

Hemodynamic Disorders

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LEC 3

Clinical correlations of venous & arterial thrombosis:

1. Arterial & cardiac thrombosis:

- M.I, Rheumatic fever & atherosclerosis are the commonest causes of mural thrombus in the cardiac chambers & arterial thrombi.
- Such mural thrombi cause obstructive effects & also act as source of emboli.

2. Venous thrombosis:

Most of venous thrombi occur in either superficial or deep veins of leg.

Superficial venous thrombi are usually occurring in the saphenous veins (varicose veins) which result in followings:

- 1- local congestion, swelling, pain & tenderness along the course of involved vein,
- 2- Rarely embolization.
- 3- Predisposing to infection & ulceration of overlying skin (varicose ulcers).

Deep venous thrombi:

Occur in large leg veins at or above the level of knee joint (popliteal, femoral, & iliac veins).

These thrombi are more serious than superficial because more risk of pulmonary embolization.

Risk conditions for deep venous thrombosis (DVT):

1. Cardiac failure (cause stasis..... DVT).
2. Trauma, surgery, & burns (reduced physical activity, injury to blood vessels, & release prothrombotic factors & decrease antithrombotic factors..... DVT).
3. Long plane flights or car travel (produce stasis like condition..... DVT).
4. Late pregnancy & postpartum period (hypercoagulability state).
5. Disseminated cancer (tumor release thrombotic factors).

Embolism:

An embolus is a detached intravascular mass that is carried by blood to a site distant from point of origin. 90% is thrombotic.

Types of emboli according to the constituents:

1. Solid
2. Liquid
3. Gaseous

Solid emboli: (examples of solid emboli)

1. Fragments detached from a thrombus, this is called thromboembolic phenomenon.
2. Fragments of an ulcerated atherosclerotic plaque.
3. fragments of tumor.
4. Droplets of fat.
5. Foreign body (bullet).

Fluid emboli:

E.g. Amniotic fluid embolus.

Gaseous emboli:

e.g. air embolism.

Clinical effects of embolism are divided according to the site where they are lodged into pulmonary & systemic thromboembolism.

Pulmonary thromboembolism:

- Incidence: 20-25/100,000 hospitalized patient.
- This is the most common preventable cause of death in hospitalized patients.
- 95% of cases are venous emboli originate from deep leg vein thrombus above the level of knee, then move to the right side of heart, then enter the pulmonary circulation.
- Other sites of origin of these emboli are (venous thrombi of pelvic, IVC and right side of heart)

The effect of pulmonary embolism depend on:

Size of embolus.

State of pulmonary circulation.

- 1- Obstruction of pulmonary trunk or both of its branches (saddle shape embolus) lead to acute heart failure & asphyxia and death.
- 2- Obstruction of medium size arteries leading to pulmonary infarction (chest pain, dyspnea & hemoptysis).
- 3- Occlusion of small arteries will cause either:
 - * No symptoms if good state of cardiopulmonary circulation.
 - * Pulmonary hypertension if bad state of cardiopulmonary circulation.

Systemic thromboembolism:

- Refers to emboli traveling within the arterial circulation.
- 80% arise from intracardiac mural thrombi (complications of myocardial infarction, mitral stenosis).
- Other causes are ulcerated atherosclerotic lesion, aortic aneurysm.
- Few cases are due to paradoxical emboli (emboli travel from right side of heart to the left side through an opening within the heart wall (ventricular septal defect).

Sites: (where did these emboli are settled?)

- Lower limbs in 75%, brain 10%, lesser extent are intestine, kidneys & spleen.
- Effects of emboli at these sites depend on collateral circulation in those organs, caliber of involved vessels, tissue sensitivity to ischemia (brain is more sensitive than intestine).
- The dangerous effect of arterial embolism is infarction of involved organs

Fat embolism:

It means presence of microscopic fat globules in the circulation.

Causes:

1. Fracture of long bones (injury to the fatty marrow).
 2. Injury to the adipose tissue; like in Burn, Fatty liver & acute pancreatitis.
- Only less than 10% of patient show clinical features.

Pathogenesis:

- 1-Fat microemboli cause occlusion of cerebral & pulmonary microvasculature (mechanical obstruction).
- 2- Free fatty acids released from fat globules leading to local toxic injury to endothelium (chemical injury).

Clinical features:

Characterized by pulmonary insufficiency, neurological symptoms, anemia, & thrombocytopenia & is fatal in about 10% of cases.

Symptoms start within 1 to 3days after injury .

Air Embolism

It means the presence of air bubbles in the circulation.

Causes:

1. neck wounds
2. cardiothoracic injury
3. venous or arterial catheterization
4. caisson syndrome (Effects of the formation of gas bubbles in the body because of rapid transition from a high-pressure environment to one of lower pressure , pilots and divers are highly susceptible to this sickness because their activities subject them to pressures different from the normal atmospheric pressure.)

Outcome (results):

- Small volume of air is harmless
- 100 ml willacute distress
- 300 ml will be fatal.

Amniotic Fluid Embolism

It is a rare obstetrical complication with a mortality rate of 80%, it is unpredictable, unpreventable event.

Signs and symptoms:

Dyspnea , cyanosis, shock, convulsions , coma.

Pathogenesis:

Underlying causes are:

1. Presence of fetal epithelial cells and fat (vernix caseosa) in the maternal pulmonary circulation.
2. Presence of mechanical obstruction within the maternal pulmonary circulation.
3. Presence of thrombogenic factors which may → intravascular coagulation .

Ischemia:

Defined as **deficient blood supply to the tissue** which is either:

1. **Complete deficiency:** caused by obstruction by a thrombus or an embolus which → **infarction.**
2. **Partial deficiency:** caused by an atheroma or spasm which → **tissue damage and fibrous tissue formation.**

Tissue susceptibility to ischemia: depends on

1. Blood supply and collateral circulation.
2. Tissue metabolism.

1- Blood supply and collateral circulation:

- Tissue with **double blood supply resist ischemia** e.g liver, lung.
- Tissues that possess a **collateral circulation resist ischemia** e.g brain, lower limbs, and bowel.
- Organs that have **end arteries** are susceptible to ischemia e.g kidney, spleen , heart (coronaries are end arteries)

2- Tissue metabolism:

- **Supporting tissues:** as fibrous tissue, fatty tissue, cartilage and bone are less susceptible to ischemia because of their low metabolic rate.
- **Parenchymal tissue:** are so susceptible to ischemia because of their high metabolic rate e.g brain, heart.