

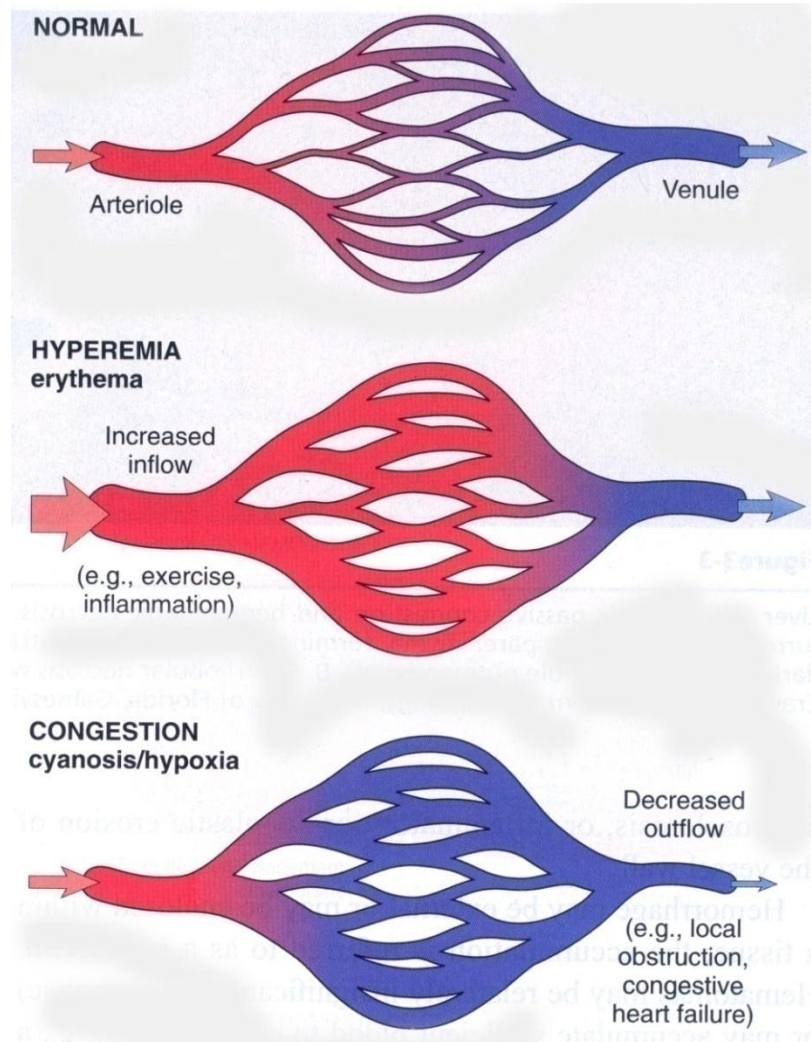
# CIRCULATORY DISTURBANCES

**Dr Eman MS Muhammad**

# Hyperemia and Congestion

- Both hyperemia and congestion indicate a local increased volume of blood in a particular tissue.

# Hyperemia versus Congestion





Normal blood flow



Arterial hyperemia



venous congestion

## Hyperemia and congestion

# Hyperemia

- **Definition:**
- It means a local increase in the blood flow in a tissue due to arteriolar vasodilatation with accumulation of blood in arterioles and capillaries.
- It is an active process (energy consuming) in which the affected tissues appear red due to engorgement of the tissue or organ with oxygenated blood.

# Types:

1. **Physiological:** e.g. in cases of:
  - a) Exercise in which hyperemia occurs in the skeletal and cardiac muscle.
  - b) Digestion in which hyperemia occurs in the GIT after meals.
2. **Pathological:** e.g. in acute inflammation.

# VENOUS CONGESTION (Passive Hyperemia)

- **Definition:**
- Venous hyperemia means increased blood in a tissue or organ due to an obstruction in the flow of blood from the affected part, so the venous radicles becoming distended.

# Pathogenesis:

- ▣ Obstruction in the flow of blood from the affected part → distended venous radicles; venous hyperemia.
- ▣ The veins, venules and capillaries in the organ become passively dilated.
- ▣ The affected tissue has a blue red color; (cyanotic) due to accumulation of venous deoxygenated blood.



# Types of venous congestion:

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1. **General:** Which may be acute or chronic.
2. **Local:** Which may be acute or chronic.

# GENERAL VENOUS CONGESTION

## A. **Acute general venous congestion:**

- Terminal condition in acute heart failure.
- All viscera becomes congested.

## B. **Chronic general venous congestion:**

- Gradual venous congestion affecting the whole venous system.

# Causes of Chronic General Venous Congestion:

- It is caused by right sided heart failure due to chronic obstructive lesions affecting:
  1. **The heart:** As mitral stenosis and myocardial fibrosis caused by coronary atherosclerosis.
  2. **The pulmonary vessels:** As congenital pulmonary stenosis, bilharziasis of the lung which causes narrowing of the pulmonary arterioles.
  3. **The lung:** As emphysema and extensive fibrosis caused by tuberculosis and pneumoconiosis.

# Pathology:

## I. **General Effects:**

1. Dyspnea.
2. Cyanosis: Caused by:
  - A. Stasis in the capillaries causes more hemoglobin reduction in the tissues.
  - B. Deficient oxygen saturation in the congested lung.
3. Cardiac edema.

# Cardiac edema

- **Definition:**

- Edema caused by right sided heart failure.

- **Causes:**

1. Increased hydrostatic pressure in the veins and capillaries caused by congestion.
2. Increased capillary permeability caused by anoxia.
3. Venous congestion in the kidney causes sodium and water retention.

□ **Sites:**

□ Edema begins around the ankle because of the effect of gravity.

□ Later it spreads upwards and becomes generalized “anasarca” and associated with ascitis, hydrothorax and hydropericardium.

□ **Characters of edema:**

□ The edema is pitting.

□ The edema fluid has a protein content below 3 gm%, a specific gravity below 1015, and it does not clot on standing.

## II. Local Effects:

### 1. Heart:

- In case of mitral stenosis the left atrium becomes distended by blood.
- Next the pulmonary veins and capillaries are distended.
- Lastly the back pressure is reflected on the right side of the heart and all systemic veins with their dilatation.

## 2. Lung:

- The lung is affected in right sided heart failure caused by mitral stenosis and in left sided heart failure as well.
- **Gross picture:**
- The lungs are enlarged, heavy, firm and dark red.
- The cut surface exudes blood stained fluid.
- The bronchial mucosa is congested and covered by a viscid layer of brownish mucus.

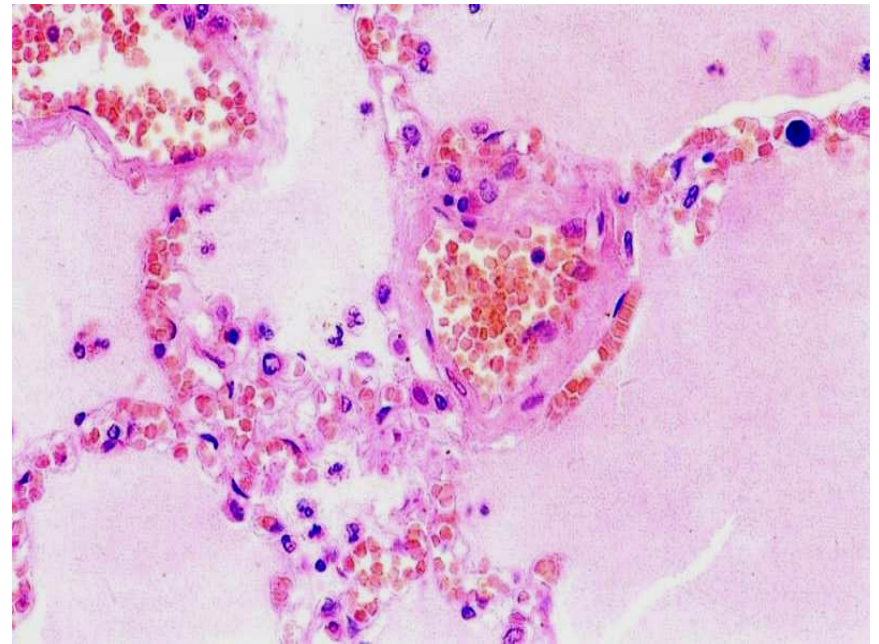
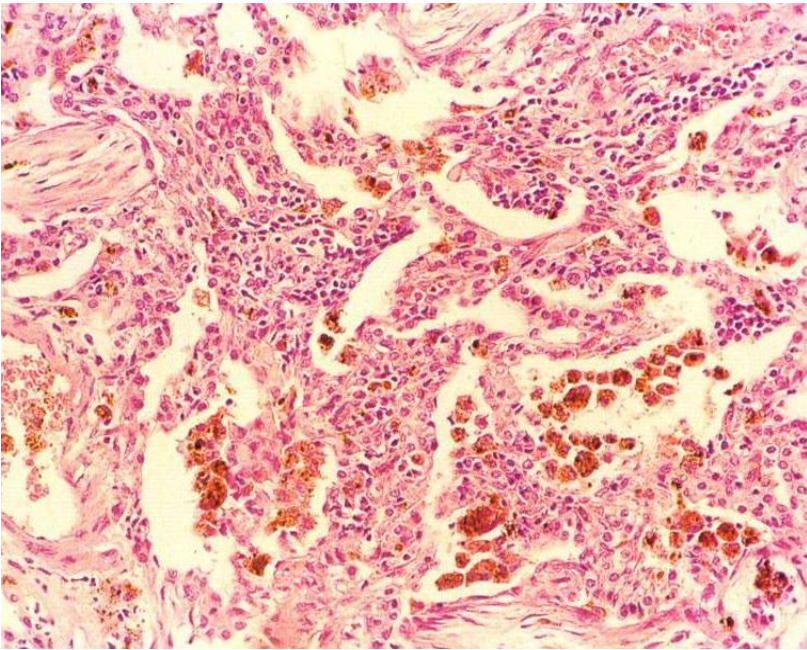


□ ***Microscopic picture:***

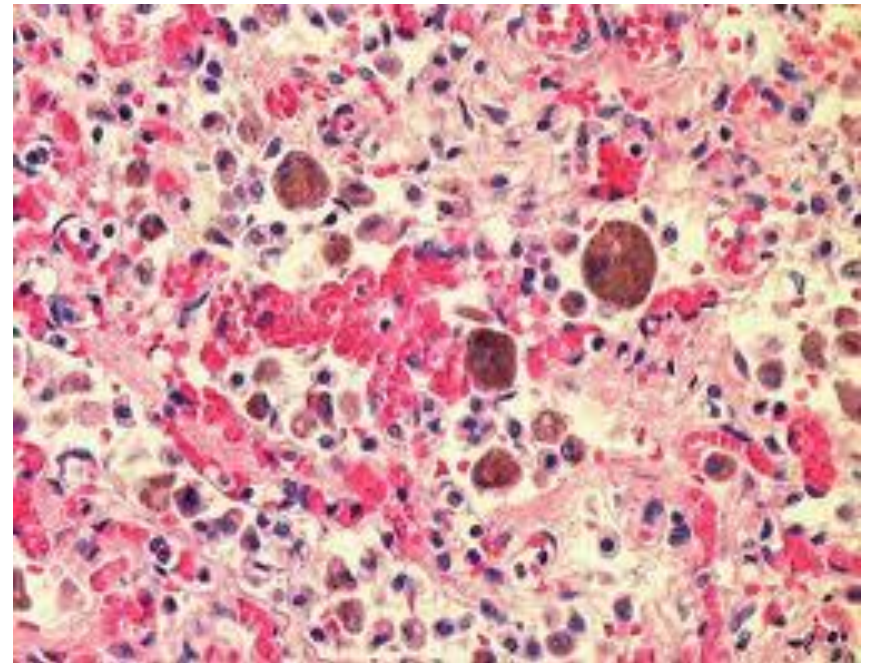
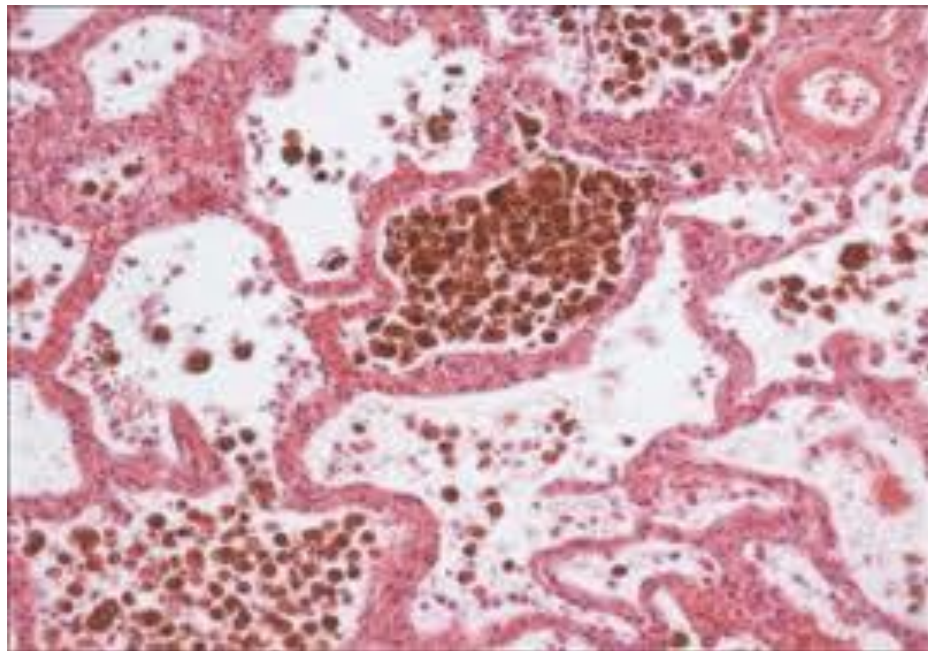
- The alveolar capillaries are dilated and congested.
- The increased pressure causes rupture of some capillaries and hemorrhage in the alveolar spaces.
- The extravasated red cells hemolyse and liberate hemoglobin with release of hemosiderin.
- Hemosiderin and the red cells are removed by macrophages which appear swollen and brown and they are called ***heart failure cells***.

- ❖ Some of these cells return back to the interstitial tissue in their way to the draining lymph node.
- ❖ Some of them die and the released hemosiderin causes fibrosis in the interstitial tissue of the lung.
- ❖ The lung becomes brown and tough; the condition is called ***brown induration***.
- ❖ Homogenous pink transudate appears in the alveoli and the interstitial tissues.
- ❖ The transudate is marked in the basal and posterior parts lung due to the effect of gravity.
- ***Clinically:***
- Chronic cough and hemoptysis.

# Lung Congestion

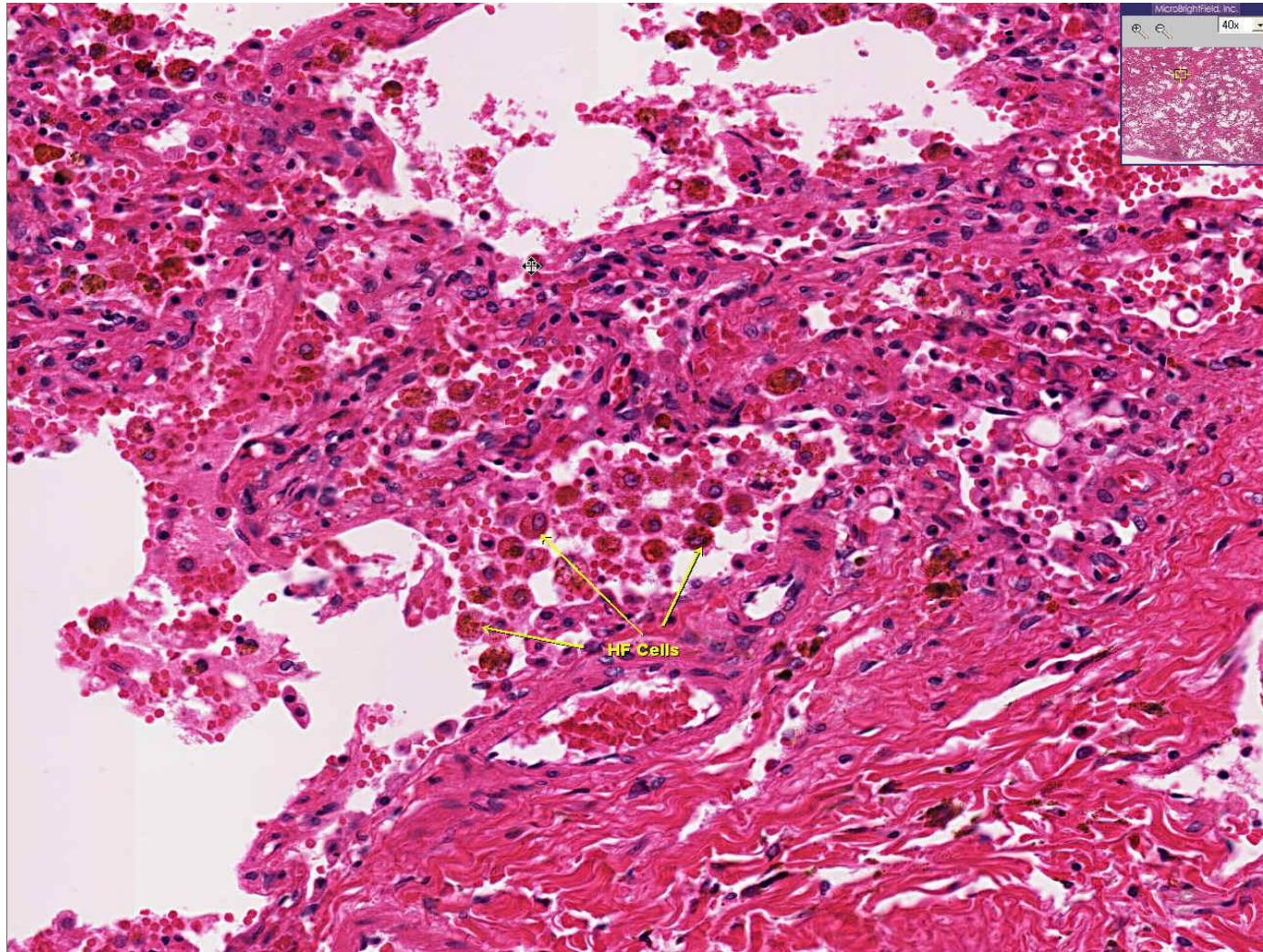






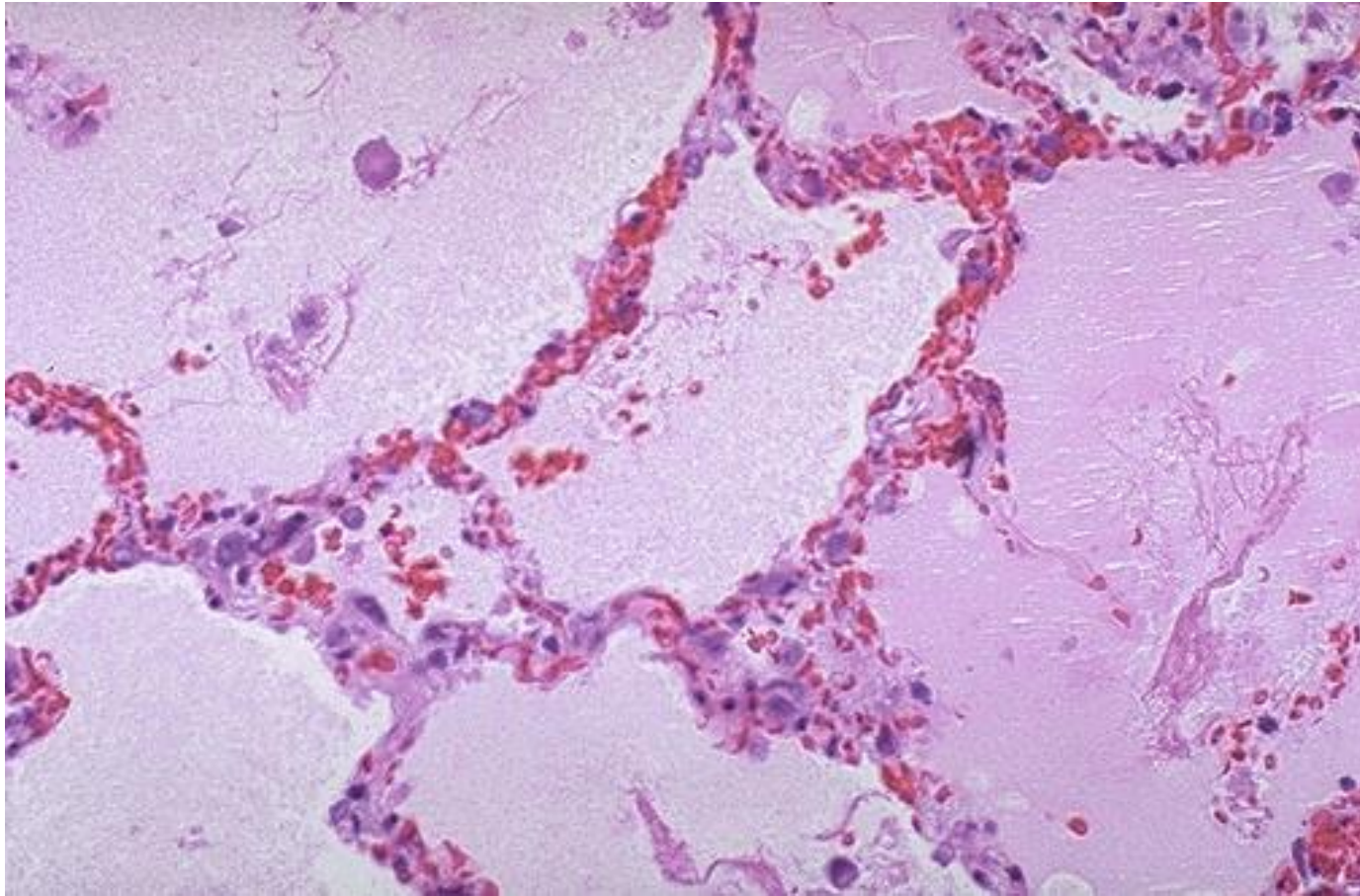


# Pulmonary congestion



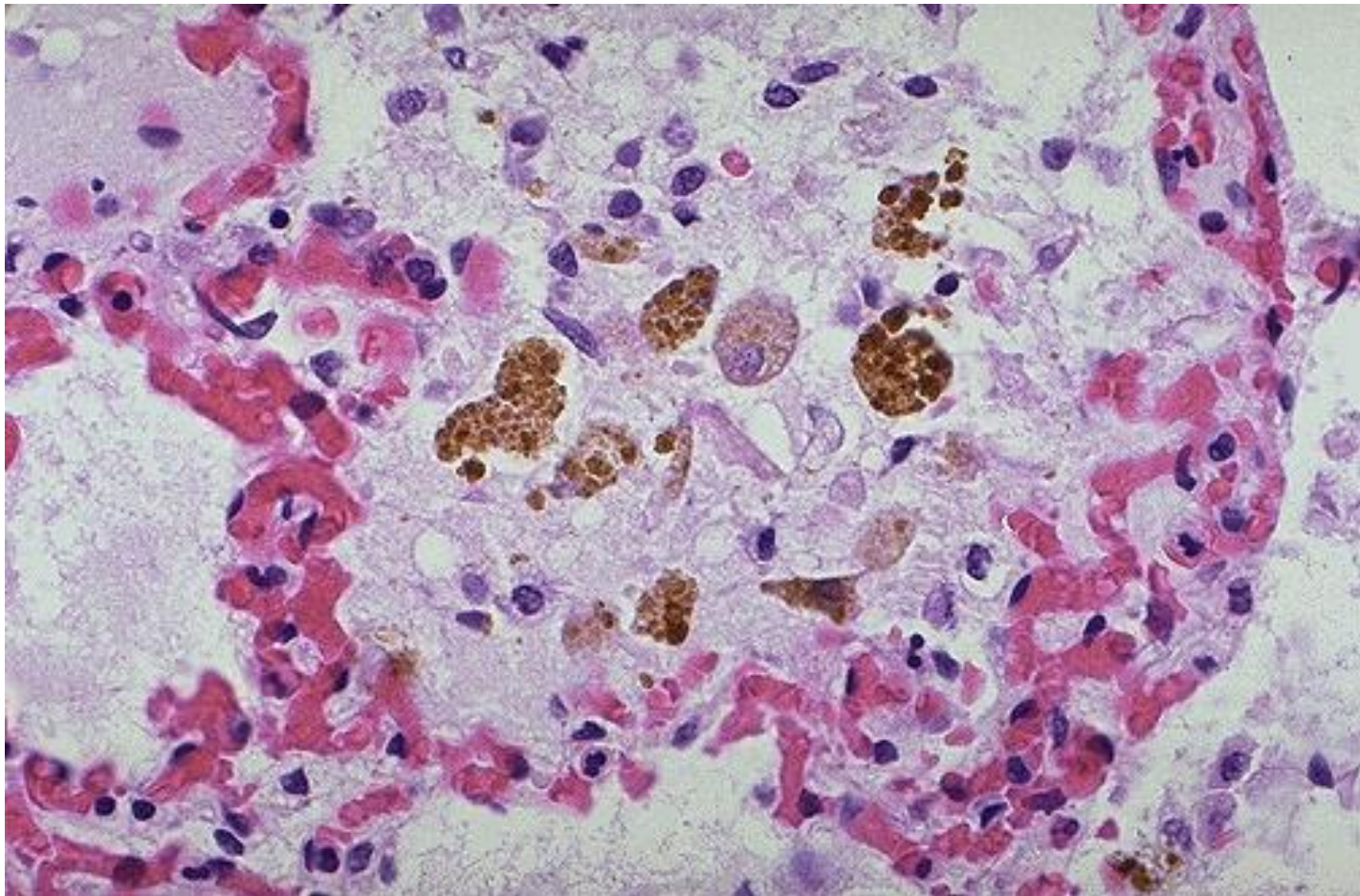


# Acute pulmonary congestion



**Pulmonary congestion, haemorrhage and oedema**

# Chronic pulmonary congestion



**Pulmonary congestion and old haemorrhage (heart failure cells)**

### 3. **Liver:**

#### □ **Gross picture:**

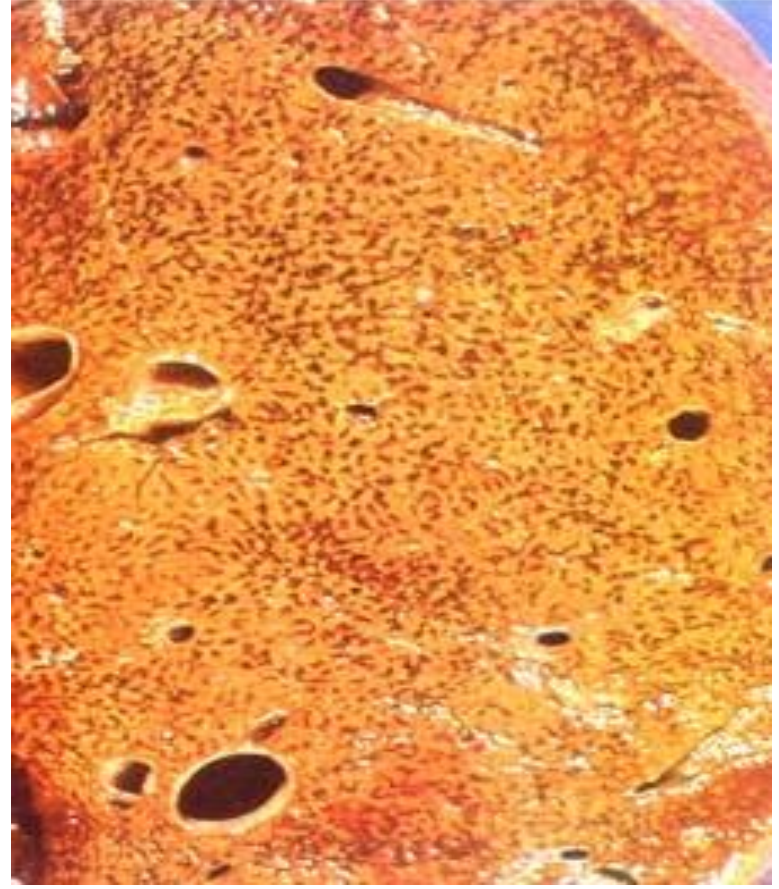
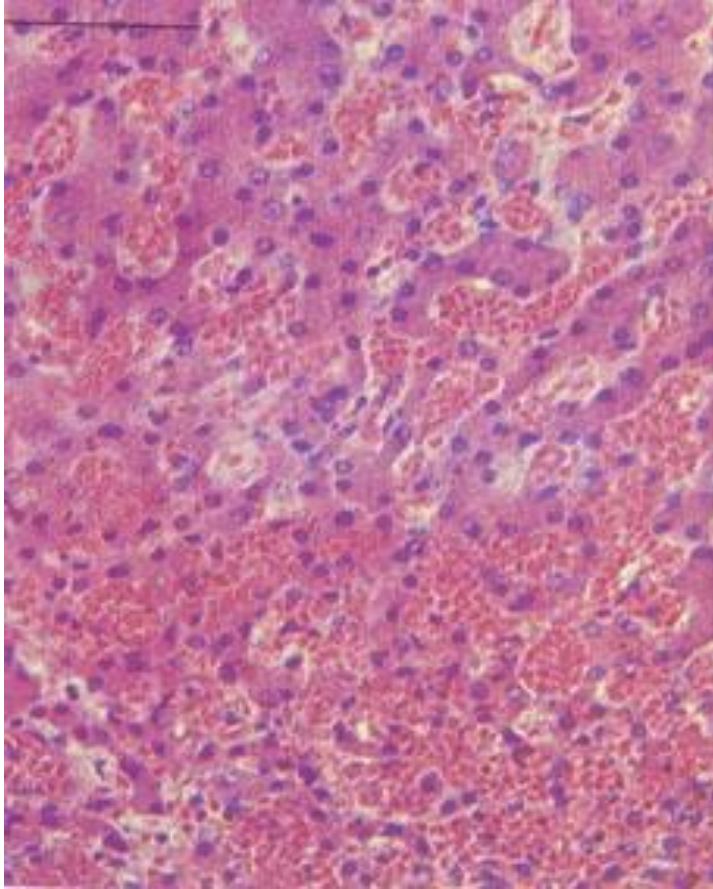
- The liver is enlarged heavy and firm.
- The capsule is tense.
- The cut surface shows alteration of brown (congested) and yellow (fatty change) coloration.
- The appearance is called **nutmeg liver**.



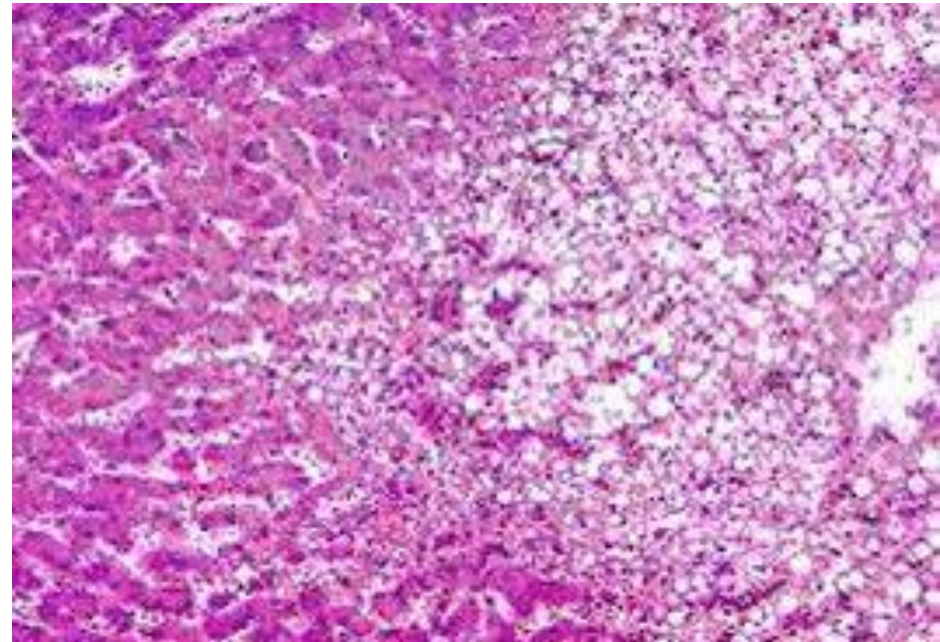
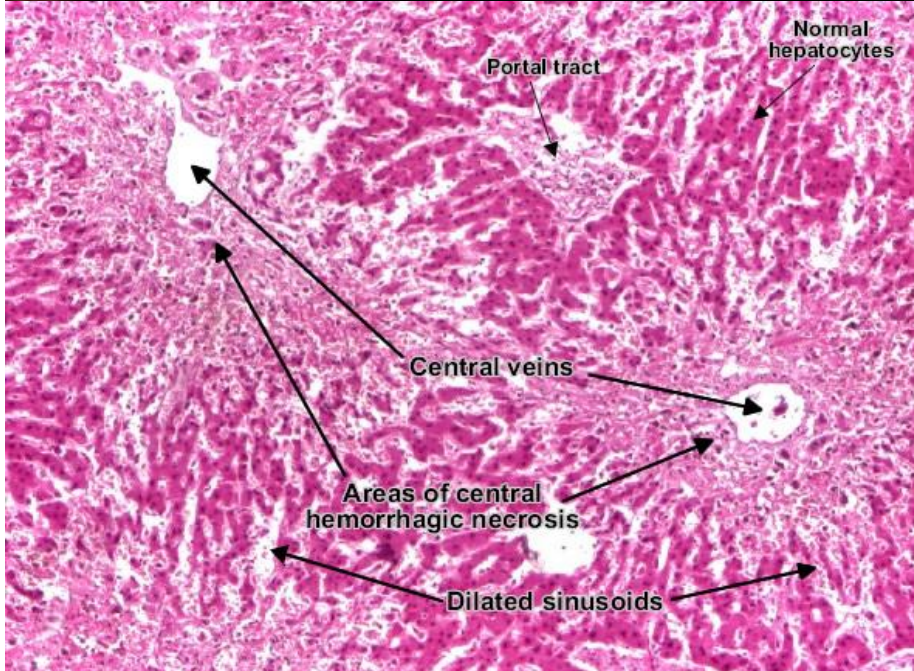
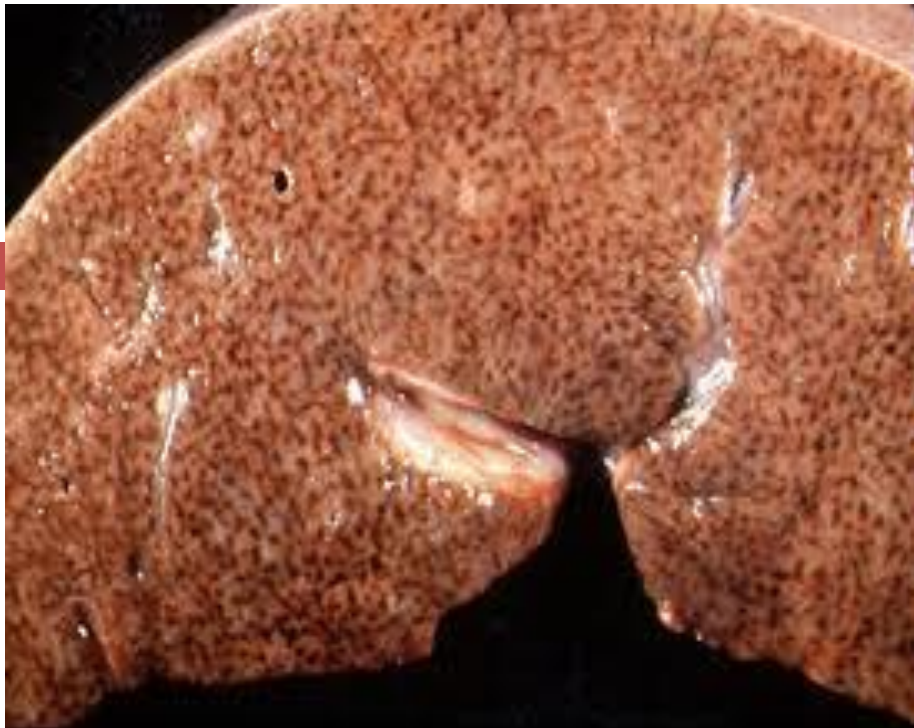
□ ***Microscopic picture:***

- The central veins and central ends of the sinusoids appear dilated and congested.
- The liver cells in the center of each lobule undergo degeneration and necrosis as a result of pressure by the congested sinusoids and anoxemia.
- The cells at the periphery of the lobules are less affected and show fatty change.
- Hemosiderin granules appear in Kupffer cells.
- In advanced cases cardiac cirrhosis occurs
- ***Clinically:***
- Enlarged, tender liver.

# Liver congestion

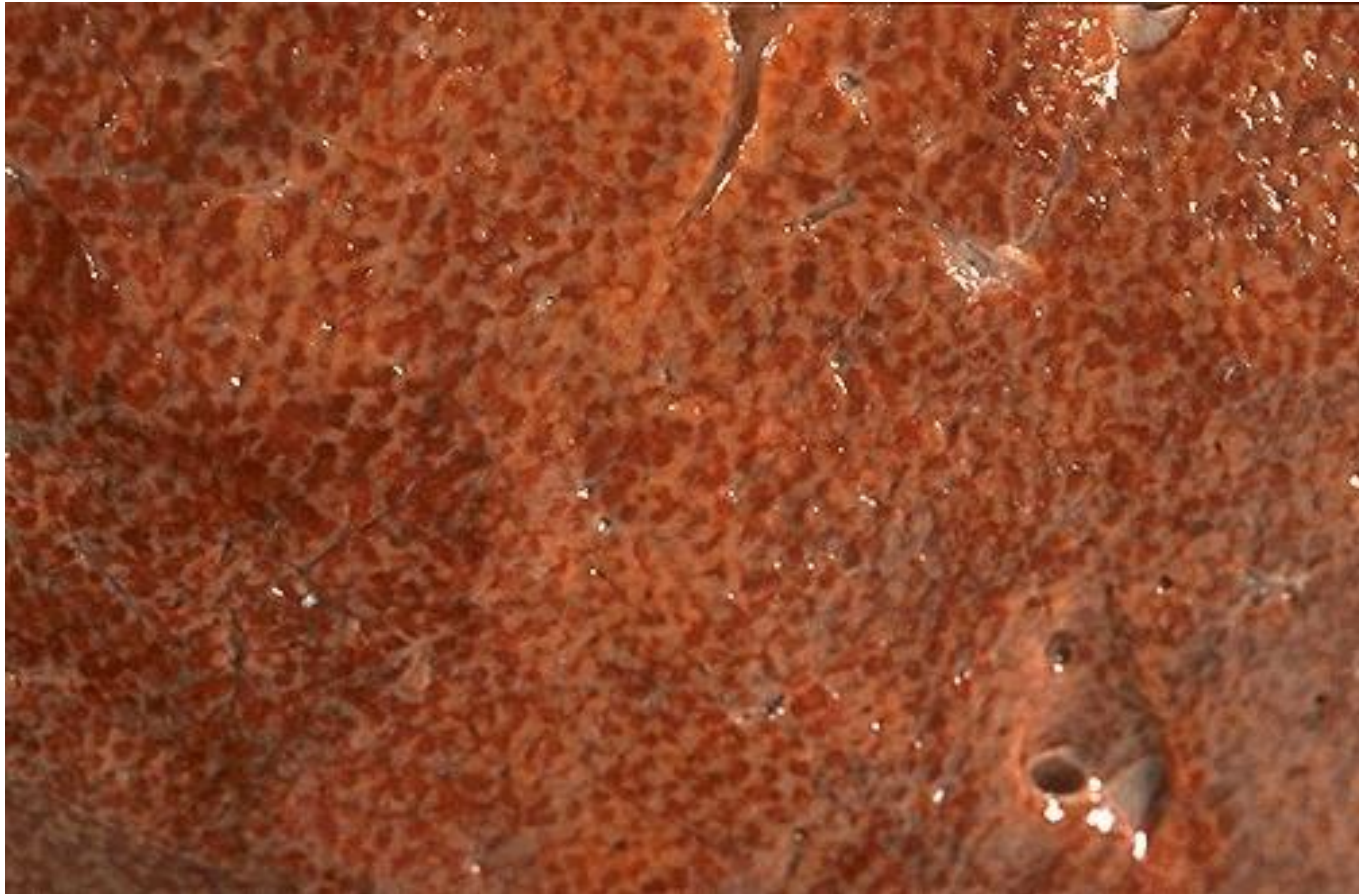






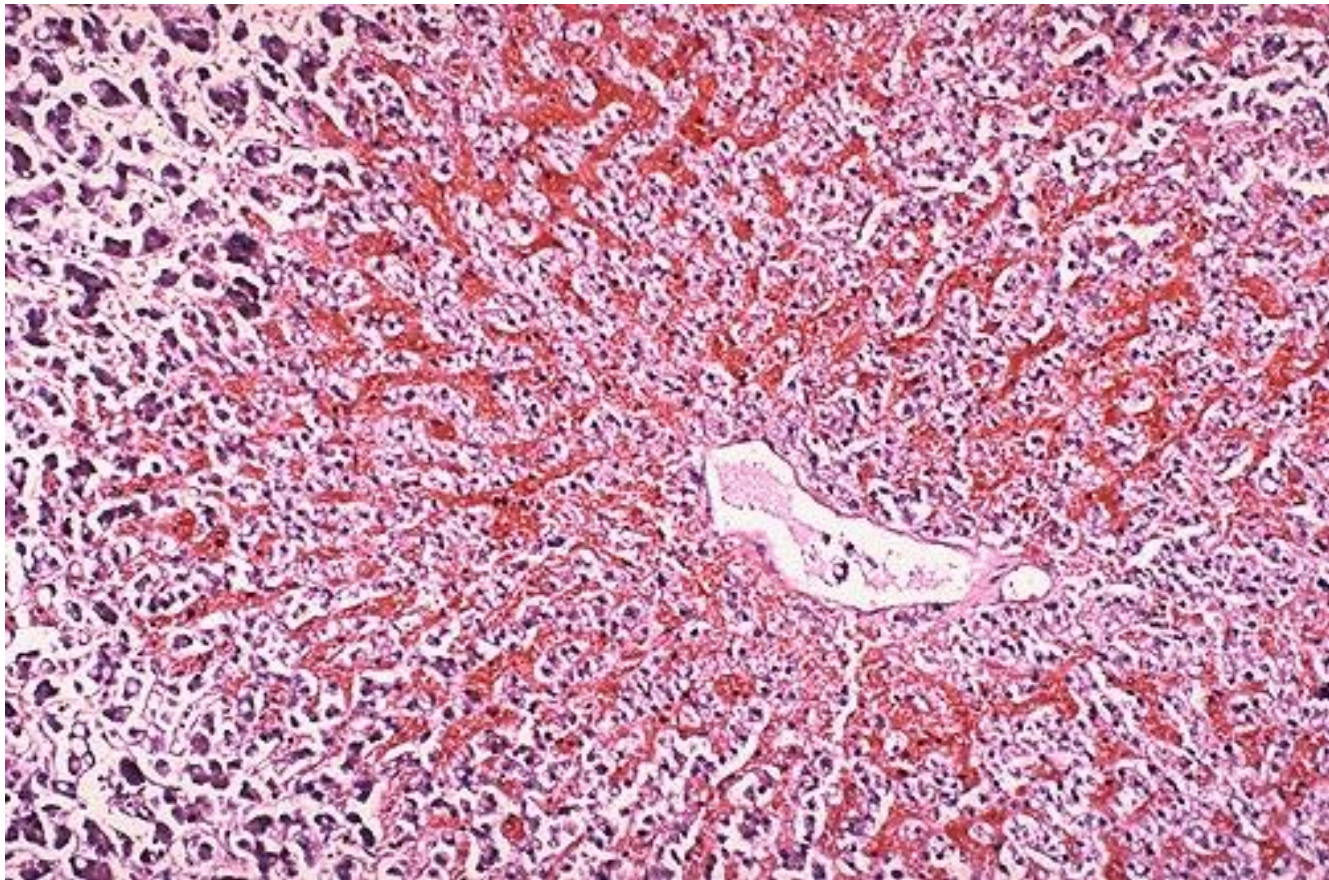


# Chronic hepatic congestion



**Centrilobular congestion and necrosis - nutmeg liver**

# Chronic hepatic congestion



Centrilobular congestion and necrosis

#### 4. **Spleen:**

##### ***Gross picture:***

- The spleen is enlarged, heavy and firm.
- The edges are sharp.
- The capsule is thick.
- The cut surface is dark red.

##### ***Microscopic picture:***

- The venous sinuses are distended with red blood cells and contain many macrophages loaded with hemosiderin.
- The littoral cells show phagocytic activity.
- The lymphoid follicles show pressure atrophy.



## 5. **Kidney:**

### □ **Gross picture:**

- The kidney is slightly enlarged, firm, dark red and bloody on cutting.
- The cut surface shows dark red dots (congested glomeruli and dark red streaks (congested vessels).

### □ **Microscopic picture:**

- The glomerular capillaries and medullary veins are congested.
- Red cells and pink transudate appear in the Bowman's space and in the tubules.

### □ **Clinically:**

- Hematuria and albuminuria.

## 6. **Stomach and Intestine:**

- The mucosa is congested, swollen and covered by viscid brown mucus.
- *Clinically:*
- Malabsorption.



# LOCAL VENOUS CONGESTION

- **Definition:**
- Localized congestion in any part of the body whose outflow becomes obstructed.

# Acute Local Venous Congestion

## ❑ Causes:

❑ Sudden complete venous obstruction due to:

❖ Thrombosis

❖ Ligature

❖ Twisting of the pedicle of a movable organ or strangulated hernia.

## ❑ Pathology:

❖ Rapid severe distention of veins and capillaries which may rupture.

❖ Edema occurs rapidly in the tissues.

# Chronic Local Venous Congestion

- **Causes:**
- Gradual incomplete venous obstruction.
- It results from compression by a tumor, enlarged lymph node or pregnant uterus.
- Also it results from liver cirrhosis and bilharzial hepatic fibrosis.

- **Pathology:**

- The veins, venules and capillaries proximal to the obstruction become dilated and congested resulting in edema.
- Gradual opening of the collateral and anastomotic veins.

- **Examples of chronic local venous congestion:**

1. ***Compression the iliac vein and/or femoral vein as during pregnancy :***
- Causes venous congestion, swelling, edema and cyanosis of the lower limb.

## 2. *Liver cirrhosis or fibrosis:*

- Causes obstruction of the hepatic veins with the following results:
  - (a) Venous congestion in the portal area.
  - (b) Ascitis.
  - (c) Splenomegaly.
  - (d) Opening of the anastomosis between portal and systemic veins causing esophageal varices hemorrhoids.

# Clinical features of Chronic Venous Congestion (CVC):

1. Cyanosis: blue discolorations of tissue, especially apparent in the skin and mucous membranes e.g., lips due to the presence of abundant reduced hemoglobin.
2. Congested pulsating neck veins due to increased venous pressure.
3. Edema of the lower limbs mainly due to increased venous pressure.
4. Enlarged tender liver.

# EDEMA

- **Definition:**
- Pathological accumulation of excess fluids (transudate, exudate, or lymph) in the interstitial tissue spaces and serous sacs.
- Approximately 60% of body weight is water, two thirds of which is intracellular with the remainder is in the extracellular compartments; mostly the interstitial tissue.

# Causes of edema:

1. **Increased capillary hydrostatic pressure:**
  - A rise in the venous pressure is followed by a rise in the capillary pressure, increased fluids into the tissue spaces and decrease re-absorption at the venous end of the capillaries, so edema occurs.
  - The condition may be generalized as in congestive heart failure or localized as in obstruction of a vein.



## 2. ***Decrease colloid osmotic pressure of the plasma:***

- When plasma proteins falls below 2.5 gm% or when the albumin drops below 1.5 gm%, the colloid osmotic pressure of the blood diminishes and excess fluid passes into the tissue spaces and serous sacs i.e. generalized edema.
- This occurs in nephrotic syndrome and liver cell failure.

## 3. ***Increased capillary permeability:***

- Caused by toxins, chemicals as histamine and serotonin in acute inflammation and hypoxia.
- The plasma escapes into the tissue spaces and withdraw more fluids from the vessels by its osmotic pressure.

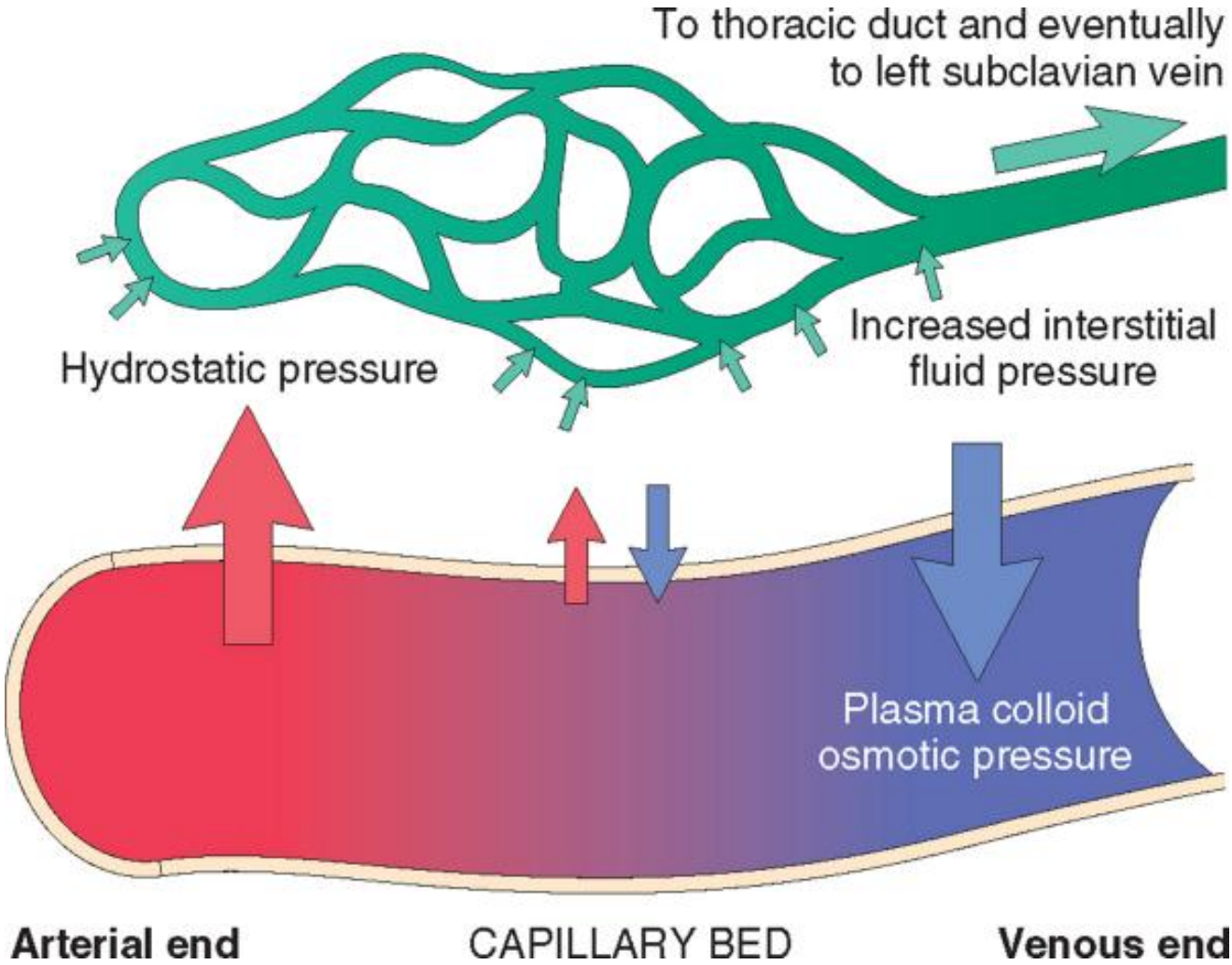
#### 4. ***Lymphatic obstruction:***

- It is specially important in the production of local edema.

#### 5. ***Sodium and water retention:***

- Retention of sodium occurs when its excretion in the urine is less than the intake.
- The excess sodium leads secondarily to retention of water.
- Sodium retention may be due to a renal mechanism or increased aldosterone.
- This occurs in congestive heart failure, liver cirrhosis, nephrotic syndrome and acute glomerulonephritis.

# Pathogenesis of edema



# Classification of edema:

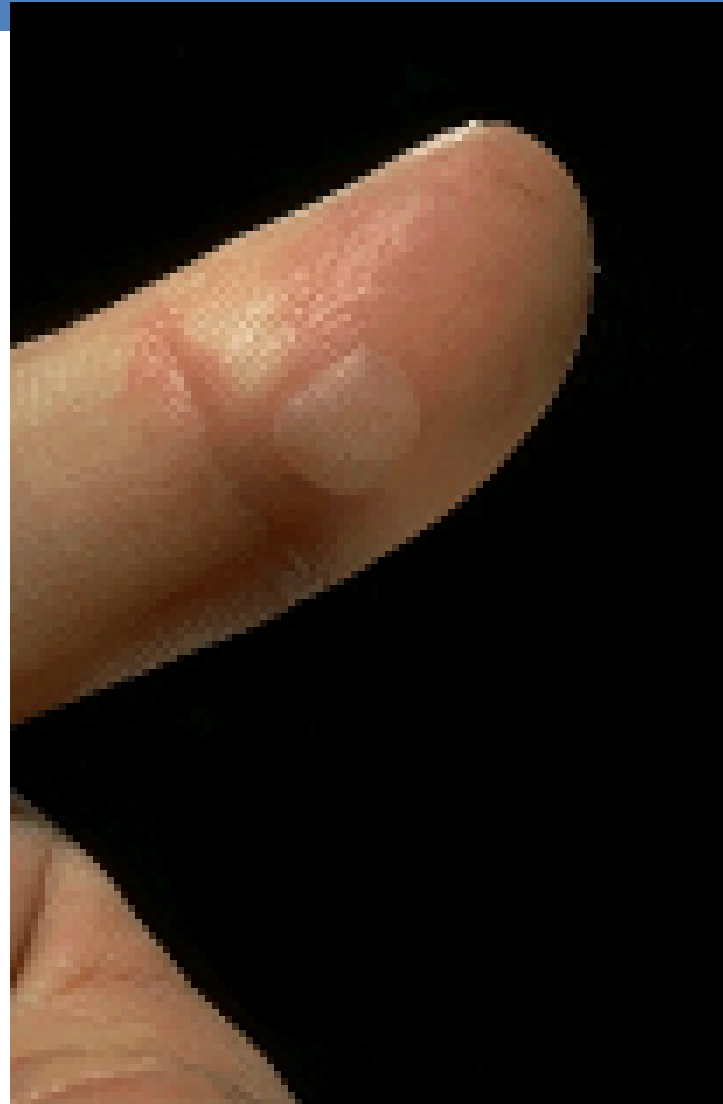
- Edema is classified into:

1. **Localized edema:**

- Localized in a part of the body.

- The total amount of fluids in the body is within normal but its distribution is wrong and abnormal amount accumulates in the affected area e.g. obstructive and inflammatory edema.

**Localised oedema -  
blister**



## 2. **Generalized edema (anasarca):**

- The process involves the whole body.
- The total amount of fluids in the body is increased e.g. cardiac, renal and nutritional edema.

□ Edema is also classified into:

1. **Soft edema (pitting):**

□ The accumulated fluid is present free in the tissue spaces and can be moved by pressure so the affected part pits on pressure e.g. cardiac, renal and nutritional edema.

2. **Hard edema (non-pitting):**

□ The edema fluid is in excess or is united with the tissue elements, so the edematous part does not pit on pressure e.g. lymphatic edema.



# I. LOCALIZED EDEMA

1. **Inflammatory edema:**
  - Occurs in acute inflammation.
  - The edema fluid is an exudate.
2. **Obstructive edema:**
  - A. Venous obstruction
  - B. Lymphatic obstruction

## A. ***Venous obstruction:***

- This leads to edema in the area drained by the obstructed vein.
- Venous obstruction increases the hydrostatic pressure in the veins and capillaries.
- Blood stagnation diminishes the oxygen supply to the tissues which increases capillary permeability.
- **Common examples of edema due to venous obstruction are:**
  - a) Liver cirrhosis and bilharzial hepatic fibrosis cause intestinal edema and ascitis.
  - b) Acute left sided heart failure causes acute pulmonary edema.

- a) The pregnant uterus compresses the iliac veins causing edema in the lower limbs.
- b) Pressure on a large vein or its obstruction by a thrombus causes edema in the area drained by the vein.

# Pitting edema



**B. *Lymphatic obstruction:***

□ Causes lymphatic edema (lymphedema) are:

- a. Acute lymphangitis and lymphadenitis.
- b. Filarial lymphangitis and lymphadenitis.
- c. Post-inflammatory and post-irradiation fibrosis in the lymph vessels and lymph nodes.
- d. Mechanical compression of the lymph vessels e.g. by tumors.
- e. Tumor emboli and cords in the lymph vessels and metastases in the lymph nodes.
- f. Surgical removal of the lymph nodes.
- g. Congenital hypoplasia of the lymph vessels causes lymphedema (Milroy's disease).

# Lymphatic edema





## II. GENERALIZED EDEMA

1. **Cardiac edema:**
  - Occurs in congestive heart failure.

## 2. **Renal edema:**

□ Occurs in renal diseases and is of **two types:**

### (a) ***Nephritic edema:***

- Occurs in acute diffuse glomerulonephritis.
- It is caused by increased capillary permeability in the subcutaneous tissue (auto-immune reaction).
- Sodium and water retention by the kidney is another factor.
- It starts at the eyelids and ankle and later becomes generalized.

(b) **Nephrotic edema:**

- Occurs in nephrotic syndrome as in membranous glomerulonephritis and renal amyloidosis.
- It is caused by massive albuminuria resulting in hypoproteinemia.
- The edema is generalized.

### 3. **Nutritional edema:**

#### □ Caused by hypoproteinemia due to:

- (a) Inadequate protein intake (Famine edema).
- (b) Interference with the intake, passage, digestion or absorption in the alimentary tract.
- (c) Decrease plasma protein formation as in chronic liver disease.

# Pitting and non pitting edema



**Pitting edema**



**Non-pitting edema**

# Pathological features of edema:

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- All tissues except bone may be the seat of edema.
- Common sites are subcutaneous tissue, areolar connective tissue, mucous membranes, lungs, brain and serous cavities.



- ***Subcutaneous tissue:***

- The affected area appears swollen.

- The covering skin is stretched, inelastic and pits under pressure.

- When the skin is incised a clear pale yellow fluid oozes out.

- ***Microscopically:***

- The edema fluid separates the connective tissue fibers from each other and its protein content coagulates to form a pale red stained homogenous substance.

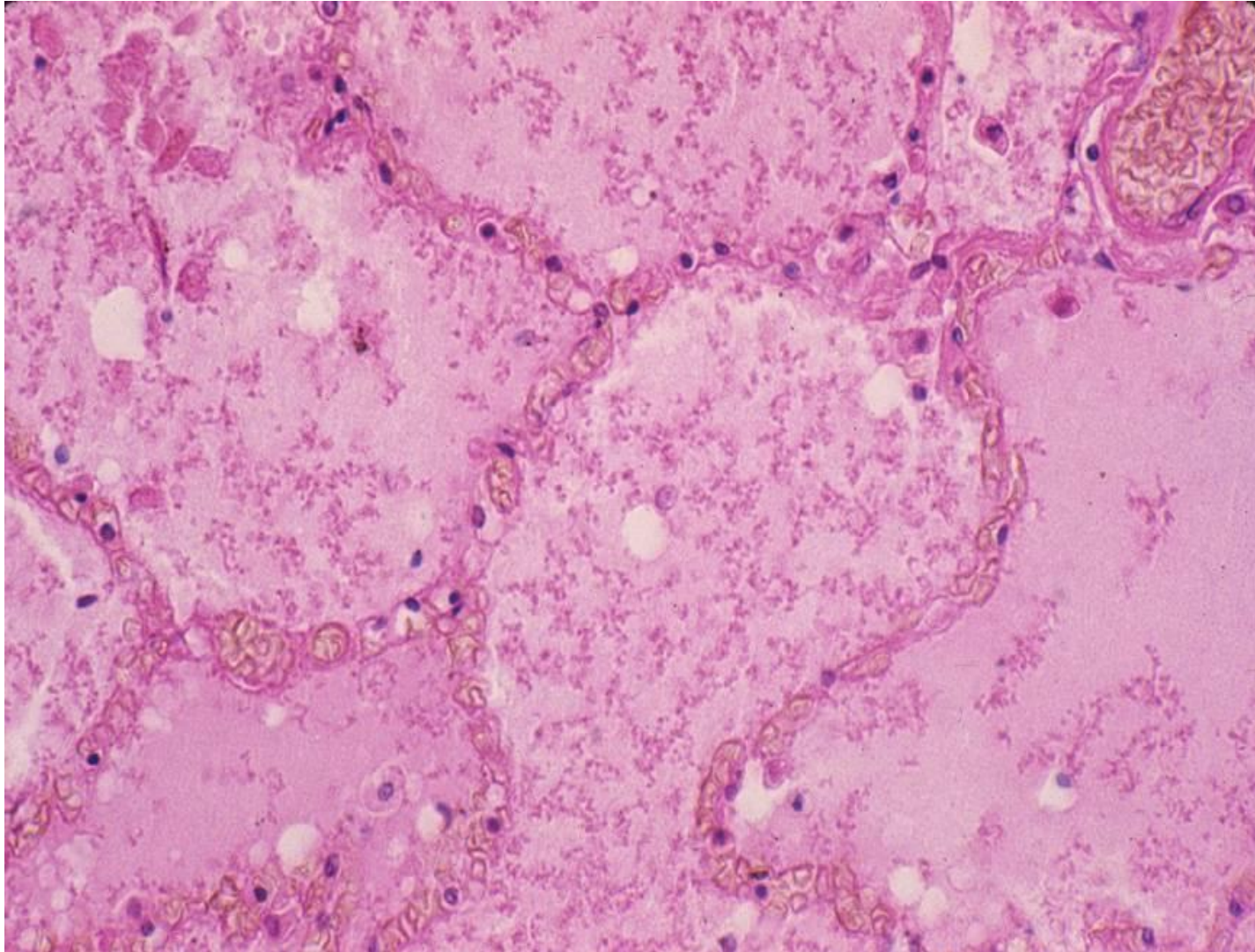
- **Lung:**

- Becomes heavy and its cut surface oozes frothy sanguinous fluid.

- **Microscopically:**

- A pale red homogenous coagulum of protein appears in the alveolar spaces.

# Pulmonary edema



□ **Brain:**

□ It becomes heavy.

□ The sulci are narrowed and the gyri are swollen and flattened against the skull bones.

□ The intracranial tension is increased.

□ **Serous cavities:**

□ A transudate accumulates, with a specific gravity below 1015, protein content below 3 gm%, and it doesn't clot on standing.

# Differences between exudate and transudate:

<b>Exudate</b>	<b>Transudate</b>
<ol style="list-style-type: none"><li>1. Fluid of inflammation.</li><li>2. High protein content 4-8 gm%.</li><li>3. Specific gravity above 1018.</li><li>4. Clots on standing.</li><li>5. Contains inflammatory cells.</li></ol>	<ol style="list-style-type: none"><li>1. Fluid of edema.</li><li>2. Low protein content below 3 gm%.</li><li>3. Specific gravity below 1015.</li><li>4. Does not clot on standing.</li><li>5. No inflammatory cells.</li></ol>



**THANK YOU**