Lec 7 Dr. Alya'a K.AL-Ghurabi

PhD. Oral Pathology

General pathology

HEMODYNAMIC DISORDERS

Edema is the result of the movement of fluid from the vasculature into the interstitial spaces; the fluid may be protein-poor (transudate) or protein-rich (exudate).

accumulation of fluid in tissues → edema

accumulation of fluid in body cavities → effusions

Edema may be caused by:

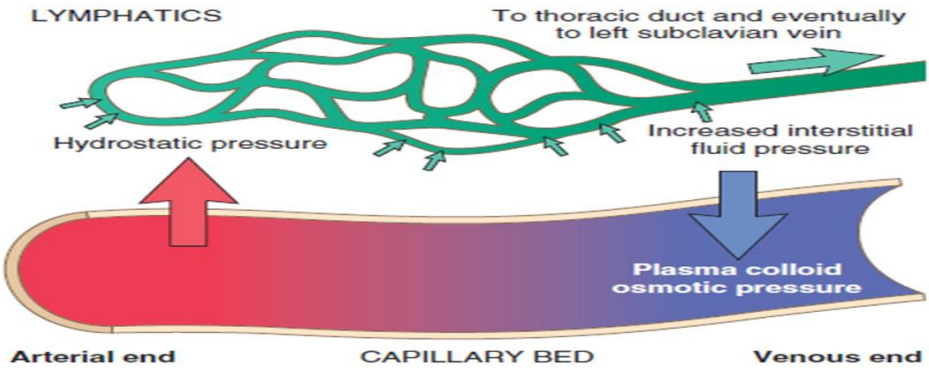
- **Increased hydrostatic pressure (e.g., heart failure)**
- **Decreased colloid osmotic pressure caused by reduced plasma albumin, either due to decreased synthesis (e.g., liver disease, protein malnutrition) or to increased loss (e.g., nephrotic syndrome)**
- **Increased vascular permeability (e.g., inflammation)**
- **Lymphatic obstruction (e.g., infection or neoplasia)**
- **Sodium and water retention (e.g., renal failure)**

Mechanisms of edema:

Under normal circumstances, the tendency of vascular hydrostatic pressure to push water and salts out of capillaries into the interstitial space is nearly balanced by the tendency of plasma colloid osmotic pressure to pull water and salts back into vessels. There is usually a small net

movement of fluid into the interstitium, but this drains into lymphatic vessels and ultimately returns to the bloodstream via the thoracic duct, keeping the tissues "dry".

Elevated hydrostatic pressure or diminished colloid osmotic pressure disrupts this balance and results in increased movement of fluid out of vessels. If the net rate of fluid movement exceeds the rate of lymphatic drainage, fluid accumulates. Within tissues the result is edema, and if a serosal surface is involved, fluid may accumulate within the adjacent body cavity as an effusion.



TYPES OF EDEMAS

1. **Inflammatory: Inflammation-related edema and effusions are protein-rich exudates accumulate due to increases in vascular permeability caused by inflammatory mediators.**
2. **Noninflammatory edema and effusions are protein-poor fluids called transudates. Noninflammatory edema and effusions are common in many disorders, including heart failure, liver failure, renal disease, and malnutrition.**

Increased Hydrostatic Pressure

Increases in hydrostatic pressure are mainly caused by disorders that impair venous return. If the impairment is *localized* (e.g., a deep venous thrombosis [DVT] in a lower extremity), then the resulting edema is confined to the affected part. Conditions leading to *systemic* increases in venous pressure (e.g., congestive heart failure) are understandably associated with more widespread edema.

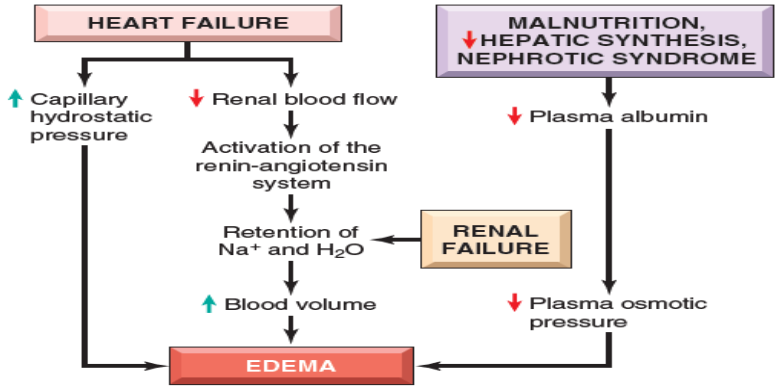


Figure 4.2 Mechanisms of systemic edema in heart failure, renal failure, malnutrition, hepatic failure, and nephrotic syndrome.

Reduced Plasma Osmotic Pressure

Under normal circumstances albumin accounts for almost half of the total plasma protein; it follows that conditions leading to *inadequate synthesis* or *increased loss of albumin* from the circulation.

1. Reduced albumin synthesis occurs mainly in severe liver diseases (e.g., end-stage cirrhosis) and protein malnutrition.

2.important cause of albumin loss is the nephrotic syndrome, in which albumin leaks into the urine through abnormally permeable glomerular capillaries.

Sodium and Water Retention

Increased salt retention—with obligate retention of associated water—causes both increased hydrostatic pressure (due to intravascular fluid volume expansion) and diminished vascular colloid osmotic pressure (due to dilution).

Lymphatic Obstruction

Trauma, fibrosis, invasive tumors, and infectious agents can all disrupt lymphatic vessels and impair the clearance of interstitial fluid, resulting in lymphedema in the affected part of the body.

Examples: 1. Parasitic filariasis, in which the organism induces obstructive fibrosis of lymphatic channels and lymph nodes. 2. Severe edema of the upper extremity may also complicate surgical removal and/or irradiation of the breast and associated axillary lymph nodes in patients with breast cancer.

MORPHOLOGY OF EDEMA &Effusions

Grossly easily recognized as swelling

microscopically, it is appreciated as clearing and separation of the extracellular matrix (ECM) and subtle cell swelling. Edema is most commonly seen in subcutaneous tissues, the lungs, and the brain.

Subcutaneous edema can be diffuse or more conspicuous in regions with high hydrostatic pressures. Its distribution is often influenced by gravity (e.g., it appears in the legs when standing and the sacrum when recumbent), a feature termed *dependent edema*.

Finger pressure over markedly edematous subcutaneous tissue displaces the interstitial fluid and leaves a depression, a sign called pitting edema.

Edema resulting from *renal dysfunction* often appears initially in parts of the body containing loose connective tissue, such as the eyelids; periorbital edema is thus a characteristic finding in severe renal disease.

pulmonary edema, the lungs are often two to three times their normal weight, and sectioning yields frothy, blood-tinged fluid—a mixture of air, edema, and extravasated red cells.

Brain edema can be localized or generalized depending on the nature and extent of the pathologic process

or injury. The swollen brain exhibits narrowed sulci and swollen gyri, which are compressed by the solid skull.

Effusions involving the pleural cavity (hydrothorax), the pericardial cavity (hydropericardium), or the peritoneal cavity (hydroperitoneum or ascites) are common in a wide range of clinical settings.

1.Transudative effusions are typically protein-poor, translucent, and straw colored; an exception are peritoneal effusions caused by lymphatic blockage, which may be milky due to the presence of lipids absorbed from the gut.

2. Exudative effusions are protein-rich and often cloudy due to the presence of white cells.

Clinical Features

1. Subcutaneous edema is important primarily because it signals potential underlying cardiac or renal

disease; however, when significant, it can also impair wound healing and the clearance of infections. 2.Pulmonary edema is a common clinical problem that is most frequently seen in the setting of left ventricular failure; it can also occur with renal failure, acute respiratory distress

syndrome and pulmonary inflammation or infection. Significant result (leading to hypoxemia) and also creates a favorable environment for bacterial infection.

3. Peritoneal effusions(ascites) resulting most commonly from portal hypertension are prone to seeding by bacteria, leading to serious and sometimes fatal infections.
4. Brain edema is life threatening; if severe, brain substance can herniate (extrude) through the foramen magnum, or the brain stem vascular supply can be compressed. Either condition can injure the medullary centers and cause death.

HYPEREMIA AND CONGESTION

both contains from increased blood volumes within tissues.

Hyperemia is an active process in which arteriolar dilation (e.g., at sites of inflammation or in skeletal muscle during exercise) leads to increased blood flow. Affected tissues turn red (erythema) because of increased delivery of oxygenated blood.

Congestion is a passive process resulting from reduced venous outflow of blood from a tissue. It can be systemic, as in cardiac failure, or localized, as in isolated venous obstruction. Congested tissues have an abnormal blue-red color (cyanosis) result from accumulation of deoxygenated hemoglobin in the affected area.

In long-standing chronic passive congestion, the associated chronic hypoxia may result in ischemic tissue injury and scarring. In chronically congested tissues, capillary rupture can also produce small hemorrhagic

foci; subsequent catabolism of extravasated red cells can leave clusters of hemosiderin-laden macrophages. As a result of increased hydrostatic pressures, congestion commonly leads to edema.

MORPHOLOGY

Macroscopically; Congested tissues take on a dusky reddish-blue color (cyanosis) due to red cell stasis and the presence of deoxygenated hemoglobin.

Microscopically, acute pulmonary congestion is marked by congested alveolar capillaries, alveolar septal edema, and focal intra-alveolar hemorrhage.

chronic pulmonary congestion, which is often caused by congestive heart failure, the septa are thickened and fibrotic, and the alveoli often contain numerous macrophages laden with hemosiderin (heart failure cells) derived from phagocytosed red cells.

acute hepatic congestion, the central vein and sinusoids are distended. Because the centrilobular area is at the distal end of the hepatic blood supply, centrilobular hepatocytes may undergo ischemic necrosis, and the periportal hepatocytes—better oxygenated because of proximity to hepatic arterioles—may only develop fatty change.

chronic passive hepatic congestion, the centrilobular regions are grossly redbrown and slightly depressed (because of cell death) and are accentuated against the surrounding zones of uncongested tan liver (nutmeg liver).

Microscopically, there is centrilobular congestion and hemorrhage, hemosiderin-laden macrophages, and variable degrees of hepatocyte retraction and necrosis.

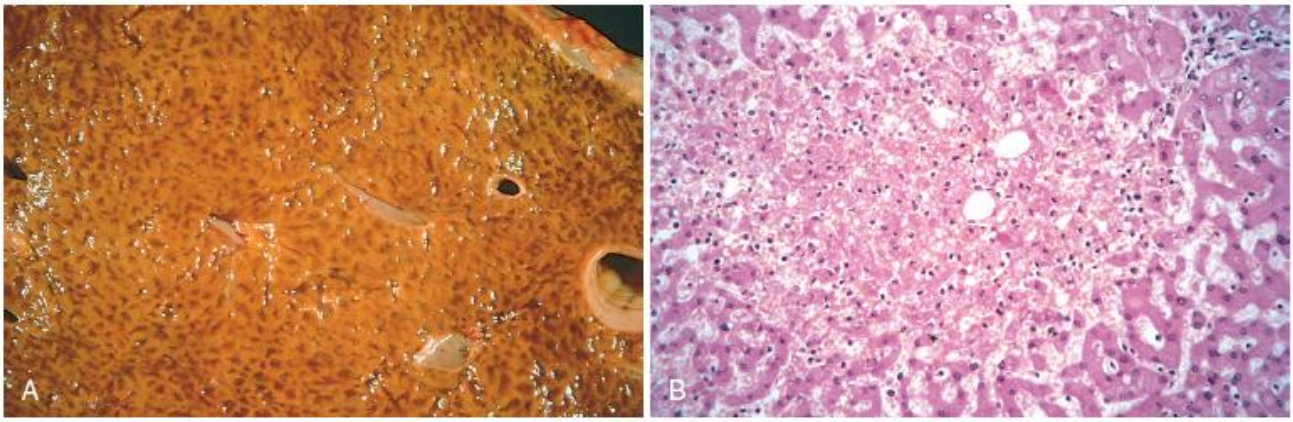


Figure 4.3 Liver with chronic passive congestion and hemorrhagic necrosis. (A) Central areas are red and slightly depressed compared with the surrounding tan viable parenchyma, forming a "nutmeg liver" pattern (so-called because it resembles the cut surface of a nutmeg). (B) Centrilobular necrosis with degenerating hepatocytes and hemorrhage. (Courtesy Dr. James Crawford, Department of Pathology, University of Florida, Gainesville, Fla.

HEMORRHAGE

Hemorrhage, defined as the extravasation of blood from vessels, is most often the result of damage to blood vessels or defective clot formation.

Causes

1. **capillary bleeding can occur in chronically congested tissues.**
2. **Trauma**
3. **Atherosclerosis**
4. **inflammatory or neoplastic erosion of a vessel wall also may lead to hemorrhage, which may be extensive if the affected vessel is a large vein or artery.**
5. **inherited or acquired defects in vessel walls, platelets, or coagulation factors.**

TYPES

1. **hematoma: Hemorrhage may be external or accumulate within a tissue. which ranges in significance from slight (e.g., a bruise) to fatal (e.g., rupture of a dissecting aortic artery)**

2. **Petechiae are minute (1 to 2 mm in diameter) hemorrhages into skin, mucous membranes, or serosal surfaces; causes include low platelet counts (thrombocytopenia), defective platelet function, and loss of vascular wall support, as in vitamin C deficiency.**
3. **Purpura are slightly larger (3 to 5 mm) hemorrhages. Purpura can result from the same disorders that cause petechiae, as well as trauma, vascular inflammation (vasculitis), and increased vascular fragility.**
4. **Ecchymosis are larger (1 to 2 cm) subcutaneous hematomas. Extravasated red cells are phagocytosed and degraded by macrophages; the characteristic color changes of a bruise result from the enzymatic conversion of hemoglobin (red-blue color) to bilirubin (blue-green color) and eventually hemosiderin (golden-brown).**
5. **Large bleeds into body cavities are described variously according to location—hemothorax, hemopericardium, hemoperitoneum, or hemarthrosis (in joints). Extensive hemorrhages can occasionally result in jaundice from the massive breakdown of red cells and hemoglobin.**

<u>The clinical significances</u>

1. **Rapid loss of up to 20% of the blood volume, or slow losses of even larger amounts, may have little impact in healthy adults.**
2. **greater losses, however, can cause hemorrhagic (hypovolemic) shock.**
3. **The site of hemorrhage also is important; bleeding that would be slight in the subcutaneous tissues can cause death if located in the brain.**
4. **chronic or recurrent external blood loss (e.g., due to peptic ulcer or menstrual bleeding) resulting in iron deficiency anemia as a consequence of a loss of iron in hemoglobin.**

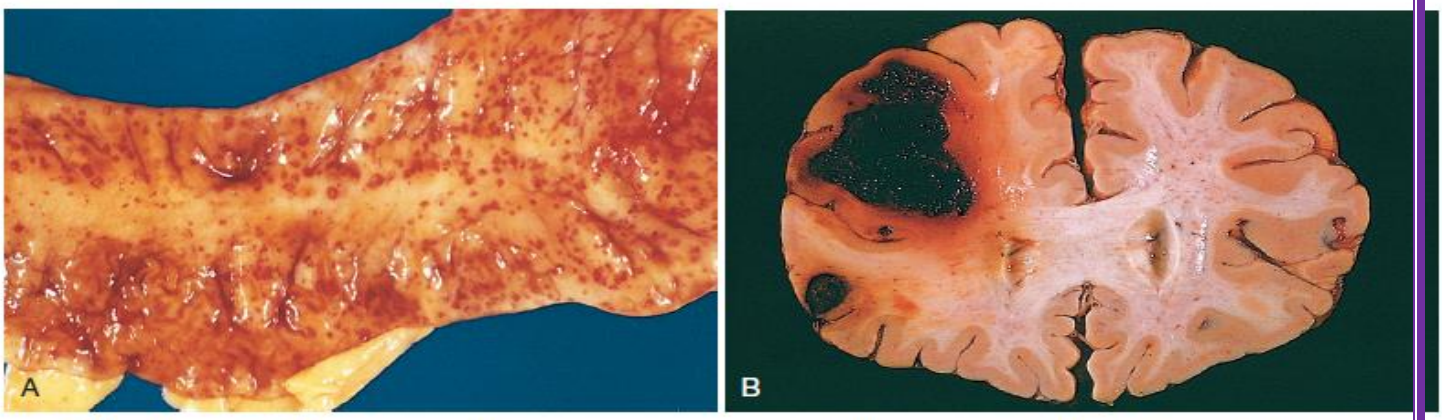


Figure 4.11 (A) Punctate petechial hemorrhages of the colonic mucosa, a consequence of thrombocytopenia. (B) Fatal intracerebral bleed.