

third lecture

Hemodynamic Disorders

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M.B.Ch.B FICMS- Pathology
(Hematology)

homeostasis and Hemodynamic disorders

Learning objectives

After studying this subject you should confidently able to :

1. Understanding pathogenesis of embolism.
2. Clinical consequences of embolism.
3. Distinguish between Types of embolism .
4. Define and describe infarction ,its types, etiology, morphological changes and clinical effects .

EMBOLISM

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

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

Less commonly, emboli are composed of fat droplets, bubbles of air or nitrogen, atherosclerotic debris (cholesterol emboli), tumor fragments, bits of bone marrow, or amniotic fluid.

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

Pulmonary Thromboembolism

Pulmonary emboli originate from deep venous thrombosis and are responsible for the most common form of thromboembolic disease. The incidence of pulmonary embolism (PE) is 2 to 4 per 1000 hospitalized patients.

Although the rate of fatal PE has declined considerably since the early 1990s, PE still causes about 100,000 deaths per year in the United States. 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.

Fragmented thrombi from DVTs are carried through progressively larger channels and usually pass through the right side of the heart before arresting in the pulmonary vasculature. Depending on size, a PE can occlude the main pulmonary artery, lodge at the bifurcation of the right and left pulmonary arteries (saddle embolus), or pass into the smaller, branching arterioles.

the major clinical and pathologic features are the following:

- *Most pulmonary emboli (60%–80%) are small and clinically silent. With time, they undergo organization and become incorporated into the vascular wall.
- *At the other end of the spectrum, a large embolus that blocks a major pulmonary artery can cause sudden death.
- * Embolic obstruction of medium-sized arteries and subsequent rupture of downstream capillaries rendered anoxic can cause pulmonary hemorrhage. Such emboli do not usually cause pulmonary infarction because the area also receives blood through an intact bronchial circulation (dual circulation).
- *Embolism to small end-arteriolar pulmonary branches usually causes infarction.
- *Multiple emboli occurring through time can cause pulmonary hypertension and right ventricular failure (cor pulmonale).

Systemic Thromboembolism

Most systemic emboli (80%) arise from intracardiac mural thrombi; two-thirds of these are associated with left ventricular infarcts and another 25% with dilated left atria (secondary to mitral valve disease). The remainder originate from aortic aneurysms, thrombi overlying ulcerated atherosclerotic plaques, fragmented valvular vegetations, or from venous system (paradoxical emboli); 10% to 15% of systemic emboli are of unknown origin.

The consequences of embolization depend on the caliber of the occluded vessel, the collateral supply, and the affected tissue's vulnerability to anoxia; arterial emboli often lodge in end arteries and cause infarction.

There are many types of emboli:

1. Thrombo-embolism (most common type)
2. Fat embolism.
3. Gas embolism (air, nitrogen).
4. Amniotic fluid embolism.
5. Atherosclerotic embolism.
6. Tumor embolism (fragments of tumor).
7. Bone marrow embolism.
8. Foreign body emboli as bullets.

Fat embolism

Soft tissue crush injury or rupture of marrow vascular sinusoids (due to a long bone fracture) release microscopic fat globules into the circulation. Fat and marrow emboli are common incidental findings after vigorous cardiopulmonary resuscitation but probably are of little clinical significance. Similarly, although fat and marrow embolism occurs in some 90% of individuals with severe skeletal injuries , less than 10% show any clinical findings.

Air Embolism

Gas bubbles within the circulation can coalesce and obstruct vascular flow and cause distal ischemic injury. Thus, a small volume of air trapped in a coronary artery during bypass surgery or introduced into the cerebral arterial circulation by neurosurgery performed in an upright "sitting position" can occlude blood flow .

A particular form of gas embolism called **decompression sickness** is caused by sudden changes in atmospheric pressure.

When air is breathed at high pressure (during a deep sea dive), increased amounts of gas (particularly nitrogen) become dissolved in the blood and tissues.

If the diver then ascends (depressurizes) too rapidly, the nitrogen expands in the tissues and bubbles out of solution in the blood to form gas emboli, which cause tissue ischemia.

Amniotic fluid embolism

Amniotic fluid embolism is an uncommon, complication of labor and the immediate postpartum period occurring in 1 in 40,000 deliveries. The mortality rate approaches 80%, making it the most common cause of maternal death in the developed world.

Onset is characterized by sudden severe dyspnea, cyanosis, and hypotensive shock, followed by seizures and coma. If the patient survives the initial crisis, pulmonary edema typically develops, along with (in about half the patients) disseminated intravascular coagulation secondary to release of thrombogenic substances from amniotic fluid.

Infarction

An infarct is an area of ischemic necrosis caused by occlusion of the vascular supply to the affected tissue.

Infarction affecting the heart and the brain is a common and extremely important cause of clinical illness. Roughly 40% of all deaths are a consequence of cardiovascular disease, with most of these deaths result from myocardial or cerebral infarction.

Pulmonary infarction is a common clinical complication, bowel infarction often is fatal, and ischemic necrosis of distal extremities (gangrene) causes morbidity in the diabetic population.

Infarction

Causes, include:

Thrombosis or embolism (most common).

Less common causes:

1. Local vasospasm.
2. Expansion of atheroma due to hemorrhage in plaque
3. Extrinsic compression of a vessel e.g. tumor.
4. Traumatic rupture of blood supply.
5. vessel twisting (e.g., in testicular torsion or bowel volvulus)
6. entrapment in a hernia sac

Infarction

Although venous thrombosis can cause infarction, the more common outcome is simply congestion; typically, bypass channels rapidly open to provide sufficient outflow to restore the arterial inflow.

Infarcts caused by venous thrombosis thus usually occur only in organs with a single efferent vein (e.g., testis or ovary).