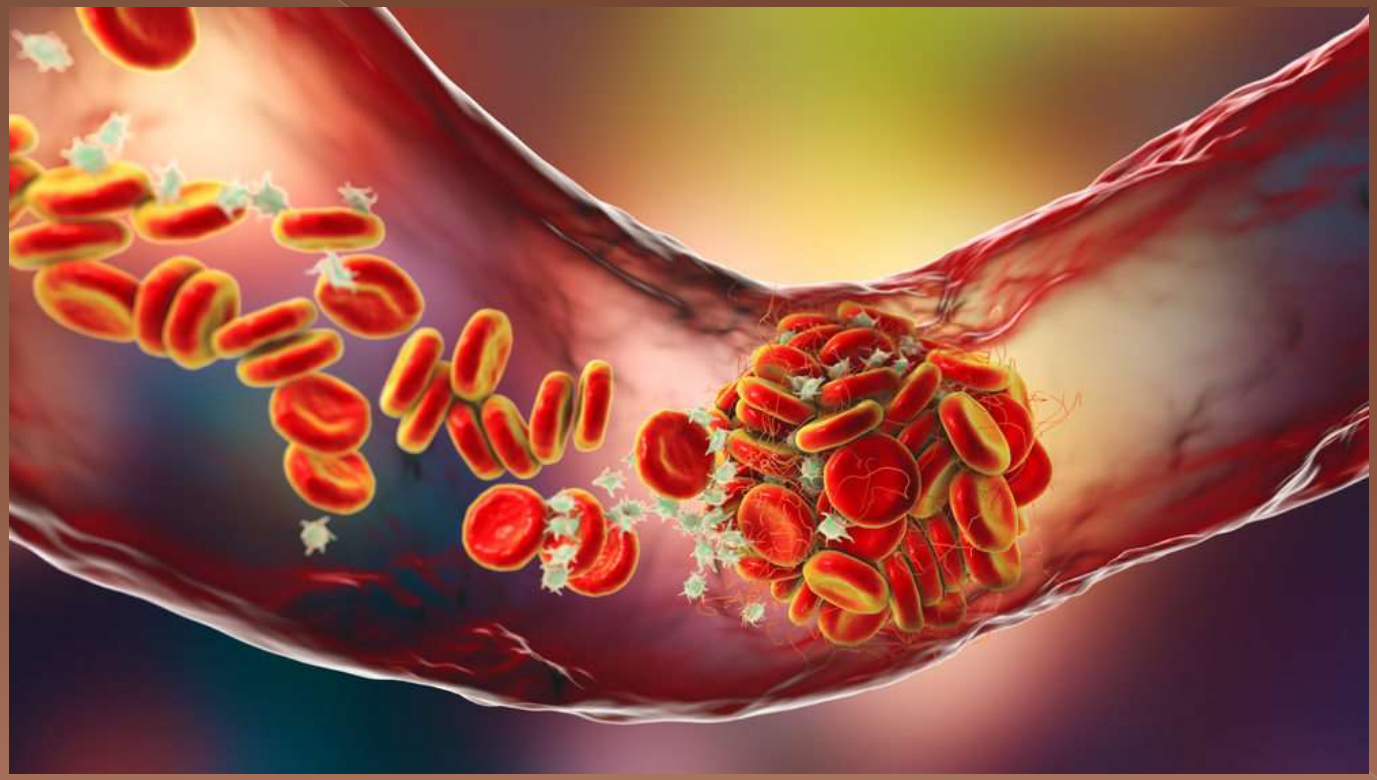
# EMBOLISM



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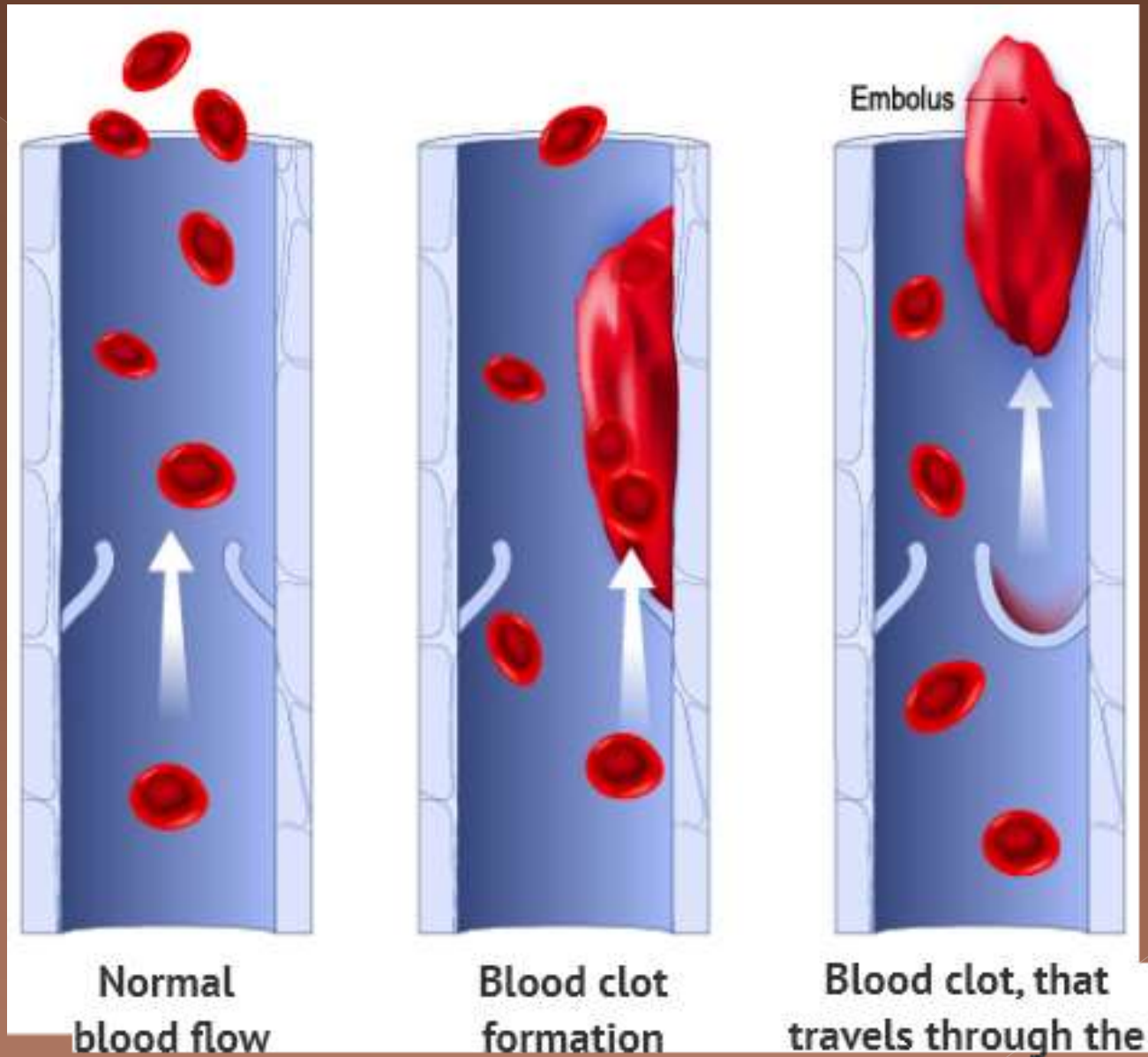
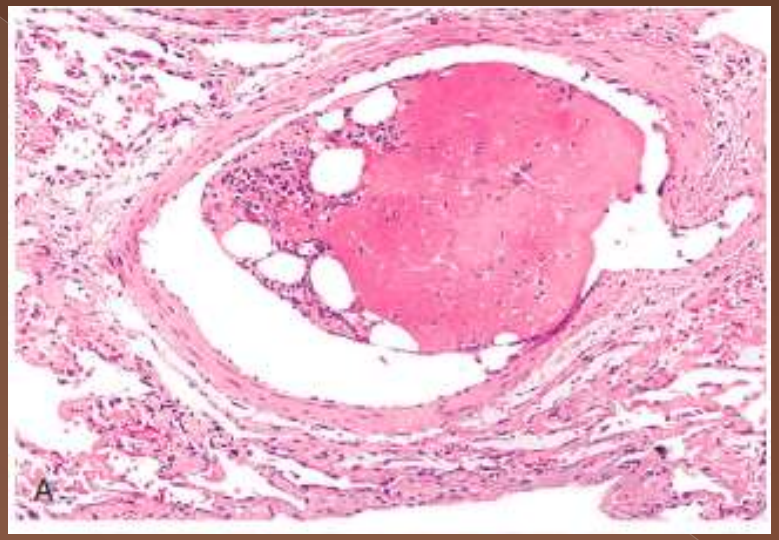
# EMBOLISM

- An embolus is a detached intravascular mass that is carried by the blood from its point of origin to a distant site, where it often causes tissue dysfunction or infarction.

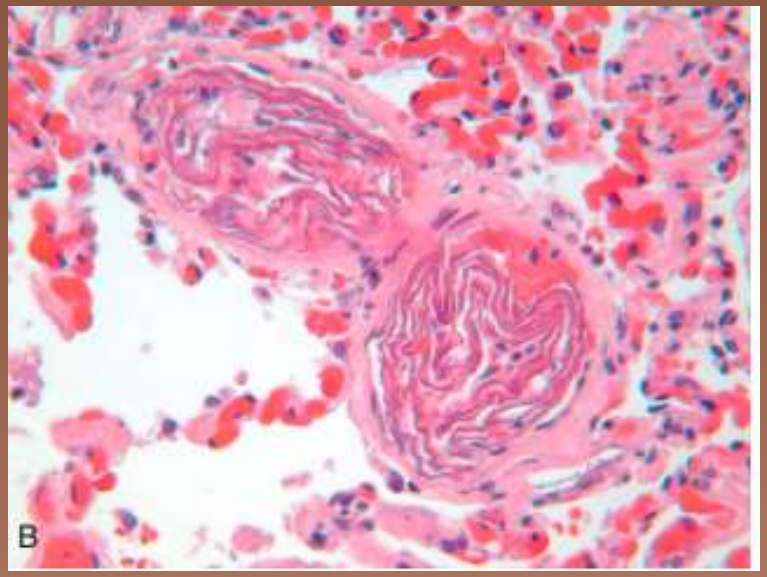
- This mass may be:
  - Solid.
  - Liquid.
  - Gaseous.

- The vast majority of emboli derive from a dislodged thrombus—hence the term thromboembolism.


Embolus
Normal blood flow
Blood clot formation
Blood clot, that travels through the




Bone marrow embolus



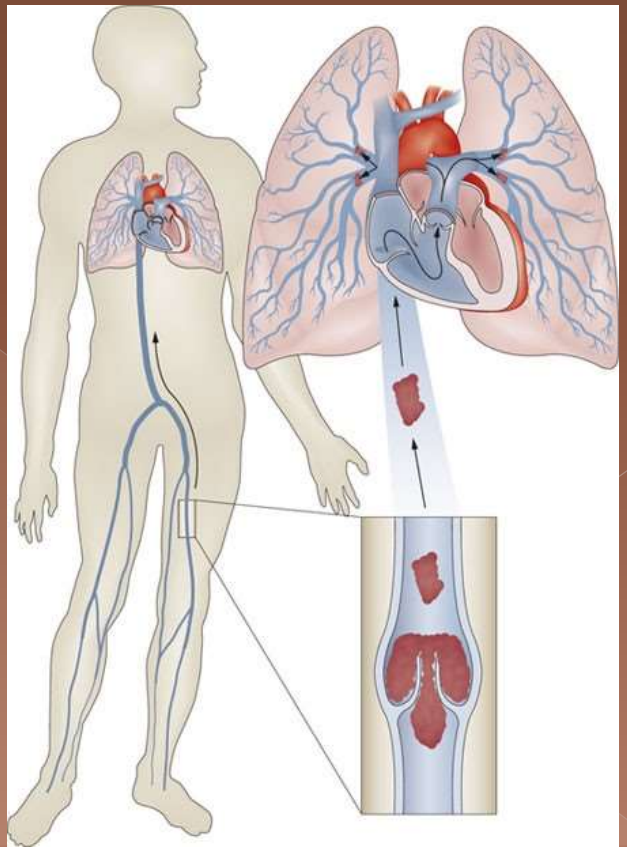

Amniotic fluid emboli

- The primary consequence of systemic embolization is ischemic necrosis (infarction) of downstream tissues.

- whereas embolization in the pulmonary circulation leads to hypoxia, hypotension, and right-sided heart failure

# 1. Pulmonary thromboembolism

- Originate from deep venous thromboses and are responsible for the most common form of thromboembolic disease.



- In more than 95% of cases, venous emboli originate from thrombi within deep leg veins proximal to the popliteal fossa; embolization from lower leg thrombi is uncommon.

Hotness

Redness

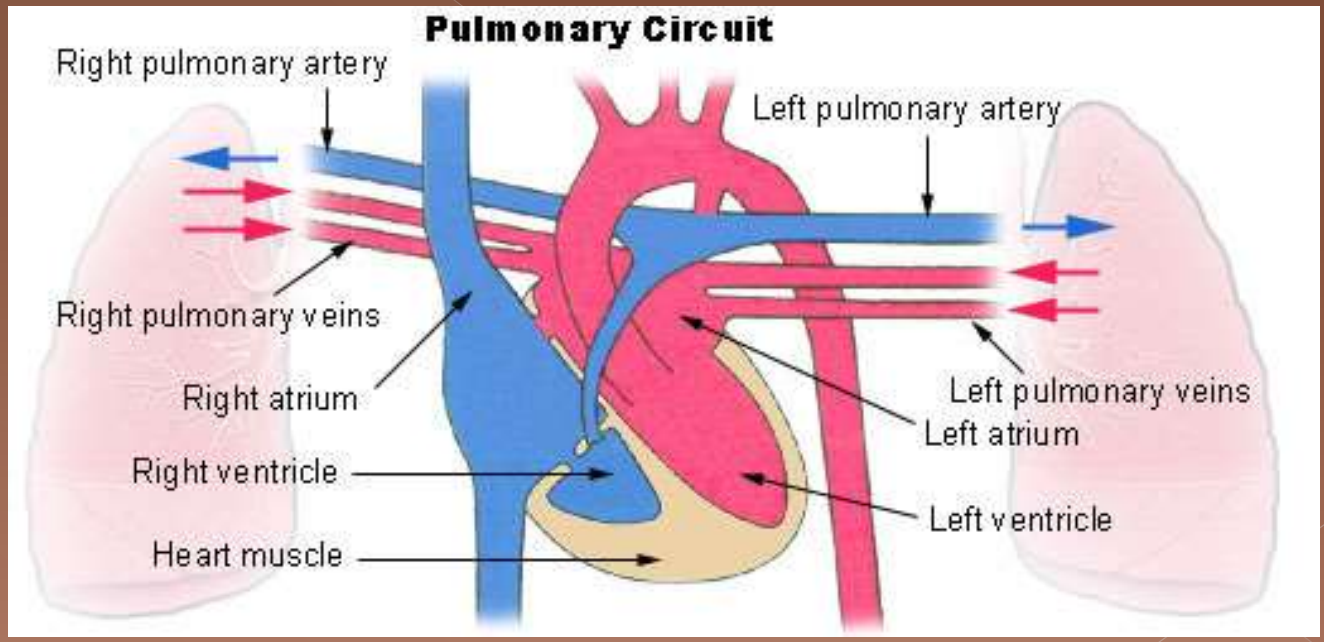
Tenderness

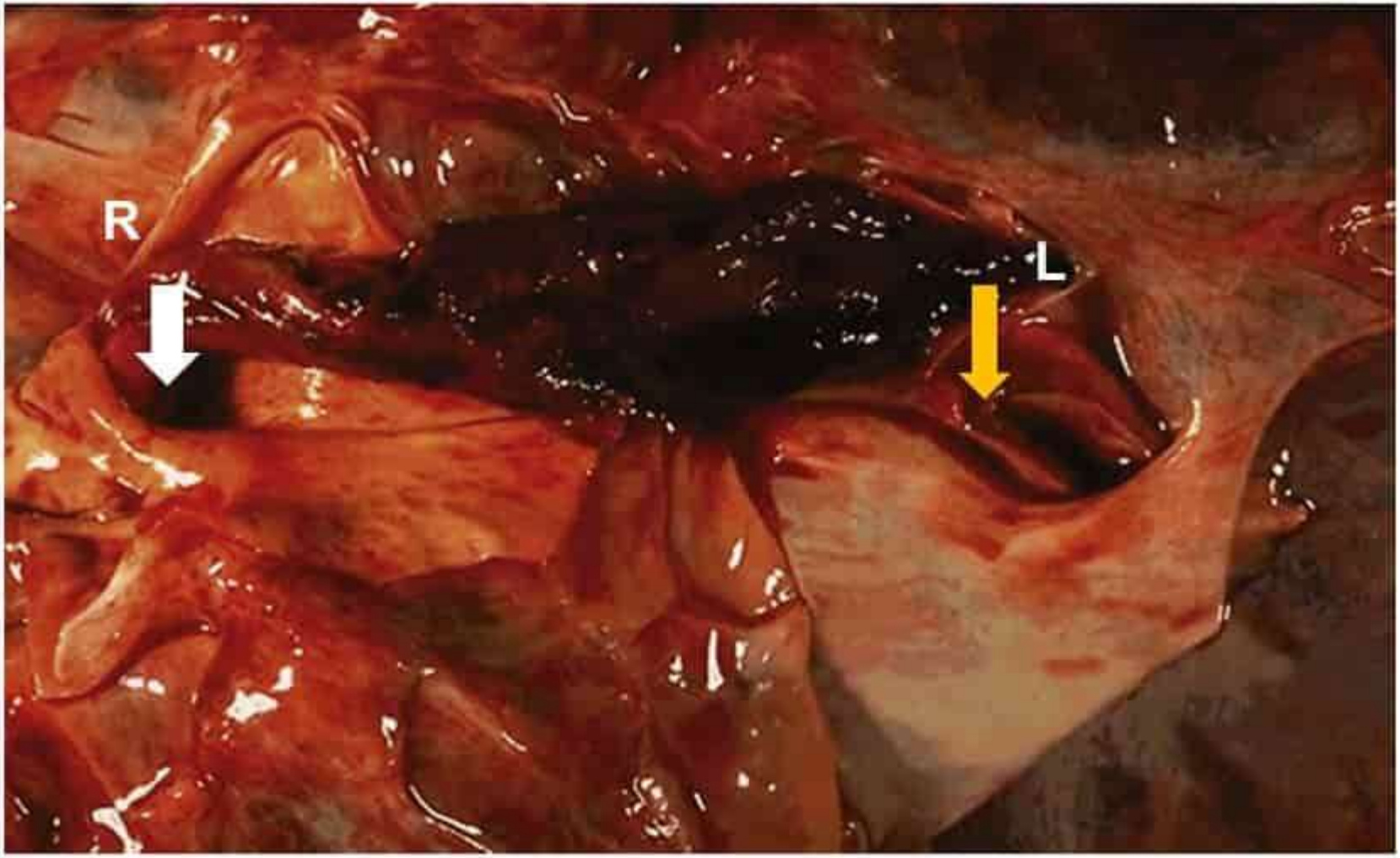
swelling

- Fragmented thrombi from DVT
- are carried through progressively larger venous channels
- pass through the right side of the heart
- arresting in the pulmonary vasculature.

## PE can occlude:

- the main pulmonary artery,
- lodge at the bifurcation of the right and left pulmonary arteries (saddle embolus),
- pass into the smaller, branching arterioles



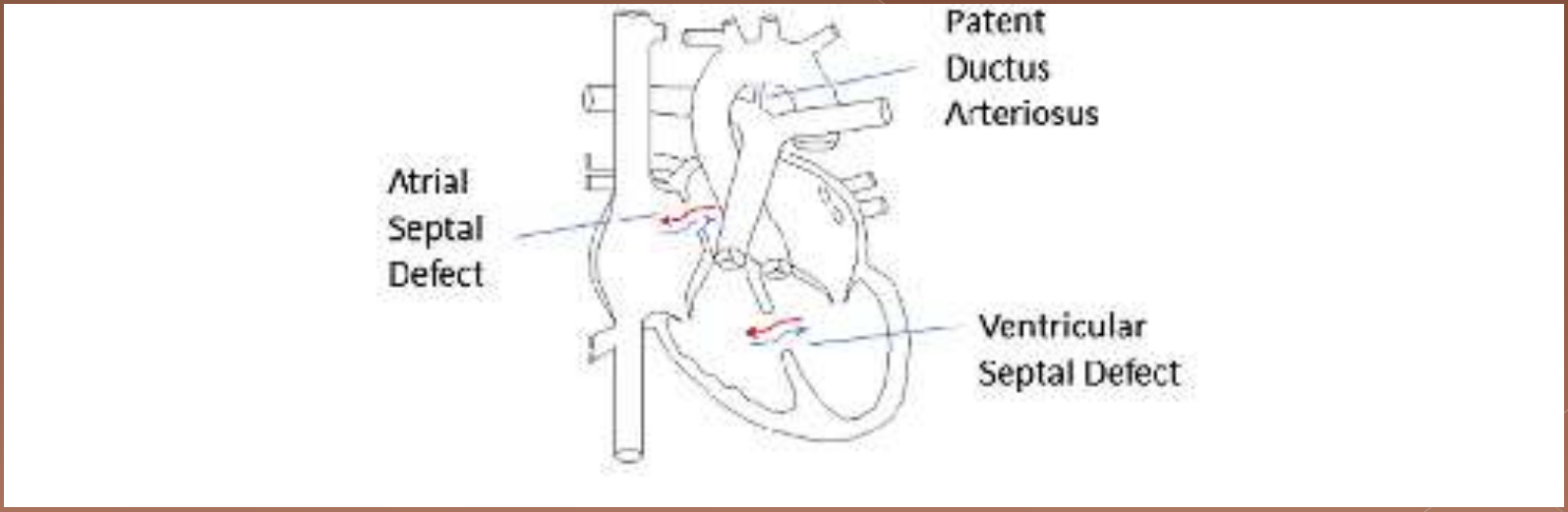



# Pulmonary embolism, gross;

A Saddle embolus that bridges the pulmonary artery trunk as it divides into right and left main pulmonary arteries.

- paradoxical embolism:

- an embolus passes through an atrial or ventricular defect and enters the systemic circulation.



# Fate of pulmonary embolism

- (60%–80%) of pulmonary emboli they undergo organization.
- a large embolus that blocks a major pulmonary artery can cause sudden death.
- Embolic obstruction of medium-sized arteries can cause pulmonary hemorrhage.#.....not pulmonary infarction?????
- Multiple emboli occurring through time can cause pulmonary hypertension and right ventricular failure (cor pulmonale).

# 2. Systemic thromboembolism

- Origin:

1.Intracardiac mural thrombi(80%).

2.Aortic aneurysms.

3.Thrombi overlying ulcerated atherosclerotic plaques.

4. Fragmented valvular vegetations .

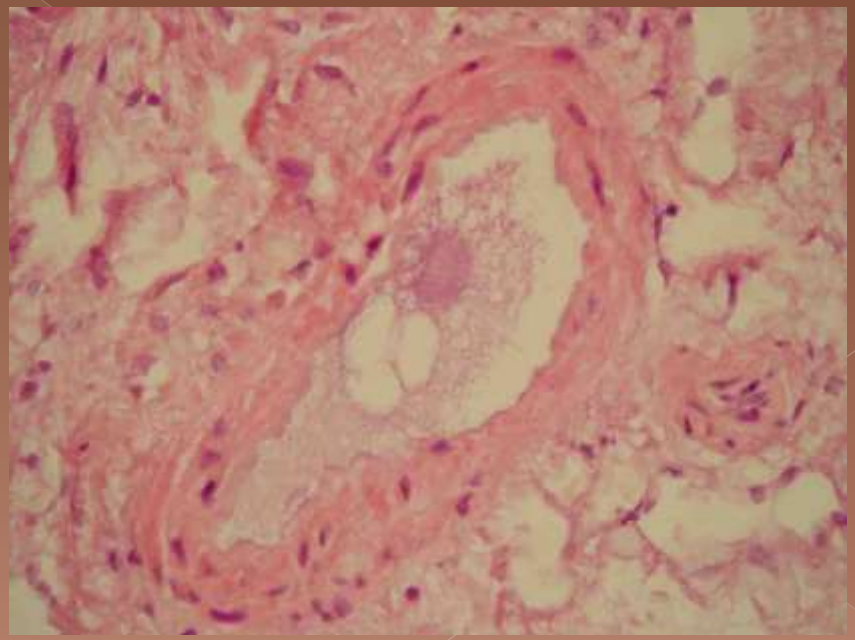
5.The venous system (paradoxical emboli).

- Common arteriolar embolization sites include:

- the lower extremities (75%).
- central nervous system (10%).
- intestines.
- Kidneys
- spleen

# 3. Fat Embolism

- Soft tissue crush injury or rupture of marrow vascular sinusoids (eg, due to a long bone fracture) release microscopic fat globules into the circulation.



# Fat embolism syndrome

- fat embolism syndrome characterized by:
  - pulmonary insufficiency.
  - neurologic symptoms.
  - anemia*
  - thrombocytopenia*
  - diffuse petechial rash*
- fatal in 10% of cases.
- Clinical signs and symptoms appear 1 to 3 days after injury.

# pathogenesis of fat emboli syndrome

- The pathogenesis of fat emboli syndrome involves:

- mechanical obstruction:
  * occlusion of pulmonary and cerebral microvasculature.

- biochemical injury:
  * triggering platelet aggregation.
  *fatty acid release from lipid globules, which causes local toxic endothelial injury.
  *granulocyte recruitment (with free radical, protease, and eicosanoid release)

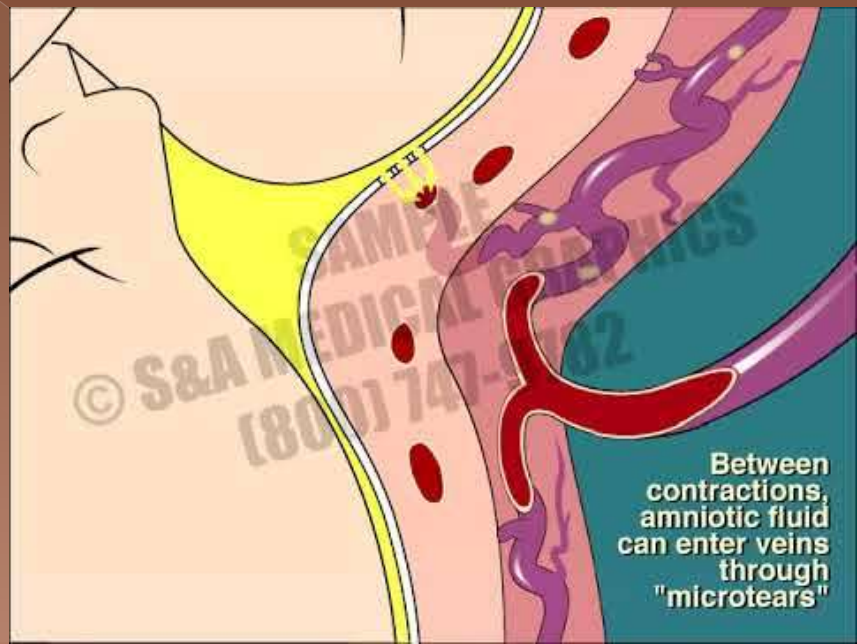
# 4. Amniotic Fluid Embolism

- Onset is characterized by:
  - sudden severe dyspnea.
  - cyanosis
  - hypotensive shock,
  - seizures and coma.

- If the patient survives the initial crisis, pulmonary edema typically develops, along with disseminated intravascular coagulation secondary to release of thrombogenic substances from amniotic fluid.

- mortality in such cases results from :

- mechanical obstruction of pulmonary vessels .
- biochemical activation of the coagulation system and the innate immune system caused by substances in the amniotic fluid



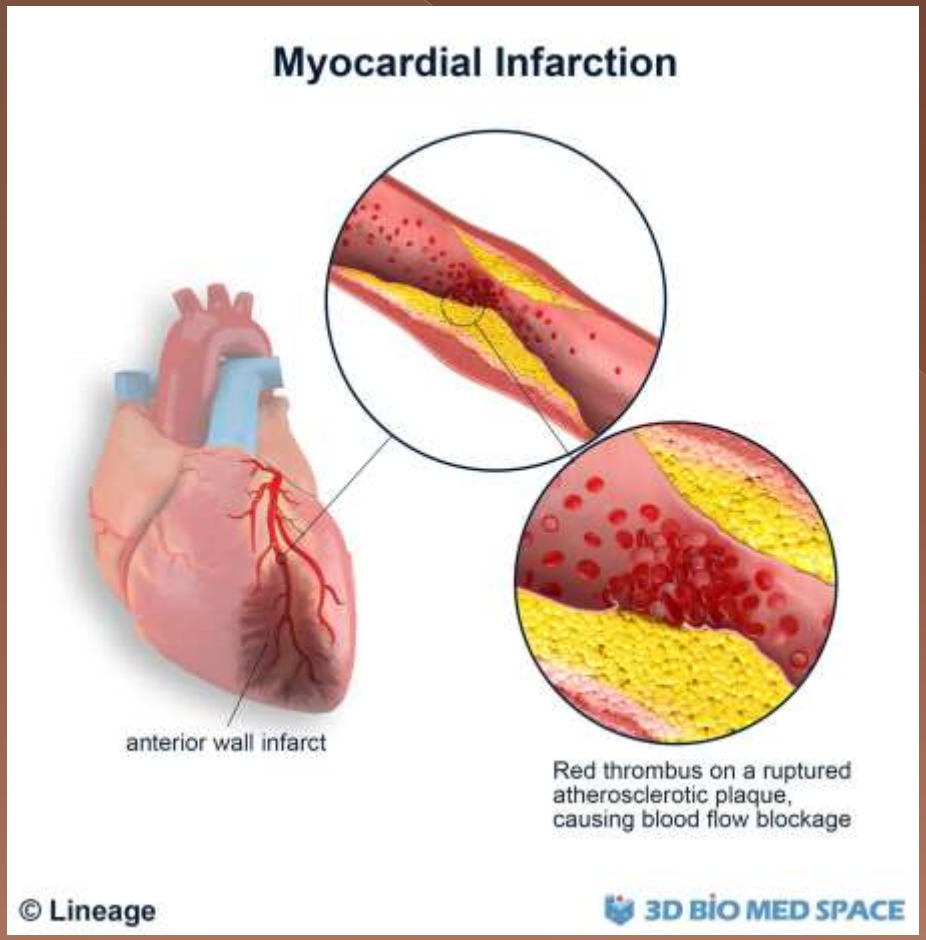
# 5. Air Embolism

- Gas bubbles within the circulation can coalesce and obstruct vascular flow and cause distal ischemic injury.

- Can occur during bypass surgery, laproscopic procedures, chest wall injury or introduced into the cerebral arterial circulation by neurosurgery.

- Gas bubbles in the pulmonary vasculature cause:
- edema.
- hemorrhages.
- focal atelectasis or emphysema.

- Bubbles in the central nervous system can cause mental impairment and even sudden onset of coma.


Myocardial Infarction
anterior wall infarct
Red thrombus on a ruptured atherosclerotic plaque, causing blood flow blockage
© Lineage
3D BIO MED SPACE

# INFARCTION

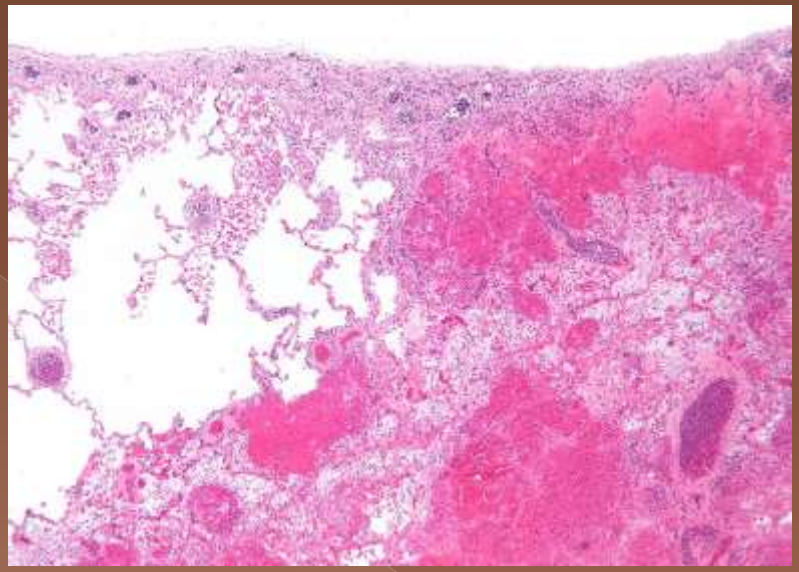
- An infarct is an area of ischemic necrosis caused by occlusion of the vascular supply to the affected tissue.
- Commonly affect heart and brain.
- Arterial thrombosis or arterial embolism underlies the vast majority of infarctions.

- Infarcts are classified based on:
- *their color
- (reflecting the amount of hemorrhage)
- may be either red (hemorrhagic) or white (anemic)

- *the presence or absence of microbial infection.
- may be either septic or bland.

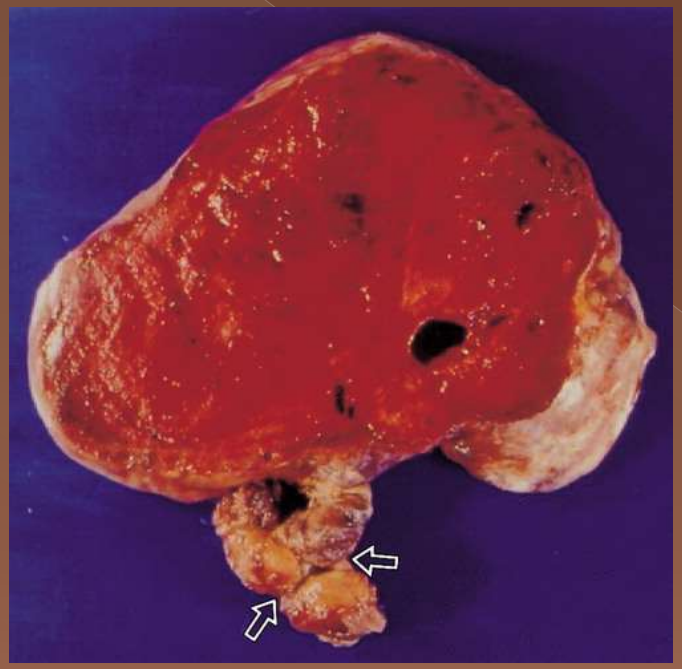
- Red infarcts occur :
- (1) in loose tissues (e.g., lung) where blood can collect in infarcted zones.

classic wedge-shaped infarct

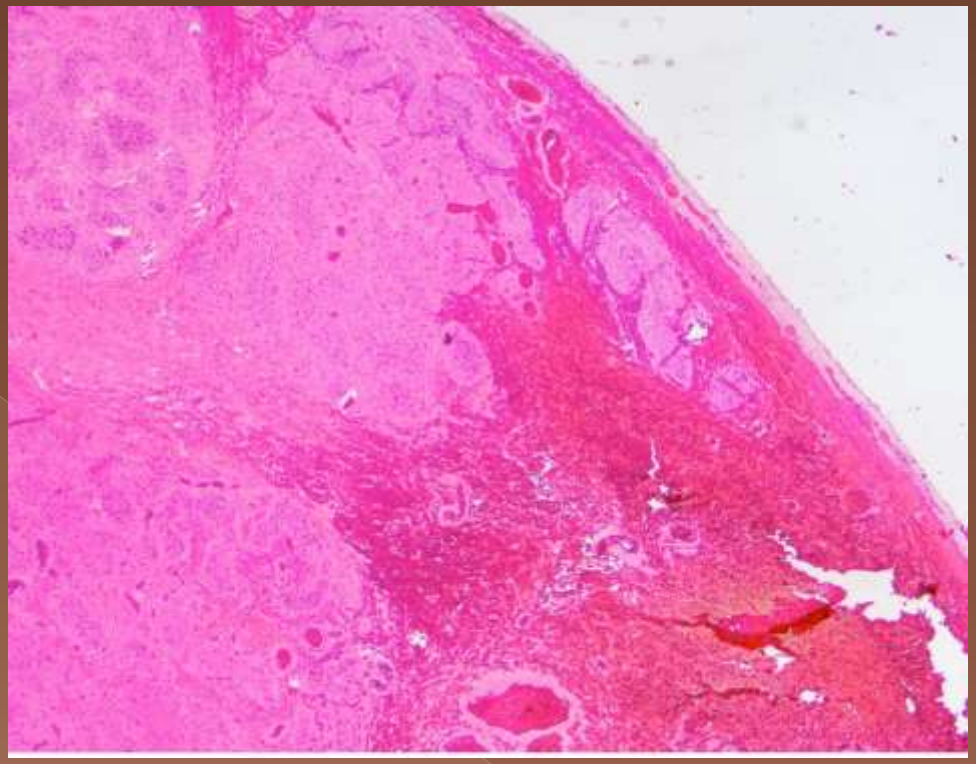


1.Necrosis of alveolar walls - loss of nuclei.
2.Alveolar hemorrhage.

- (2) as a result of venous occlusions (such as in ovarian torsion).



dark brown, ovarian mass with a twisted, thickened left fallopian tube (arrows).



Hemorrhage and necrosis

- (3) in tissues with dual circulations such as lung where partial, inadequate perfusion by collateral arterial supplies is typical.

- (4) in previously congested tissues (as a consequence of sluggish venous outflow).

- White infarcts
- occur with arterial occlusions in solid organs with end-arterial circulations (e.g., heart, spleen, and kidney),


(A) Hemorrhagic, roughly wedge-shaped pulmonary infarct (red infarct). (B) Sharply demarcated pale infarct in the spleen (white infarct)

# Factors That Influence Infarct Development

- 1. Anatomy of the vascular supply. The presence or absence of an alternative blood supply is the most important factor.

- Organ with the dual supply are resistant to infarction:
- Liver
- Lung
- hand and forearm.

- Organ with end-arterial circulation are more susceptible for infarction:
- Kidney
- spleen

- 2. Rate of occlusion

- 3. Tissue vulnerability to hypoxia.
  - Neurons undergo damage after 3 to 4 minutes.
  - Myocardial cells, die after 20 to 30 minutes.
  - fibroblasts within myocardium remain viable after many hours of ischemia.