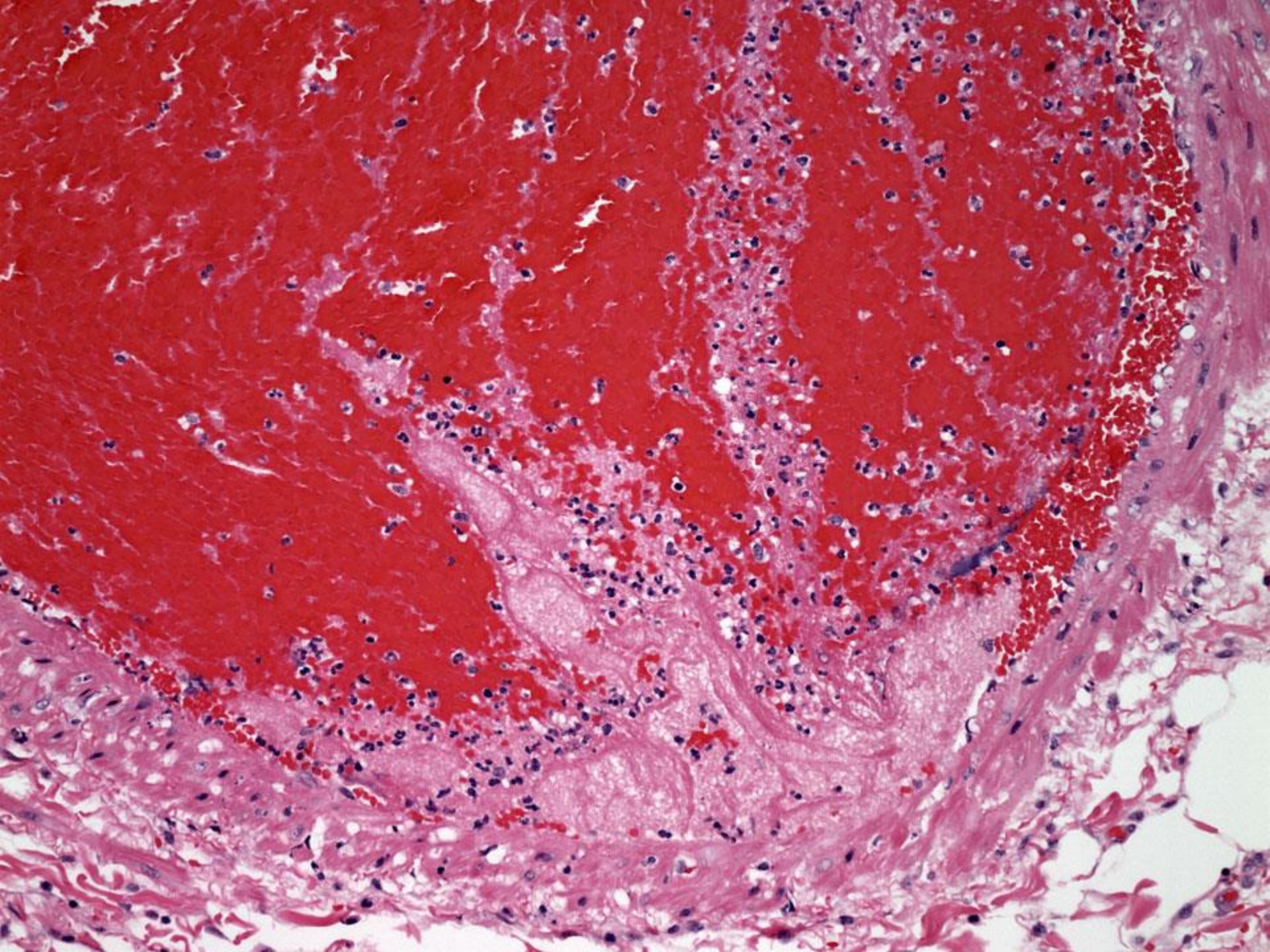
Large mural thrombus on top of myocardial infarction



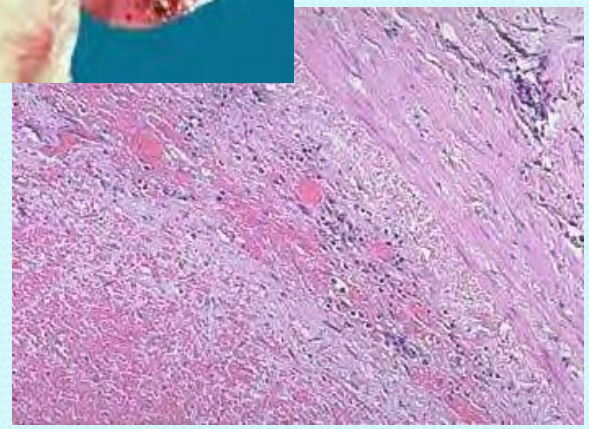
Left atrial mural thrombus in a case of rheumatic mitral stenosis


Blood clot
(thrombus)
Fragment of blood clot
(embolus) traveling
through vein



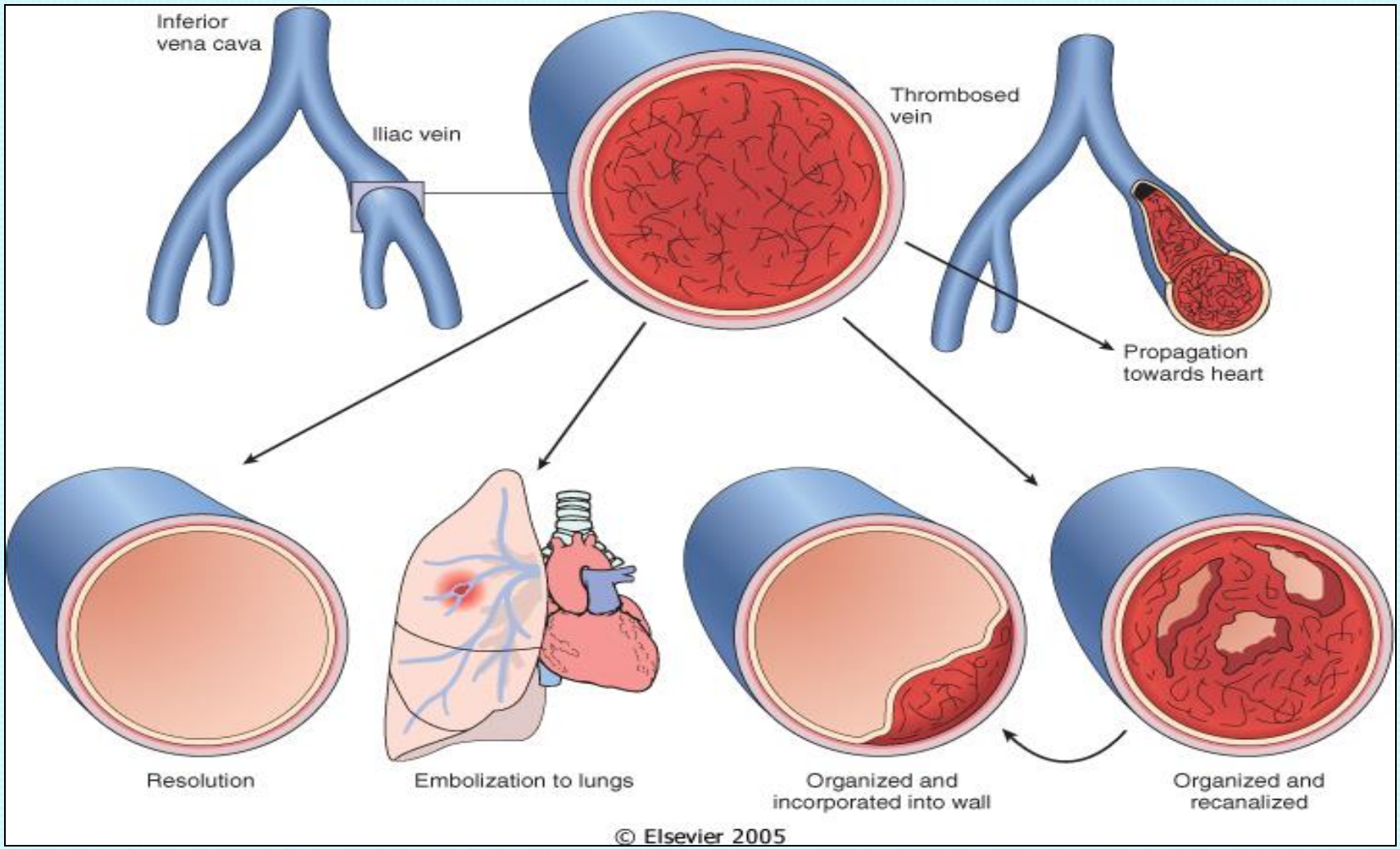


Venous Thrombi: Fates



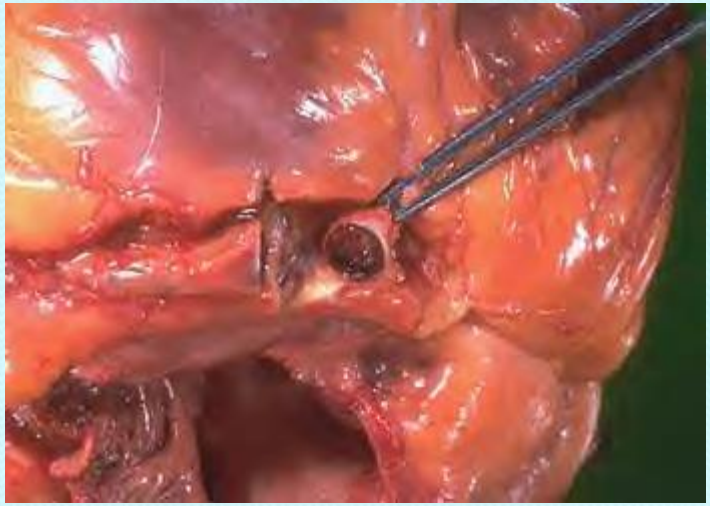
- Organization
  - Ingrowth of cells into thrombus with incorporation into wall
- Resolution
  - It goes away
- Embolization
  - Travels from its site of origin to a distal part of circulation

VENOUS THROMBI FATES

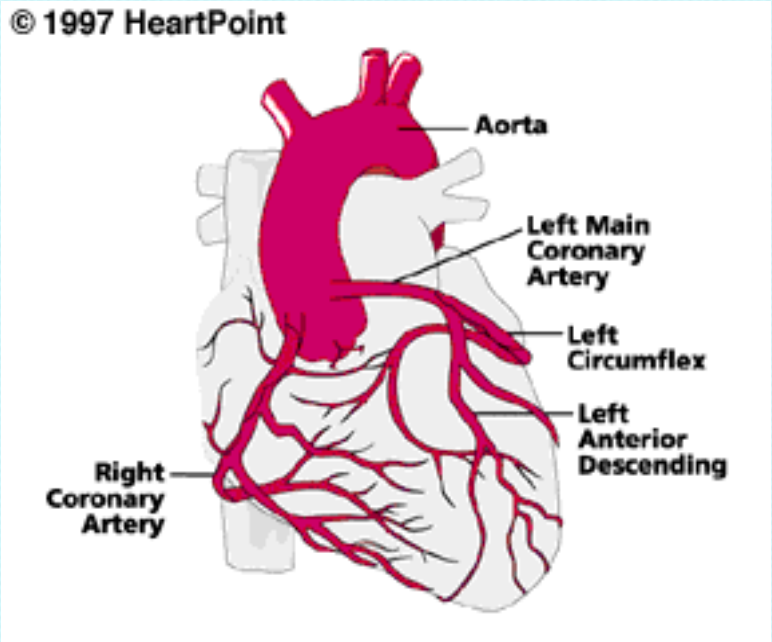


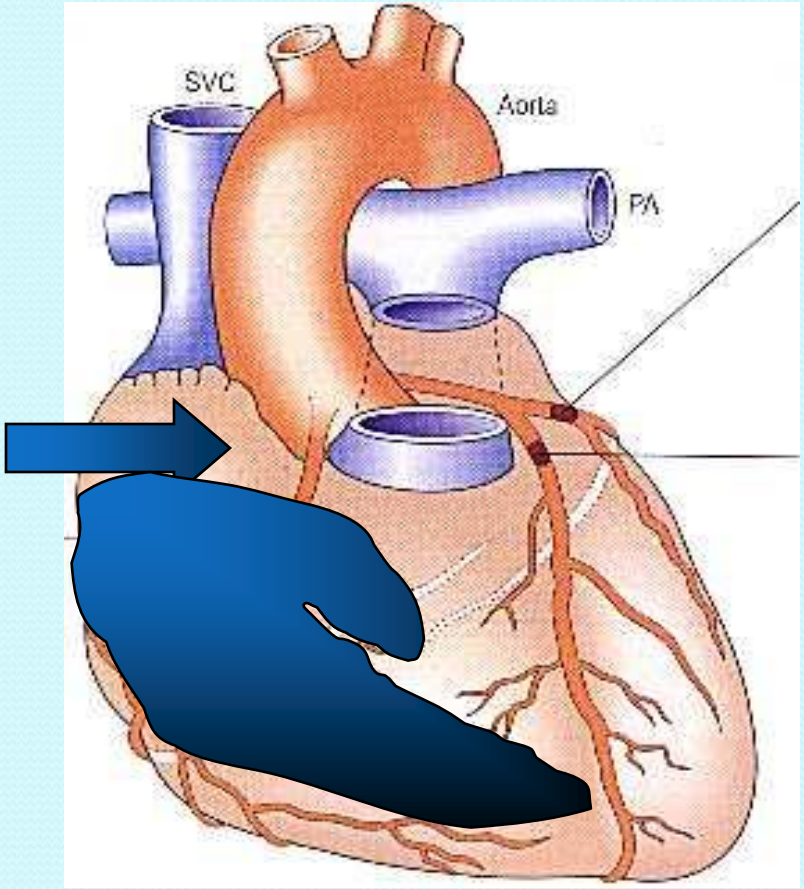
Arterial Thrombi Morphology

- Adherent masses of blood that demonstrate areas of pale alternating with areas of red
  - Lines of Zahn

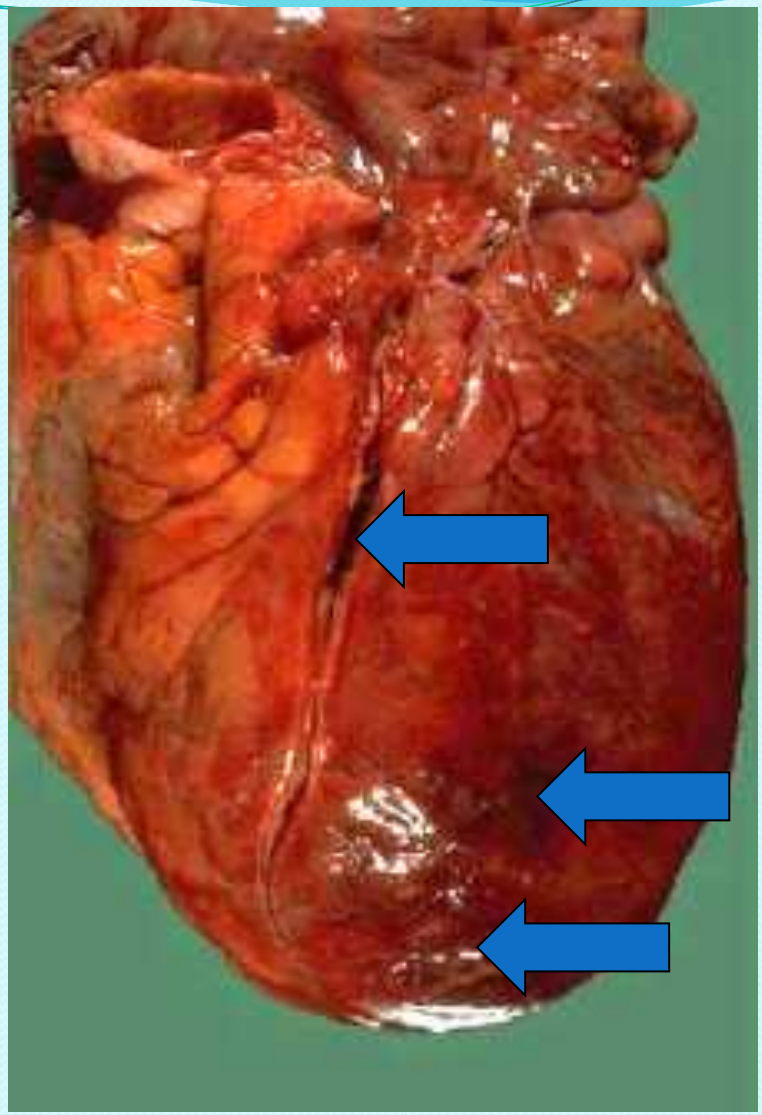


Coronary Atheorsclerosis

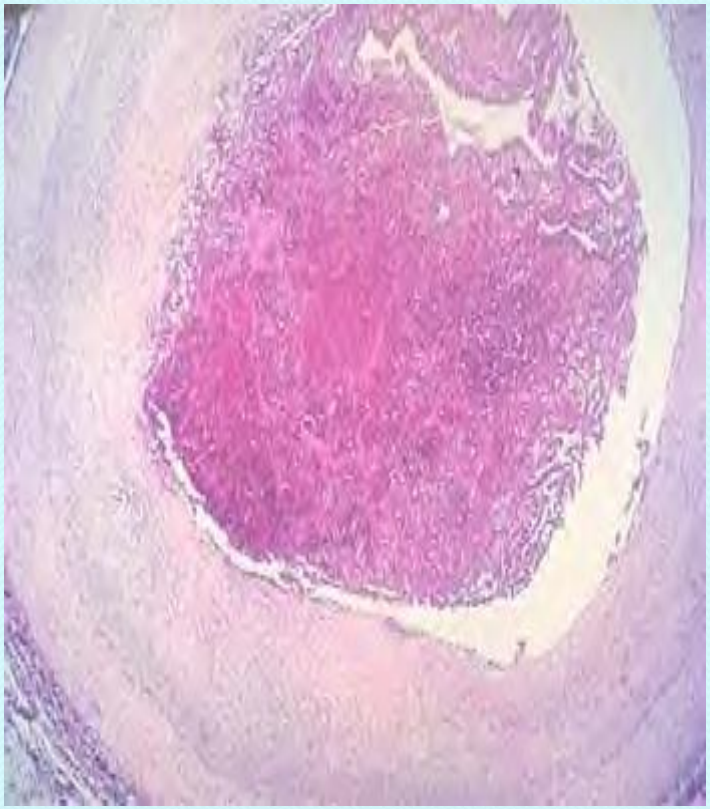


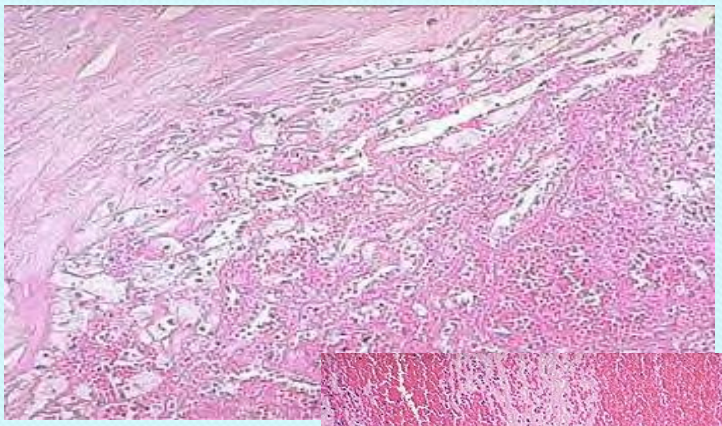


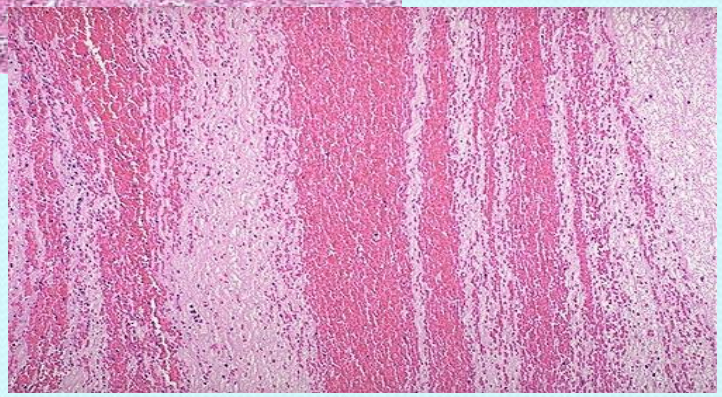
Coronary Thrombosis With Infarction



Arterial Thrombi Morphology

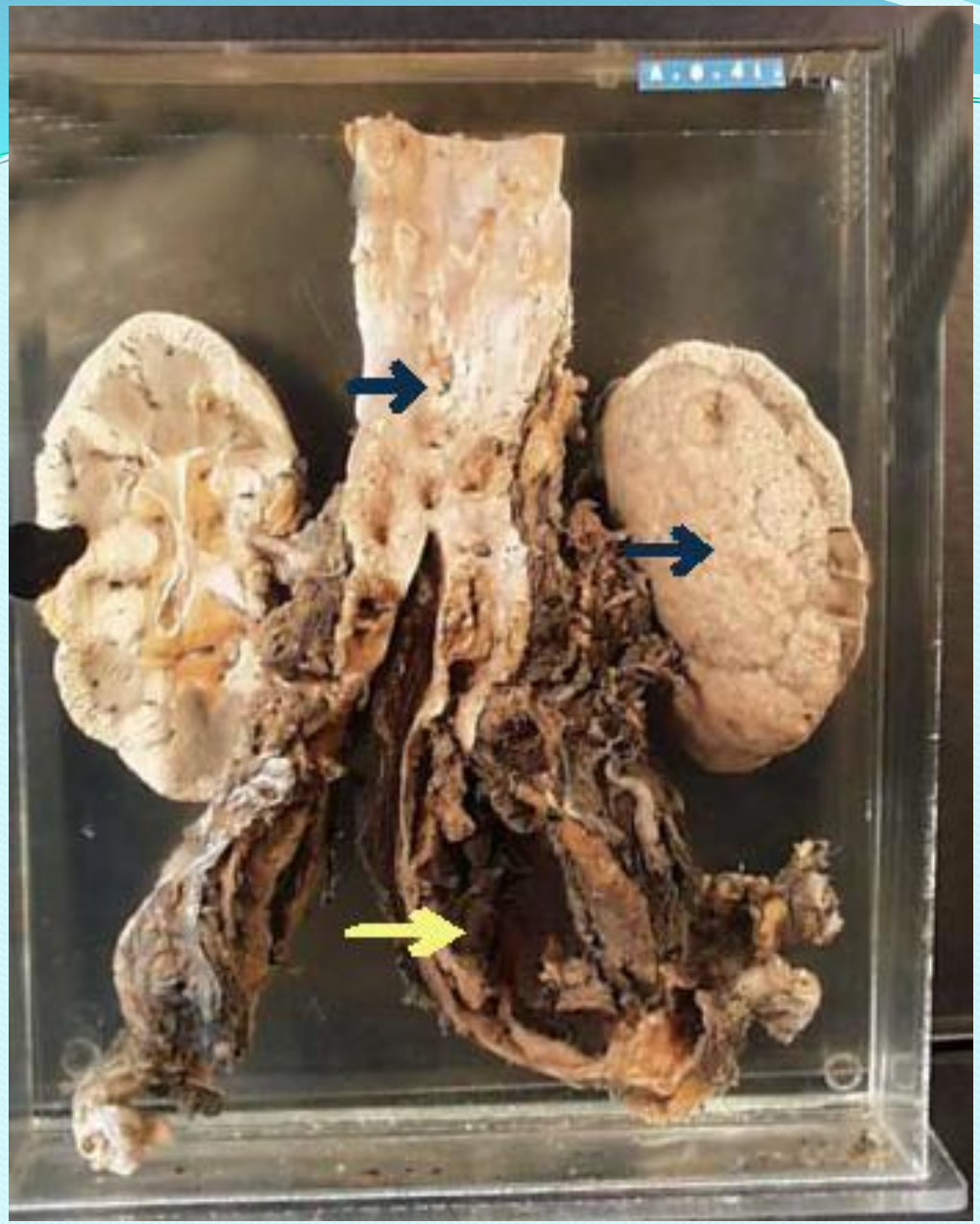






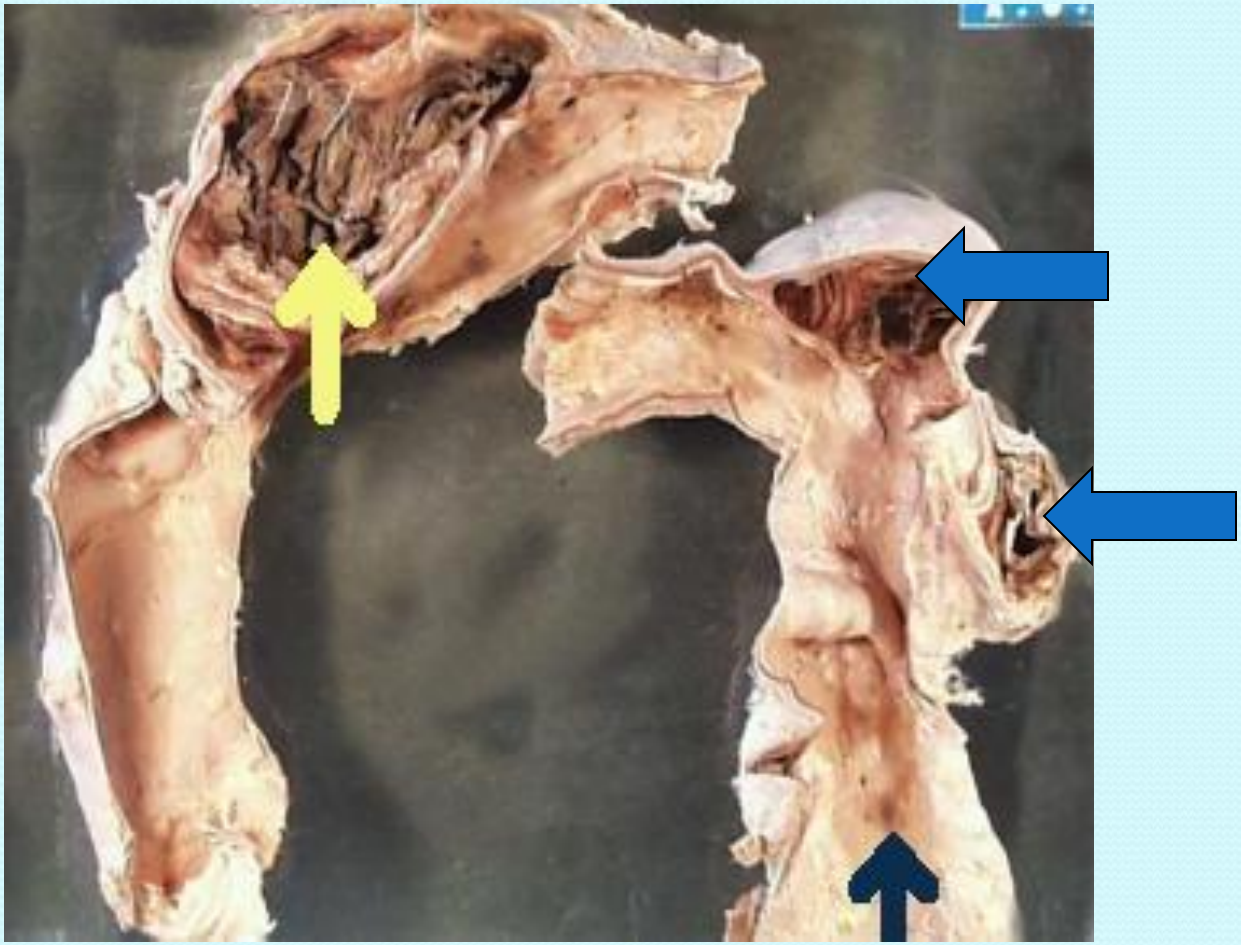
Arterial Thrombi Outcome

- Similar to venous thrombi
  - Resolution
  - Organization/Incorporation/Recanalization
  - Embolization (arterial)
  - Propagation

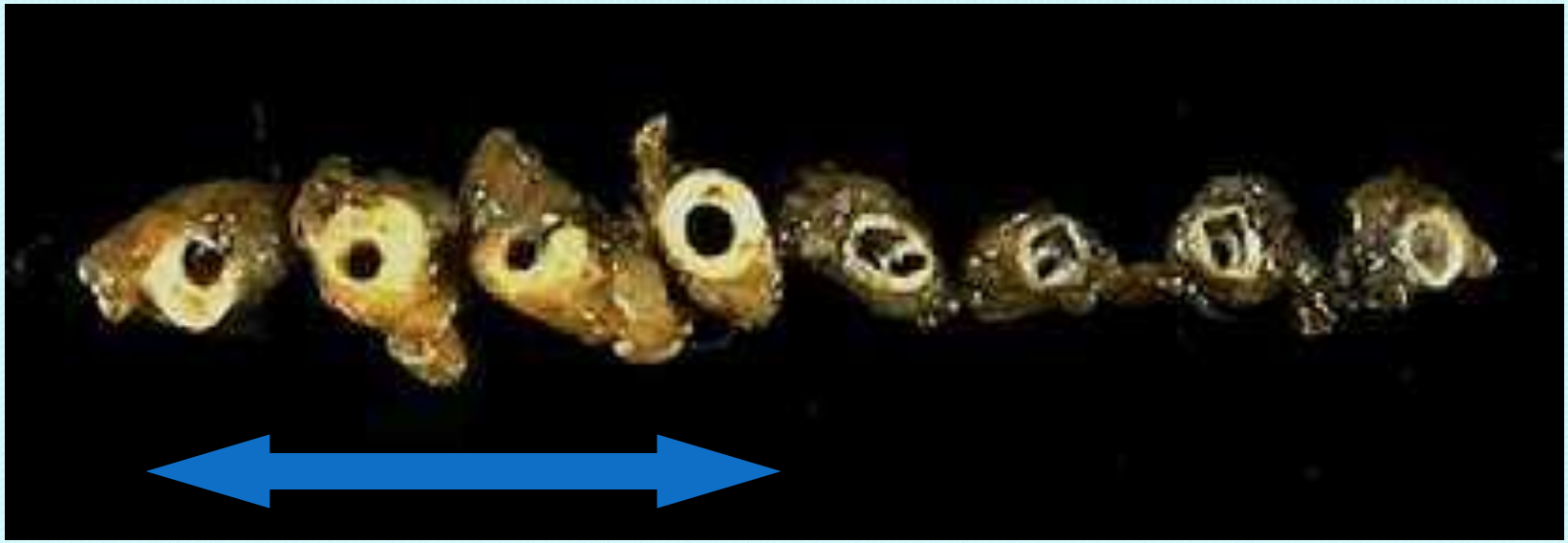


Atherosclerosis
Aorta
Ruptured aneurism
Nephrosclerosis

Aorta Dissecting Aneurisms:

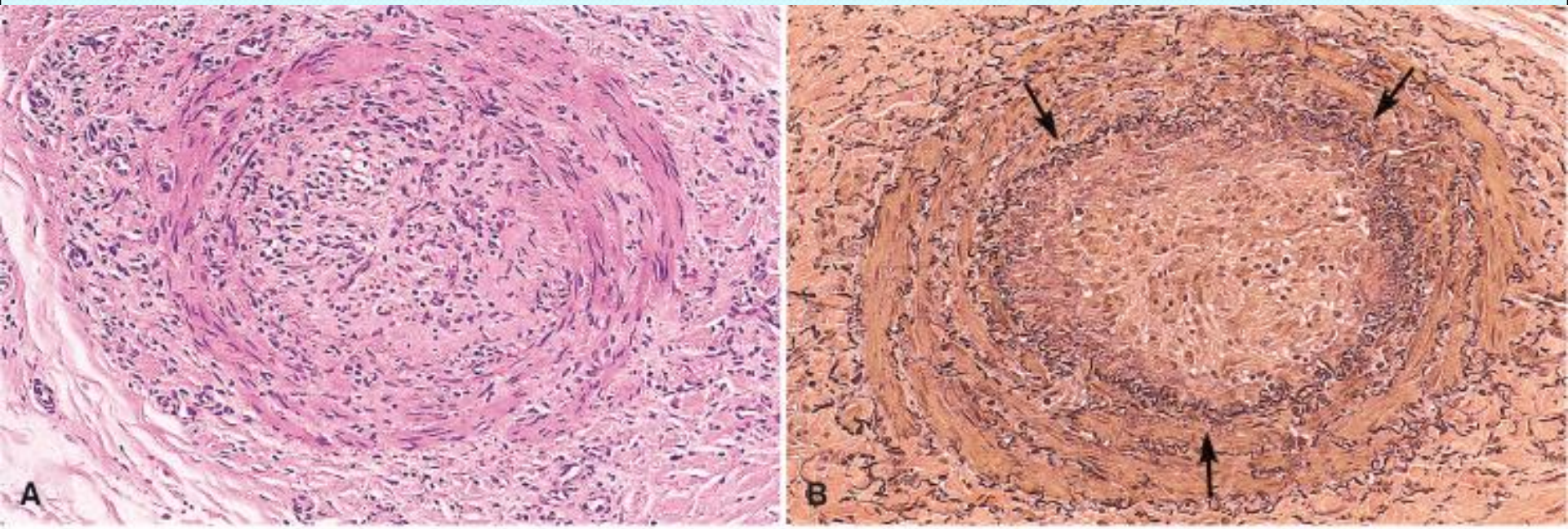


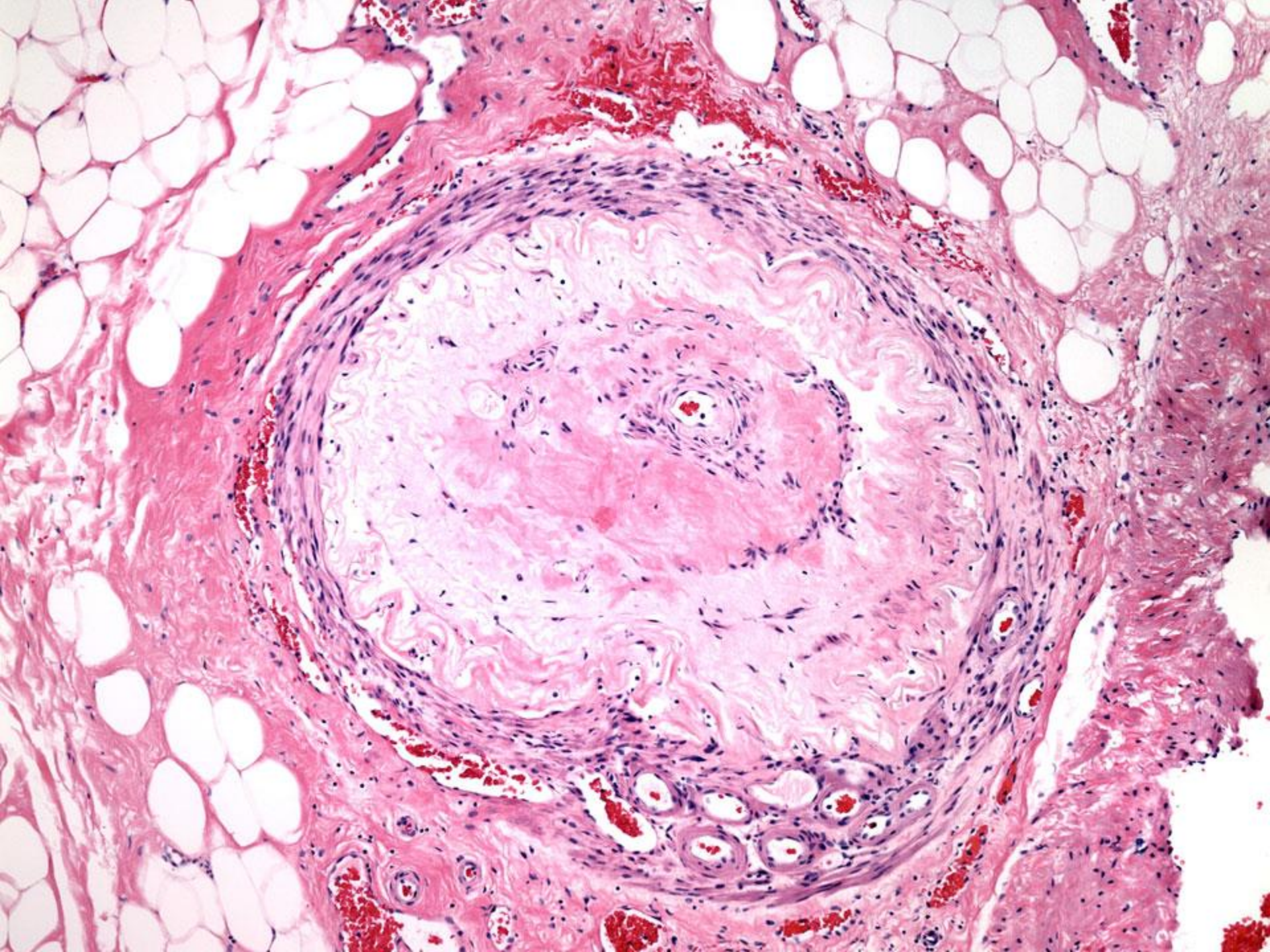
Coronary Narrowing in Atherosclerosis:

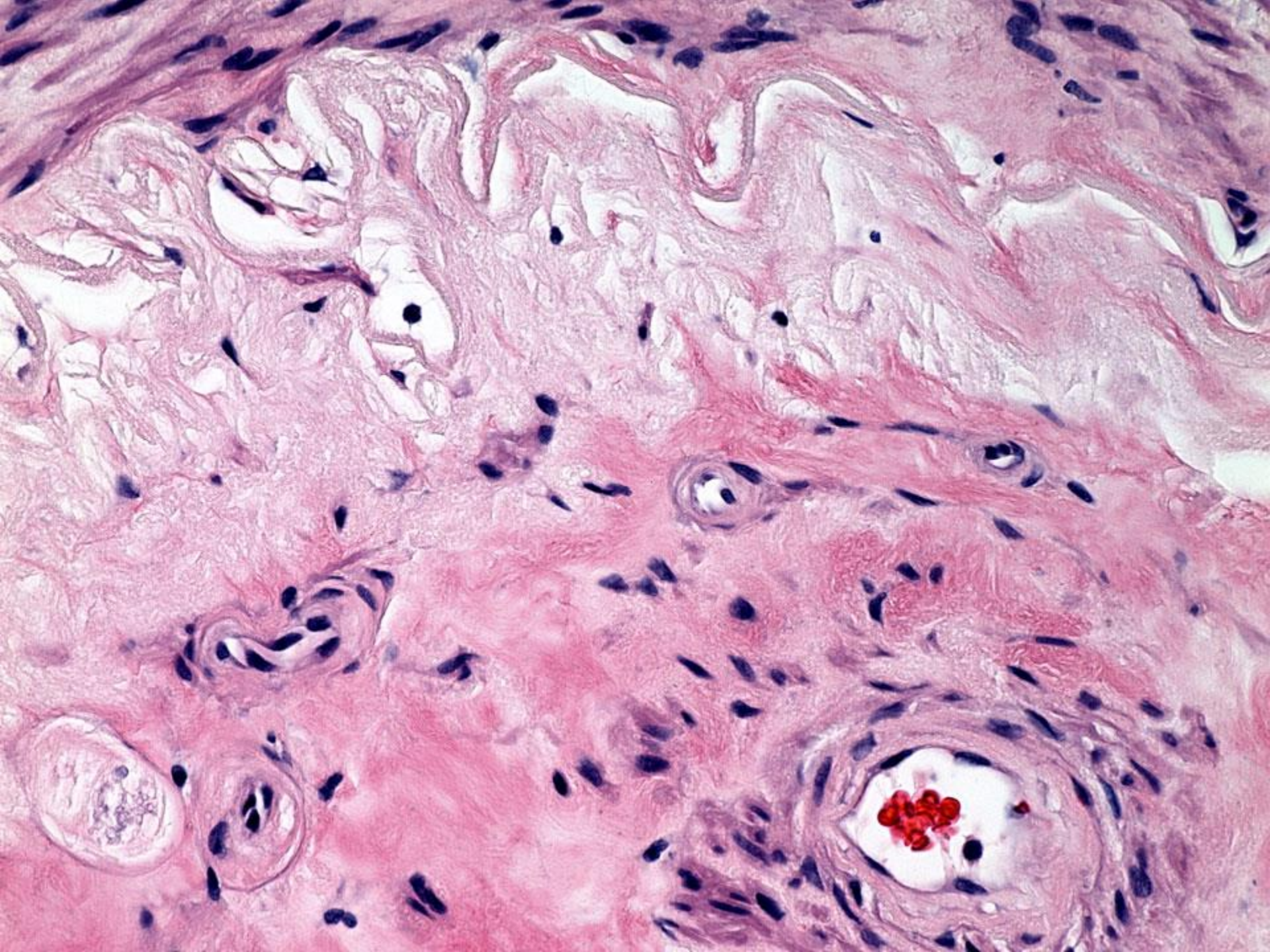


Low-power view of a thrombosed artery.

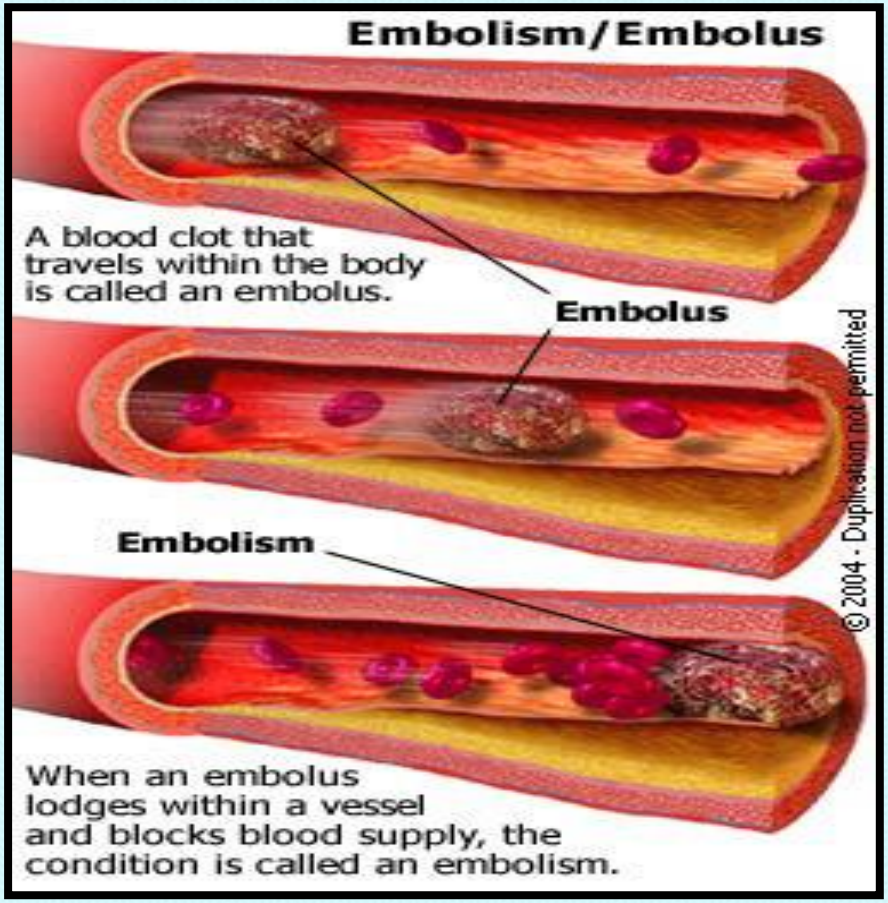
A, H&E-stained section. B, Stain for elastic tissue. The original lumen is delineated by the internal elastic lamina (arrows) and is totally filled with organized thrombus, now punctuated by a number of small recanalized channels.







Embolism & Thromboembolism

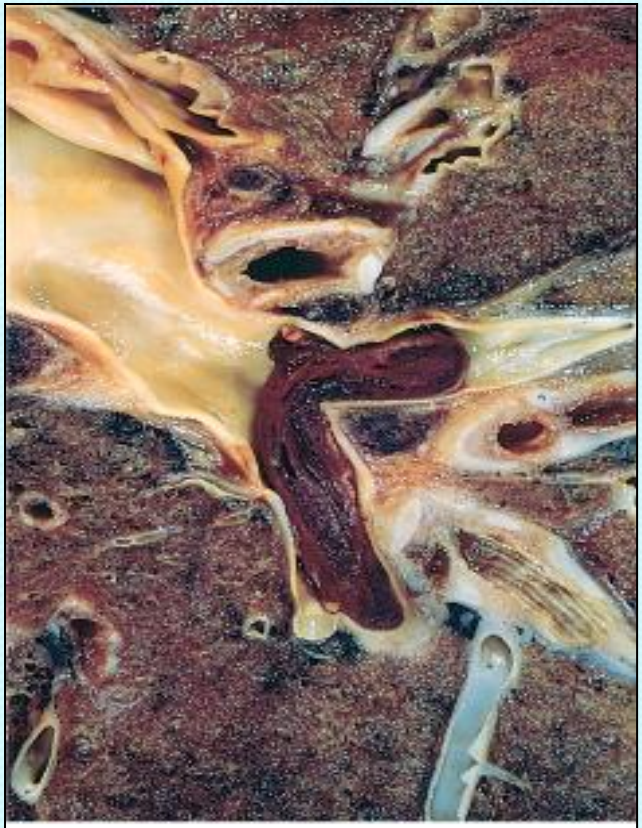


Embolism:

- 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

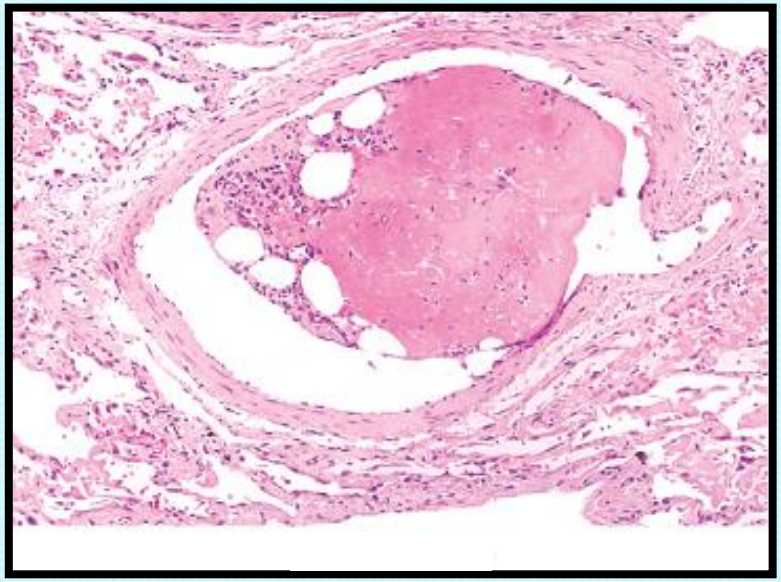
Pulmonary Thromboembolism

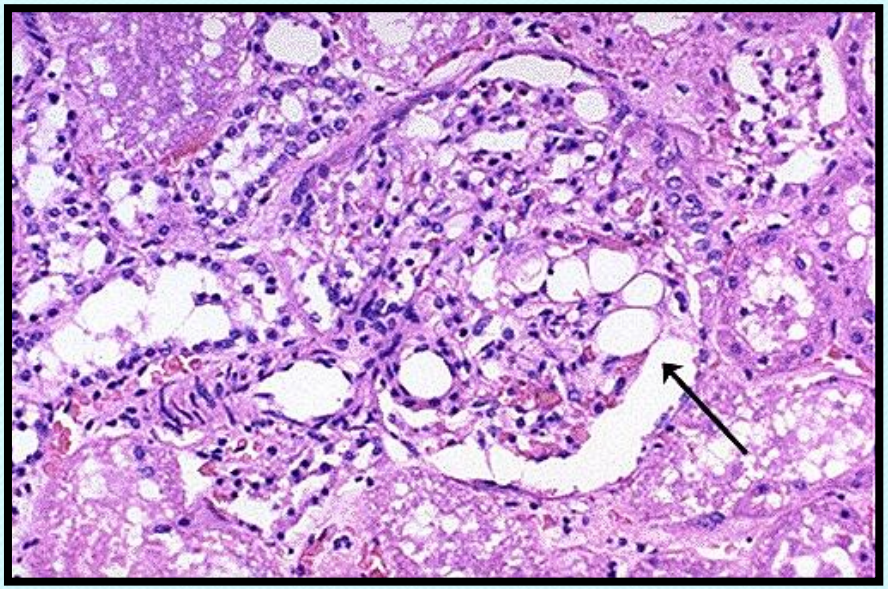
- 20-25 per 100,000 hospitalized patients
- May be fatal if 60% of pulmonary circulation is obstructed (acute cor pulmonale)
- Saddle PE straddles the bifurcation of the main PA
- Sequelae: Sudden death, clinically silent – resolution – organization, shortness of breath, pulmonary infarction
- Pathogenesis: Deep venous thrombi usual cause –often following immobilization-bed rest from hospitalization



Fat Embolism

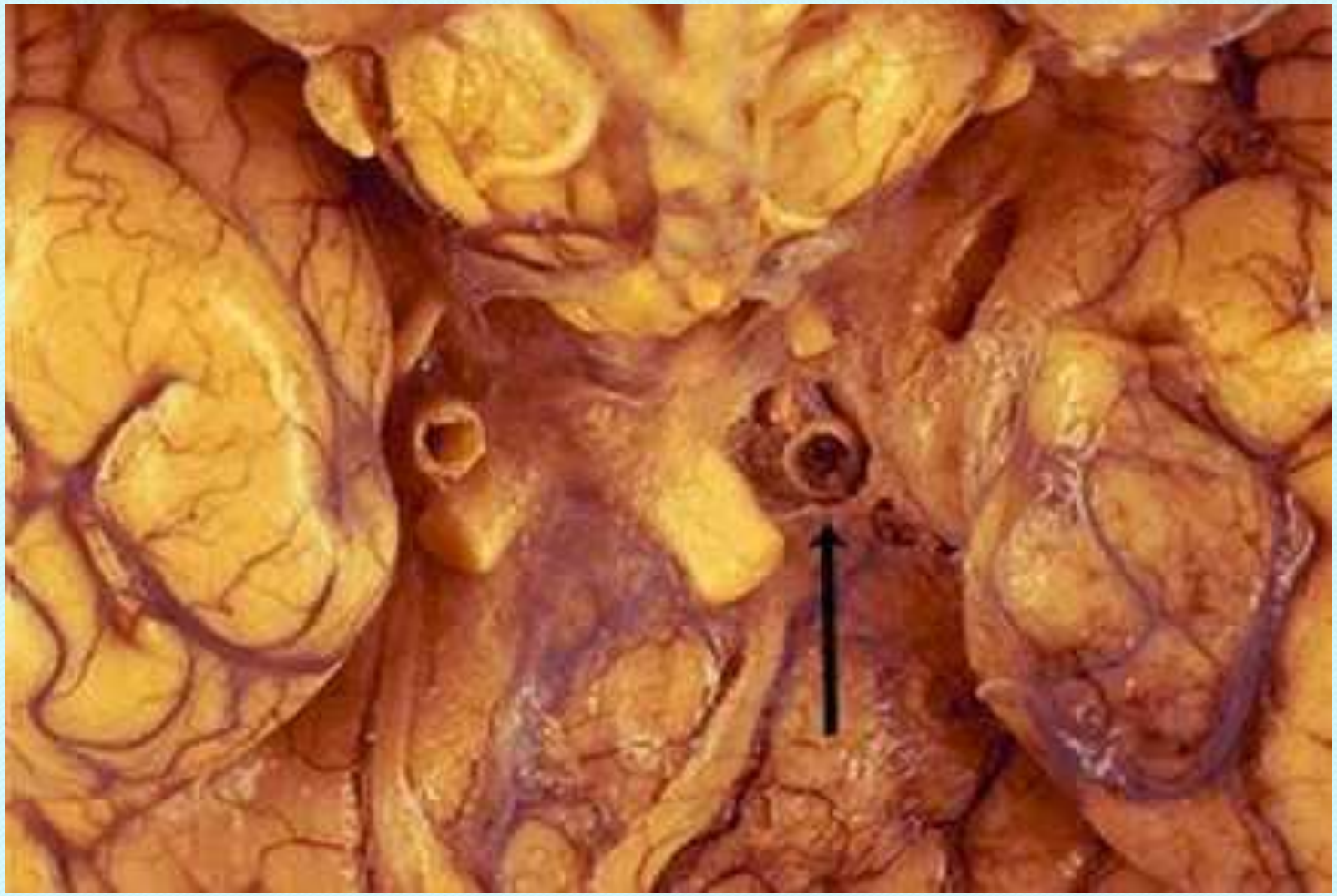
Bone marrow embolus in the pulmonary circulation.





Fat embolus in a glomerulus

Thrombo-embolism



PARADOXICAL EMBOLI

- **EMBOLI WHICH TRAVEL FROM VENOUS TO ARTERIAL CIRCULATION VIA A COMMUNICATION BETWEEN ARTERIAL AND VENOUS CIRCULATION**