

# Circulatory disturbances

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# Summary

- 1. Edema
- 2. Hyperemia and Congestion
- 3. Hemorrhage
- 4. Thrombosis
- 5. Embolism
- 6. Ischemia / Infarction

# 1. Edema

**Edema means increased ↑ fluid in the interstitium**

- cavities – hydrothorax, hydropericardium, ascites
- anasarca = severe generalized edema
- 3 major factors:
  - hydrostatic pressure
  - plasma colloid osmotic pressure
  - lymphatic drainage
- inflammation

# 1. Edema

- **1. increase  $\uparrow$  hydrostatic pressure**
  - impaired venous return
    - congestive heart failure
    - constrictive pericarditis
  - liver cirrhosis – ascites
  - venous obstruction or compression
    - thrombosis
    - external pressure

# 1. Edema

- **2. Decrease ↓ Plasma colloid osmotic pressure**
- loss or reduced albumin synthesis
  - nephrotic syndrome
  - protein-losing gastroenteropathy
  - liver cirrhosis
  - malnutrition

# 1. Edema

- **3. lymphatic obstruction**

- → lymphedema

- inflammatory → elephantiasis

- Filariasis - *Wuchereria bancrofti*

- Erysipelas – *Streptococcus pyogenes*

- neoplastic – breast carcinoma (orange peel skin)

- post-surgical (LN resection) + postirradiation

# 1. Edema

- subcutaneous tissue (pitting edema) + cavities
- generalized x locally prominent
- right-sided heart failure – lower limbs
- left-sided heart failure - pulmonary edema
- nephrotic syndrome – periorbital edema (eyelids)
- brain edema – localized x generalized.

## 2. Hyperemia and Congestion

**Hyperemia and congestion mean increased<sup>↑</sup> blood volume in particular tissue**

- **a. hyperemia – active (arteriolar dilation)**
  - red color
  - striated muscle exercise
- **b. congestion – passive (impaired venous return)**
  - systemic x local
  - blue-red color (cyanosis), edema
  - event. hypoxemic necrosis, e.g. bowel
  - accumulation of deoxygenated Hb
  - chronic → chronic hypoxia → regressive changes + small hemorrhages → siderophages



## 2. Hyperemia and Congestion

- pulmonary congestion
- acute
  - by blood fulfilled septal capillaries
  - septal + alveolar edema + small hemorrhages
- chronic
  - septa thickening → fibrosis (induration)
  - alveoli - siderophages (heart failure cells)

## 2. Hyperemia and Congestion

- liver congestion
- acute
  - by blood fulfilled central veins + sinusoids
- chronic – “nutmeg liver” – red-brown + fatty color
  - centrilobular necrosis + hemorrhage
  - periportal fatty change
  - in time - cardiac fibrosis
- bowel congestion
  - hemorrhagic necrosis

# 3. Hemorrhage

**Hemorrhage is the extravasation of blood from blood vessels**

- external (+ in hollow organs)
- internal: within tissue – hematoma
- hemorrhagic diatheses – insignificant injury
  - vasculopathies
  - thrombocytopenia + -patia
  - coagulopathy

# Hemorrhage is classified into four types (types of hemorrhage)

- **1. Petechiae** (1-2 mm) - skin + mucosa
- increase  $\uparrow$  intravascular pressure, decrease  $\downarrow$  platelets
- **2. Purpuras** (3-5 mm)
  - trauma, vasculitis, vascular fragility
- **3. Ecchymosis** (1-2 cm) = hematoma (bruise)
  - RBC phagocytosis by macrophages
  - Hb (red-blue)  $\rightarrow$  bilirubin (blue-green)  $\rightarrow$  hemosiderin (golden-brown)
- **4. According to the location in the Cavities**
  - hemothorax, hemopericardium, hemoperitoneum
  - hemarthros

# 3. Hemorrhage - sequelae

- 1. loss volume
  - > 20% → hemorrhagic shock
- 2. loss rate
  - acute → hemorrhagic shock
  - chronic (peptic ulcer, metrorrhagia, colonic adenoma)
    - iron deficiency anemia
- 3. site
  - subcutaneous x brain

# Disseminated Intravascular Coagulation (DIC)

- basis: widespread activation of thrombin
- Microscopically: fibrin thrombi in microcirculation
- 1. stage
  - multiple fibrin thrombi in microcirculation → consumption of PLT + coagulation proteins
- 2. stage
  - fibrinolytic system activation → serious bleeding

# DIC - causes

- 1. obstetric complications
  - septic abortion
- 2. infections
  - sepsis (Gram +, Gram- bacteria)
  - meningococemia
- 3. neoplasms
  - carcinomas of pancreas, prostate, lung, leukemias
- 4. tissue injury
  - burns

# 4. Thrombosis

**Thrombosis is means intravascular blood clotting**

- Causes:
- 1. endothelial injury
  - physical – hypertension, turbulence
  - chemical – hypercholesterolemia, smoking, vasculitis
- 2. alteration of blood flow
  - stasis – immobilization, cardiac chamber dilation
- 3. hypercoagulability
  - primary (genetic) x secondary
  - neoplasms, drugs



# Thrombosis can be classified into 2 types (types of thrombi)

- **1. Arterial thrombi**
- occlusive
- coronary + cerebral + femoral aa.
- upon AS plaque + bifurcation
- Grossly: gray-white, friable
- Microscopically: PLT + fibrin, RBC + WBC

# 4. Thrombosis

- **2. Venous thrombi (phlebothrombosis)**
- occlusive
- deep veins of LL + pelvic plexus
- Grossly: firm, red, attached to the wall
- Microscopically: RBC + fibrin
- !!! asymptomatic (50%) !!!

# Fate of thrombus

- **1. propagation**
- **2. embolization**
- **3. dissolution**
  - fibrinolysis (recent thrombi)
- **4. organization**
  - endothelial cells, smooth muscle cells, fibroblasts, capillaries
- **5. recanalization**
  - new small lumina

# 5. Embolism

**Embolism means detached intravenous solid, liquid, or gaseous mass carried by the blood to a distant site from point of origin.**

- 1. thromboembolism (99%)
  - pulmonary x systemic → infarction
- 2. fat
- 3. air
- 4. foreign bodies – catheter.
- The embolism has 2 types:
  - 1. pulmonary thromboembolism.
  - 2. systemic thromboembolism.

# 6. Ischemia / Infarction

**Ischemic necrosis due to occlusion of arterial supply or venous drainage.**

- **causes:**

- **thrombotic or embolic events (99%)**
- **vasospasm, hemorrhage in AS plaque**
- **external compression (tumor)**
- **twisting (testicular + ovarian torsion, bowel volvulus)**

# Infarction can be classified into 3 types (types of infarcts)

## ● 1. Red infarcts

- venous occlusion
- loose tissue (lung) – blood collection
- dual circulation – lung + bowel
- previously congested organs
- reperfusion (angioplasty, drug-induced thrombolysis)

## ● 2. White infarcts

- arterial occlusion
- solid organs – heart (yellow), spleen, kidney

### 3. Septic infarctions

- infective endocarditis (vegetations)
- suppurative thrombophlebitis
- infarction → abscess → granulation tissue  
→ scar

# 8. Shock

**Shock means systemic hypoperfusion due to a reduction of cardiac output / effective blood volume circulation**

- hypotension → cellular hypoxia
- features – hypotension, tachycardia, tachypnea, cool cyanotic skin (x septic s. – warm)
- initial threat + shock manifestations in organs
- prognosis
  - origin + duration



## Shock classified into 5 types (types of shock)

- **1. Cardiogenic shock:** failure of myocardial pump
  - myocardial infarction, arrhythmias
  - pulmonary embolism
- **2. Hypovolemic shock:** inadequate blood/plasma volume
  - hemorrhage
  - fluid loss (vomiting, diarrhea, burns, trauma)
- **3. Septic shock:** vasodilation + endothelial injury
  - Gram+, Gram-bacteria
- **4. Neurogenic shock:** loss of vascular tone
  - spinal cord injury
- **5. Anaphylactic shock:** as IgE-mediated hypersensitivity

- **Thank you**