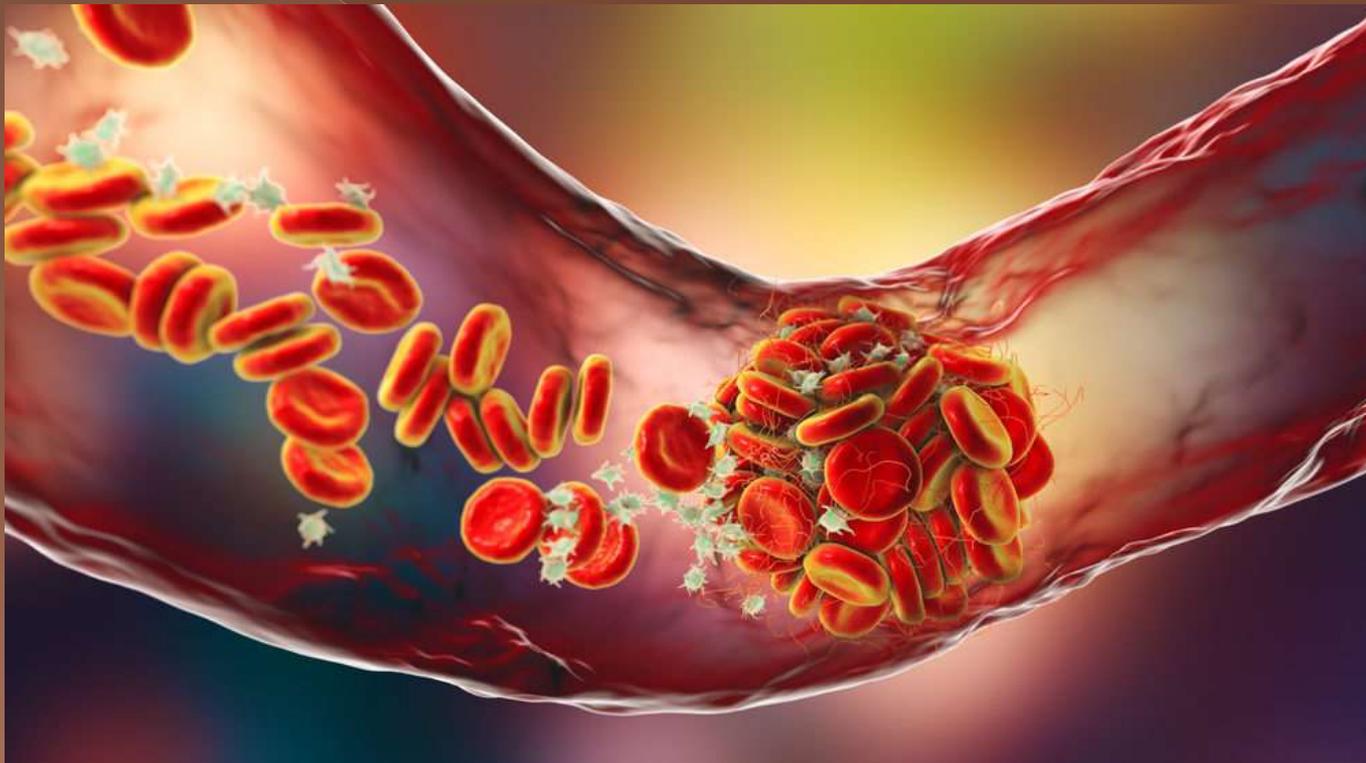


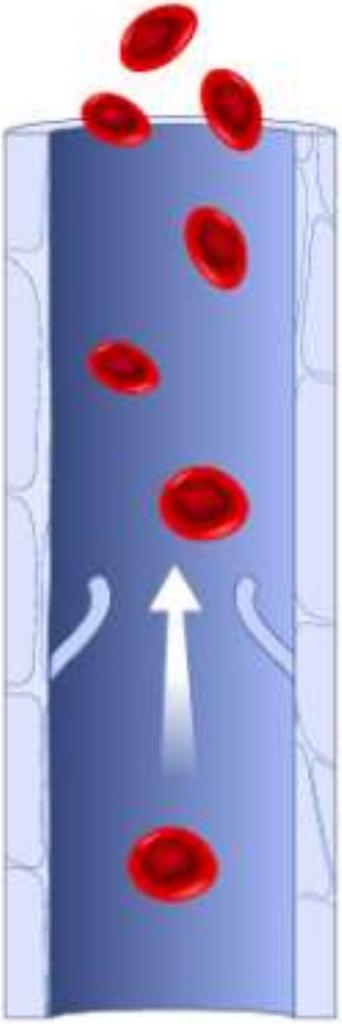
EMBOLISM



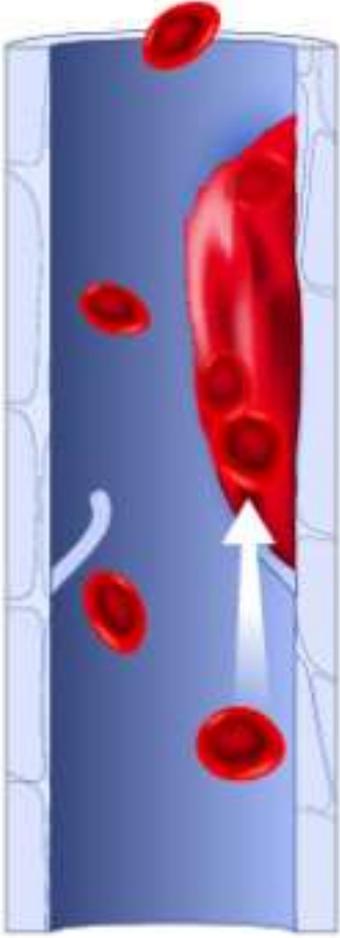
Dr.Eman Kreishan, M.D.
13-12-2023.

EMBOLISM

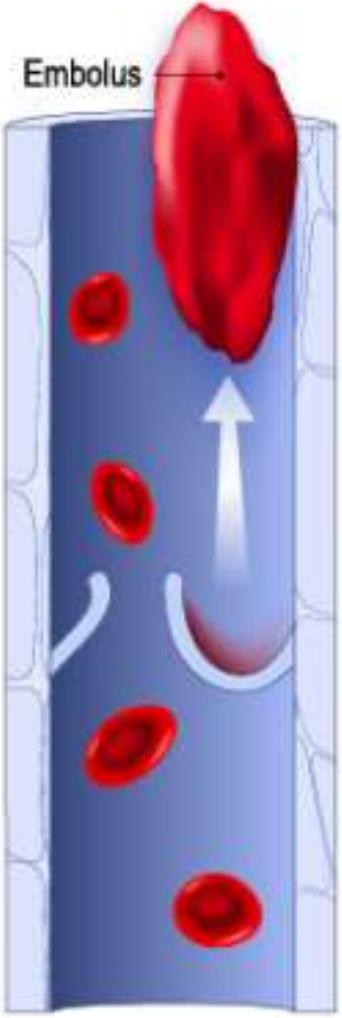
- ◉ An embolus is a detached intravascular mass that is carried by the blood from its point of origin to a distant site, where it often causes tissue dysfunction or infarction.
- ◉ This mass may be:
 - Solid.
 - Liquid.
 - Gaseous.
- ◉ The vast majority of emboli derive from a dislodged thrombus—hence the term thromboembolism.



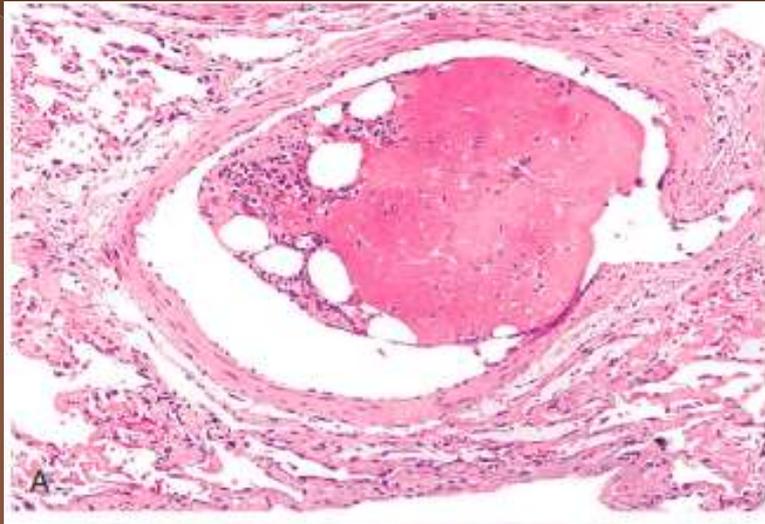
Normal
blood flow



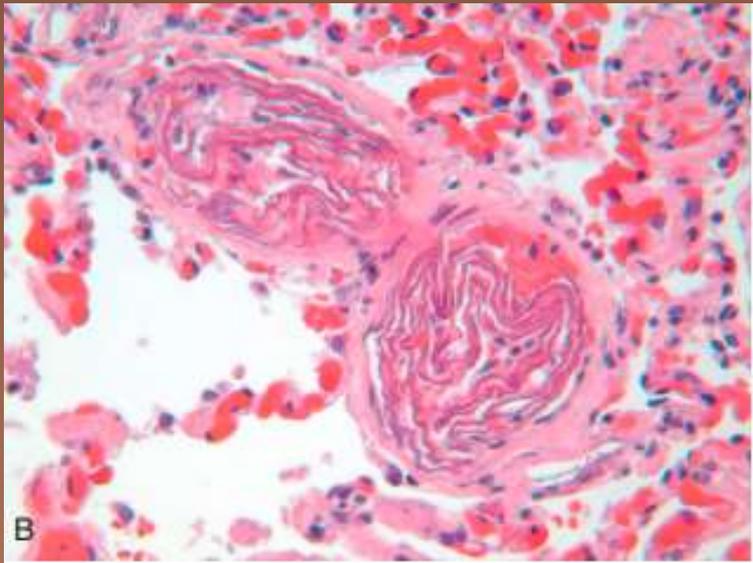
Blood clot
formation



Embolus
Blood clot, that
travels through the



Bone marrow embolus

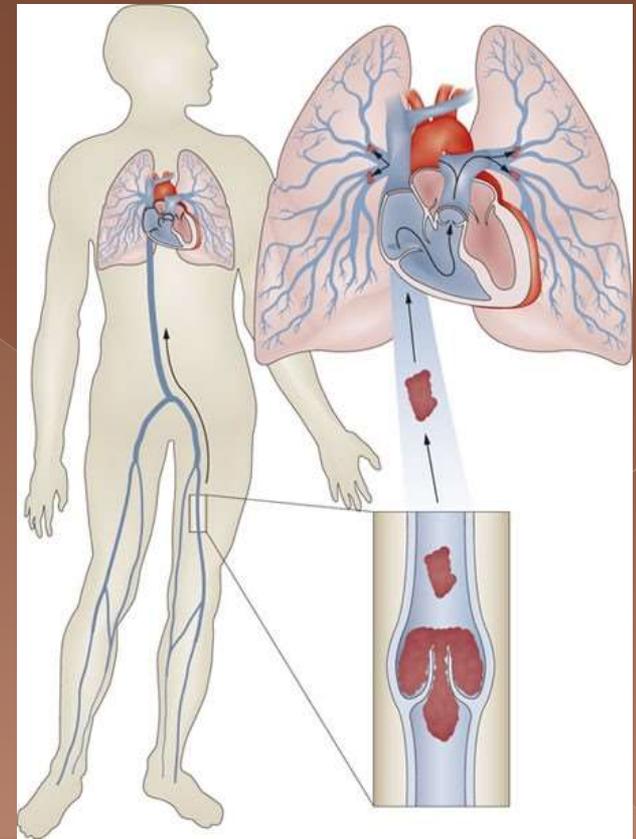


Amniotic fluid emboli

- 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



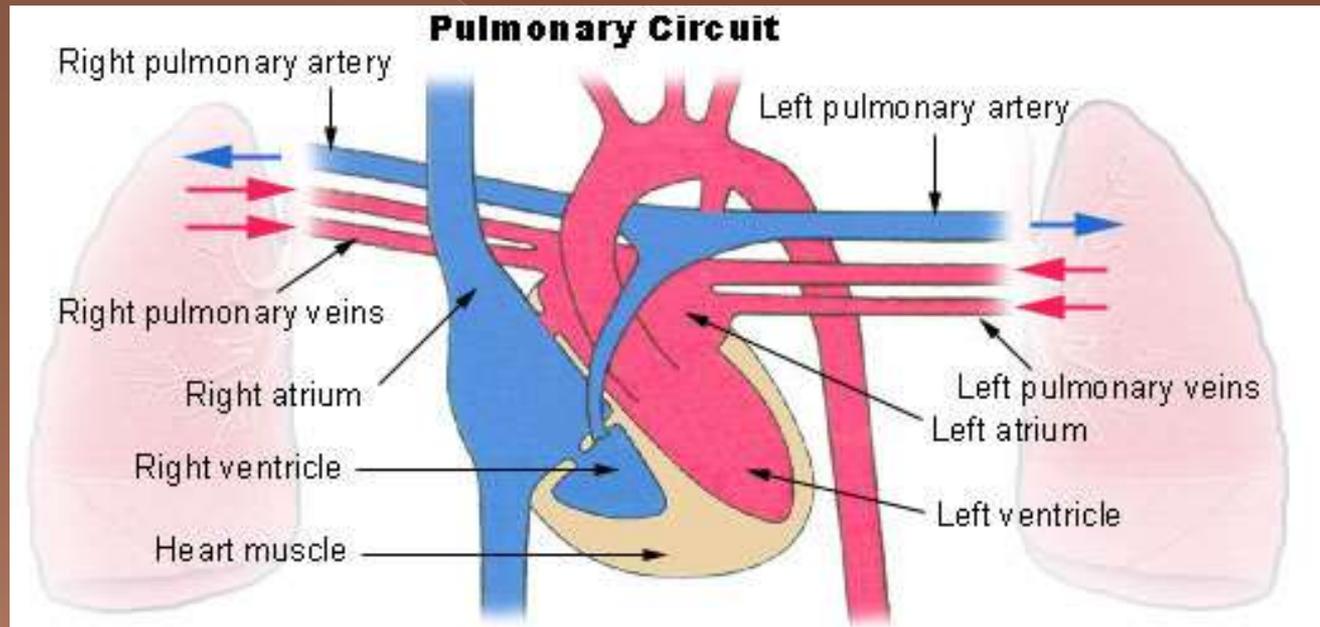
- pass through the right side of the heart

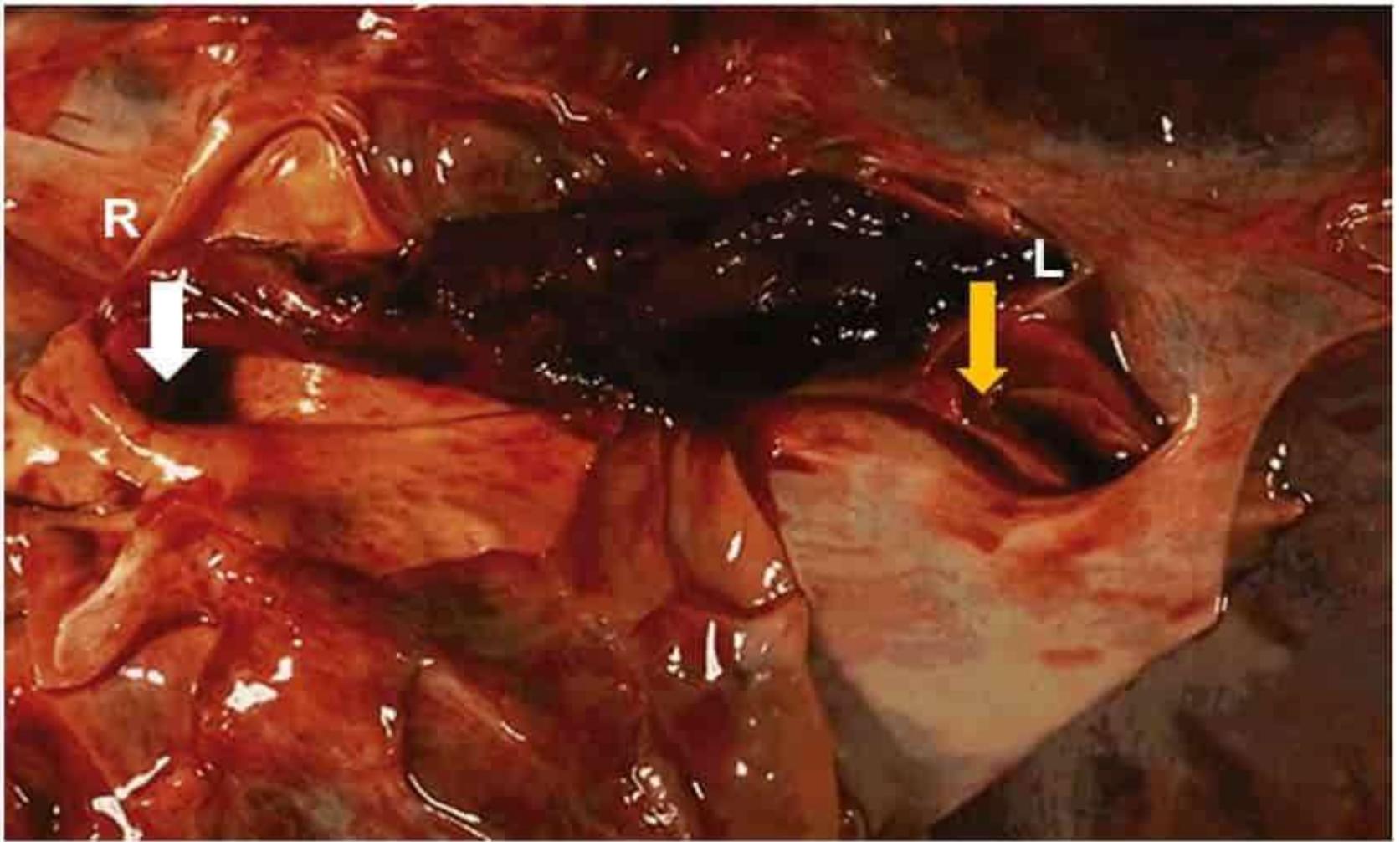


- arresting in the pulmonary vasculature.

◎ 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



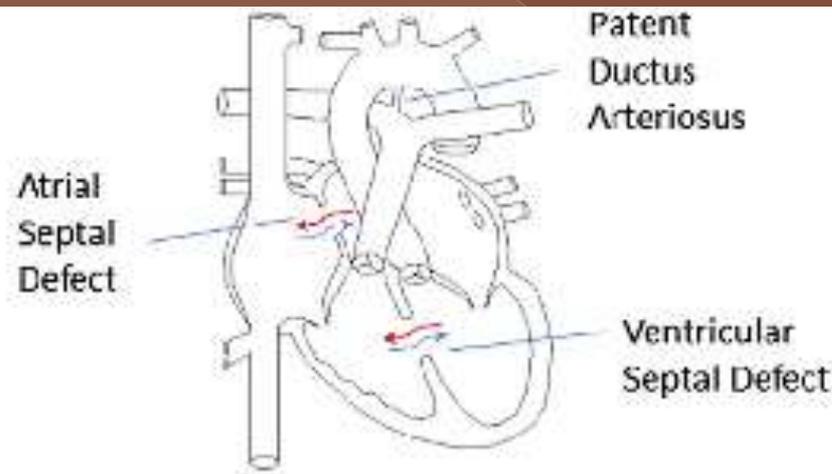


Pulmonary embolism, gross;

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:

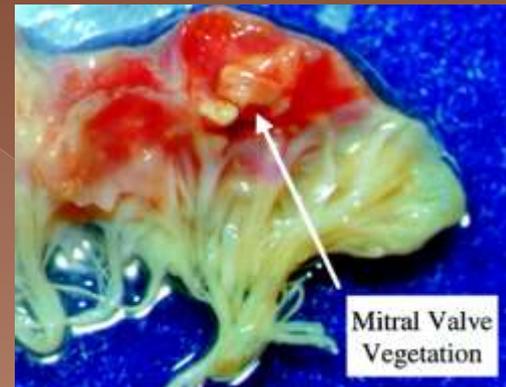
1. Intracardiac mural thrombi (80%).

2. Aortic aneurysms.

3. Thrombi overlying ulcerated atherosclerotic plaques.

4. Fragmented valvular vegetations .

5. The venous system (paradoxical emboli).

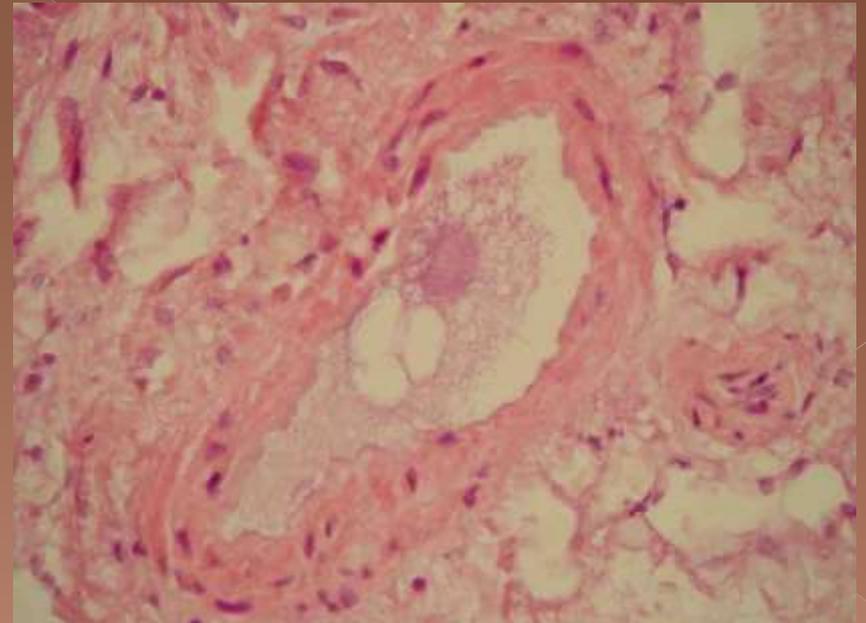


○ Common arteriolar embolization sites include:

- 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.

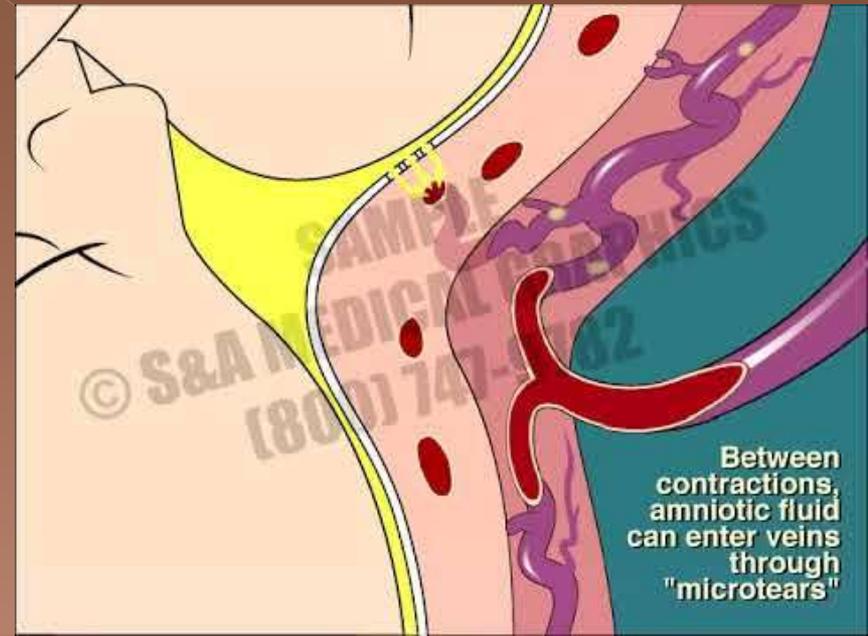
pathogenesis of fat emboli syndrome

- 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

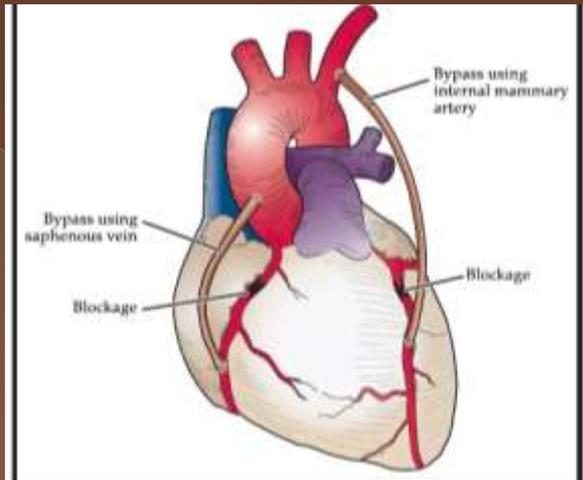
- Onset is characterized by:
 - sudden severe dyspnea.
 - cyanosis
 - hypotensive shock,
 - seizures and coma.
- If the patient survives the initial crisis, pulmonary edema typically develops, along with disseminated intravascular coagulation secondary to release of thrombogenic substances from amniotic 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.
 - introduced into the cerebral arterial circulation by neurosurgery.



bypass surgery



laparoscopic procedures

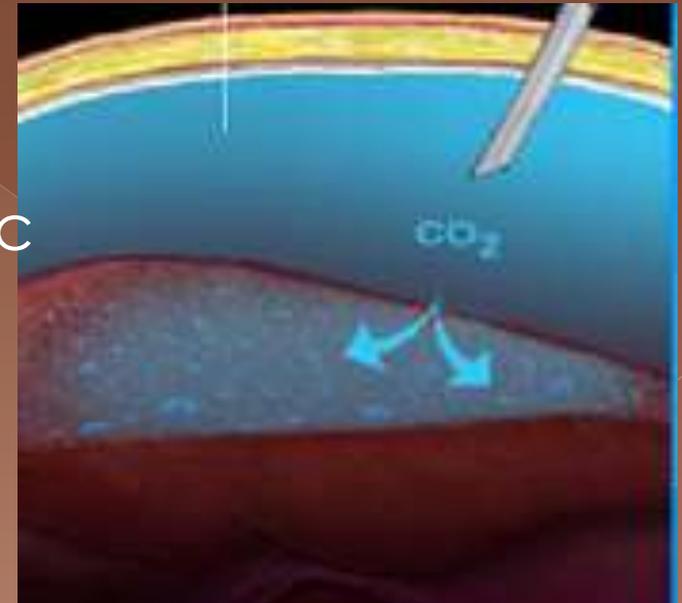
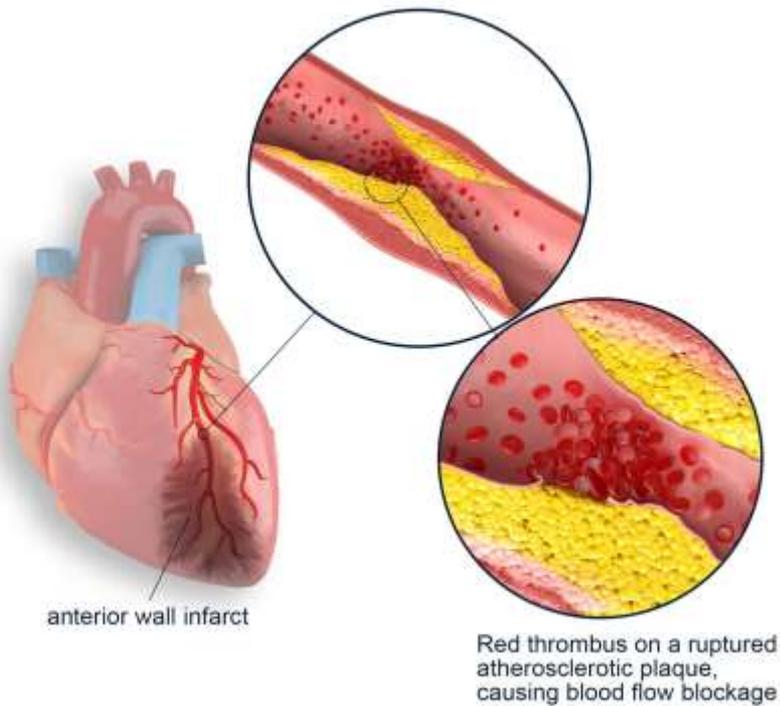


Figure 1: Conventional laparoscopic cholecystectomy being carried

- ◉ 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



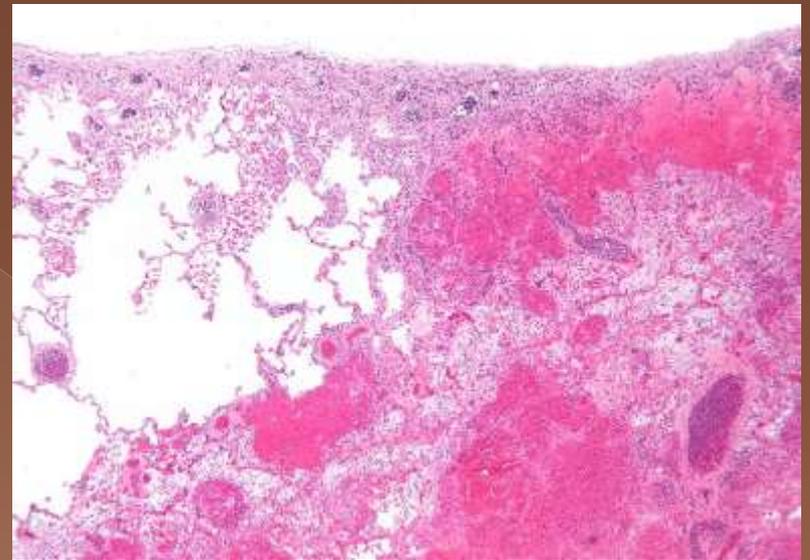
INFARCTION

- 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.



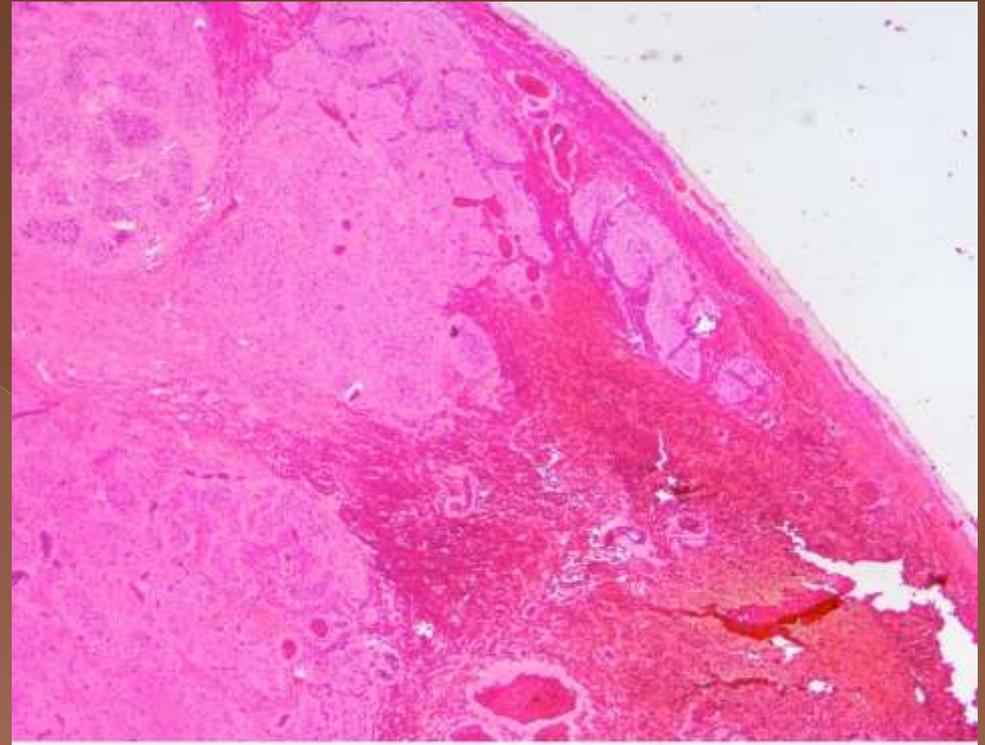
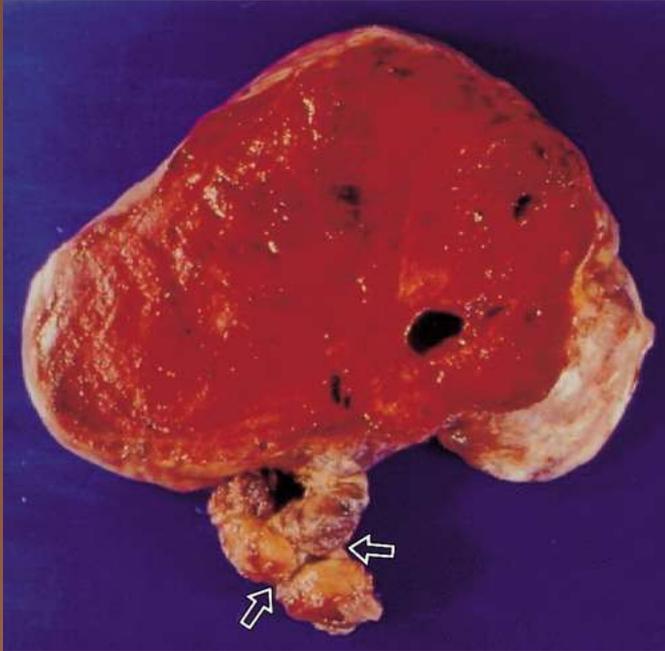
- Red infarcts occur :
- (1) in loose tissues (e.g., lung) where blood can collect in infarcted zones.



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

classic wedge-shaped infarct

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

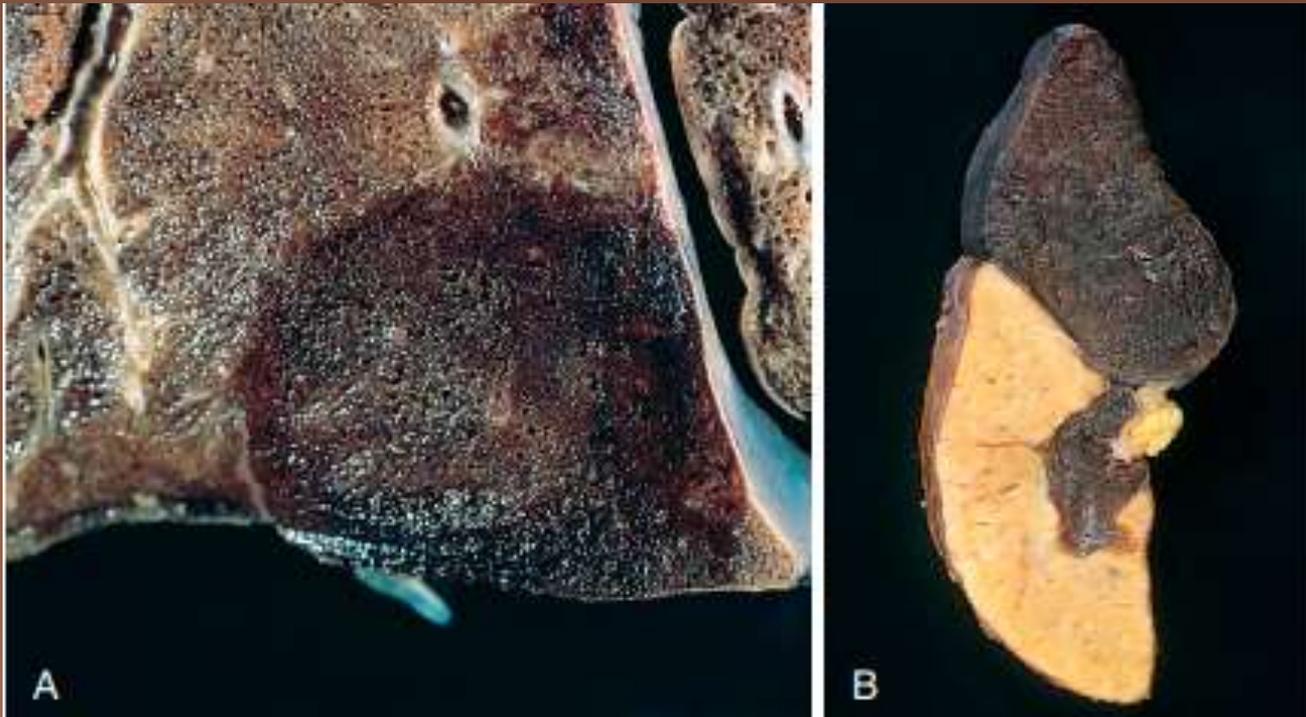


dark brown, ovarian mass with a twisted, thickened left fallopian tube (arrows).

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.