Hemodynamic disorders

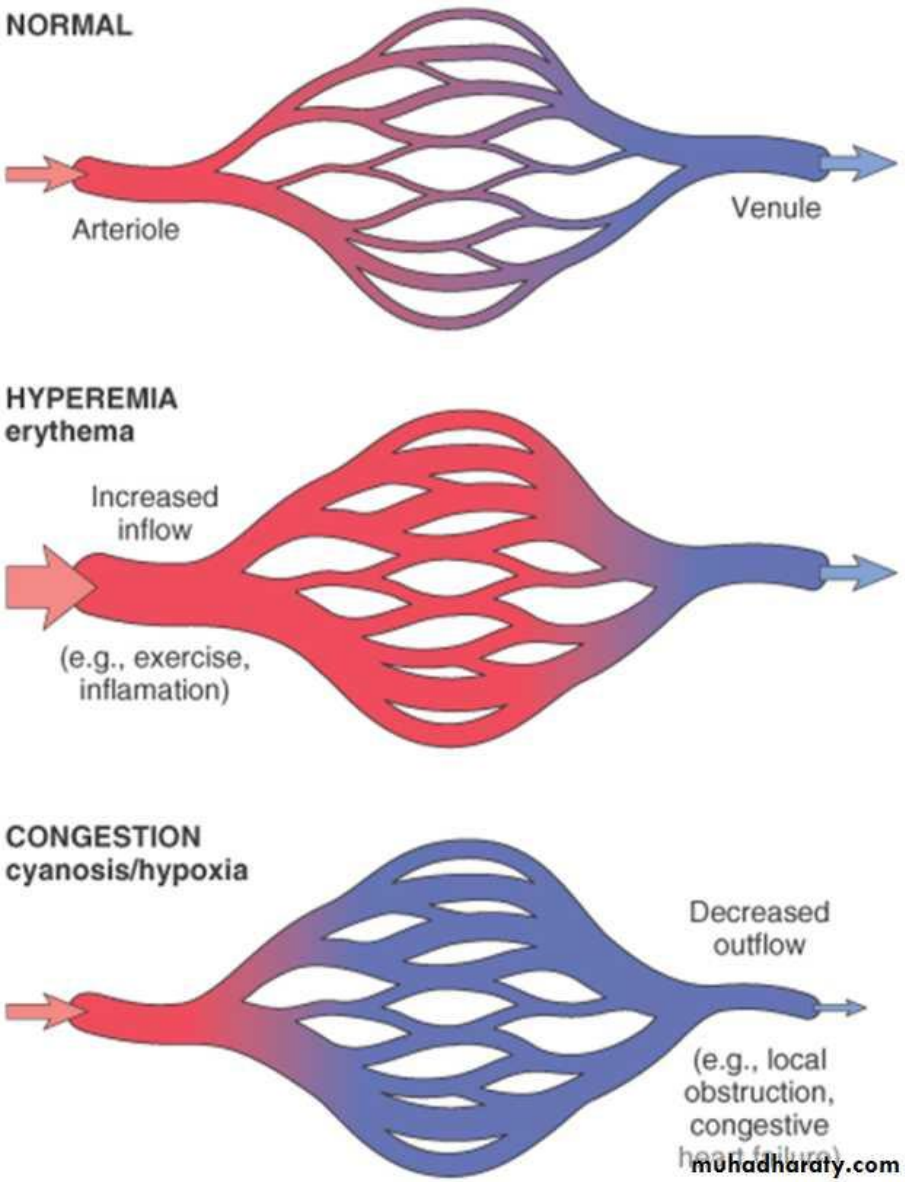
Hemodynamic disorders

- Hyperemia
- Congestion
- Hemorrhage
- Edema
- Infarction
- Thrombosis
- Embolism
- Shock

- Hyperemia – active process
- Congestion – passive process

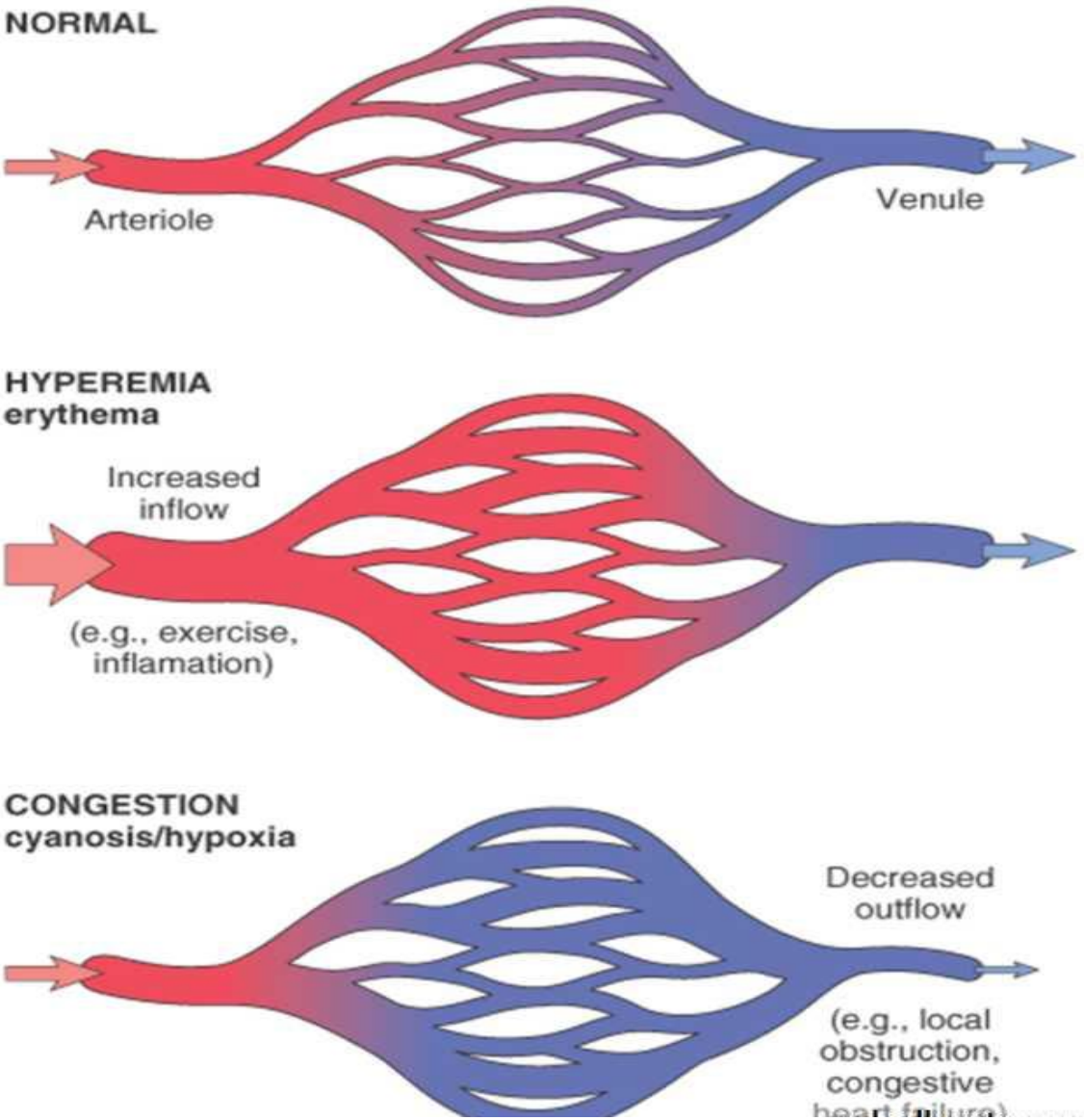
Hyperemia

- It is an increased amount of blood in **arterial side** of the vascular system.
- Brought about by **arteriolar dilation**
- Increased blood flow into the tissue
- Increased oxygenated blood supply
- E.g. inflammation, exercise , blushing
- It helps the tissues during increased rate of metabolism by supplying additional nutrient and oxygen to them and removing the waste material.
- Hyperemic tissues are redder than normal



Congestion

- Passive process
- Impaired venous outflow from a tissue
- Systemic or local
- Hypoxia
- Cyanosis (blue-red color)
- Cell death, tissue firbrosis, haemorrhages in venous side of tissue



Robbins and cotran pathologic basis f diseases @ 2005 Elsevier

Congestion

- Acute/ chronic
- Increased venous pressure
- Obstruction inside a vein
- Obstruction outside the vein
- Lead to reduced outflow of blood from tissue
- Accumulation of deoxygenated blood

Congestion

- Systemic – when sec to heart failure- LHF- CVC in lungs, RHF- sytemic congestion
- Local – local venous obstruction
- The affected tissue is cool, edematous, dusky blue gray in color.

Consequences of chronic congestion

- Parenchyma of organs – atrophy, deg changes, necrosis
- Venous statis- leads to – increased hydroststic pressure in venous circulation- edema
- Capillary rupture- haemorrhages may develop
- Hemorrhagic Blood then breaks into hemosiderin- deposited in the tissues and taken up by macrophages
- Tissue repair results in fibrosis- scars- dystrophic calcification

Chronic venous congetsion

- Lung
- Liver
- Spleen

lungs

- LEFT SIDED HEART FAILURE

- Chronic congestion of lungs
- Increased hydrostatic pressure in the vessels

- Lung edema, hemorrhage of capillaries
- Lung weight increases, sogginess, crepitant texture

Section-

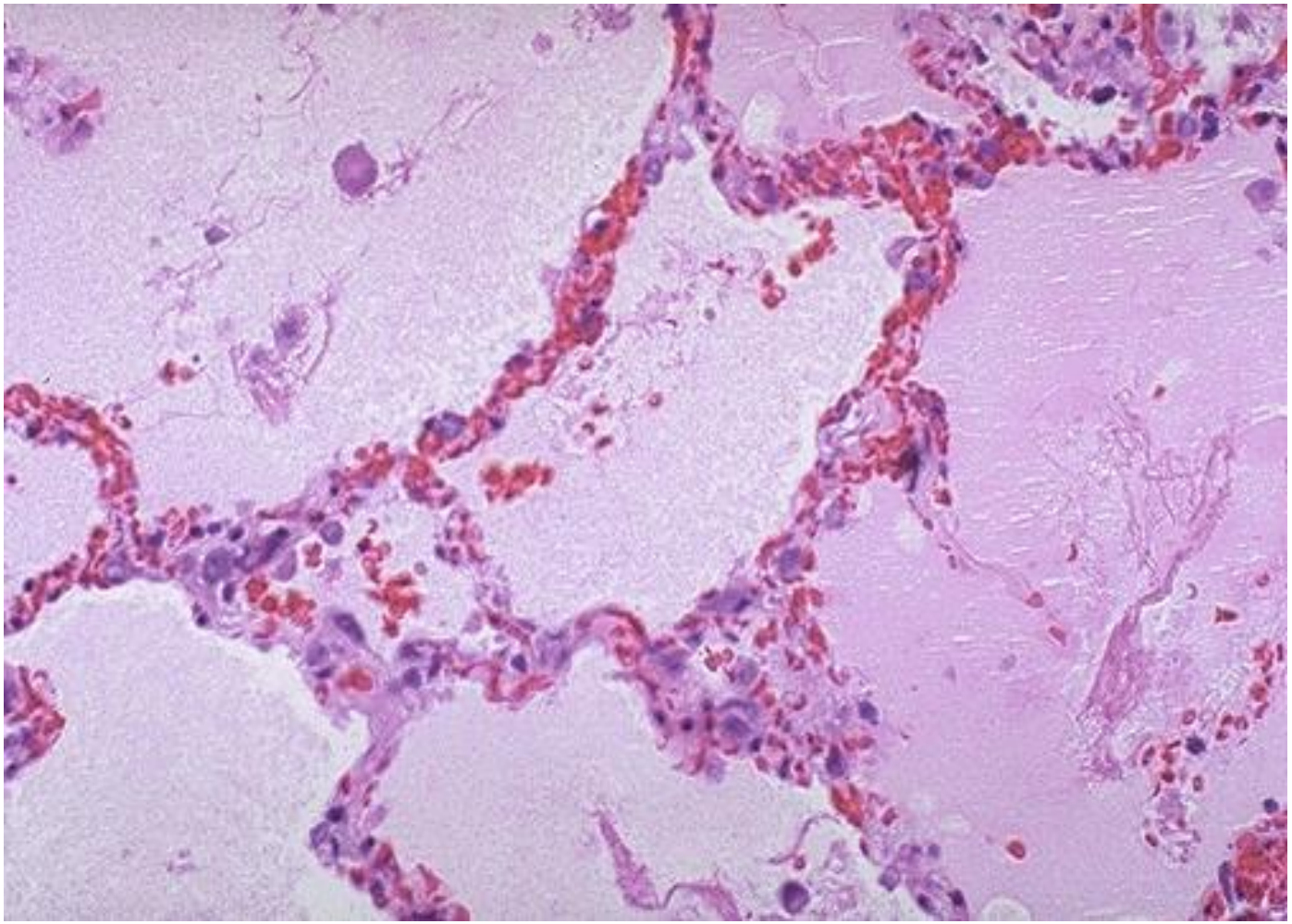
- Escape of a frothy hemorrhagic fluid

microscopy

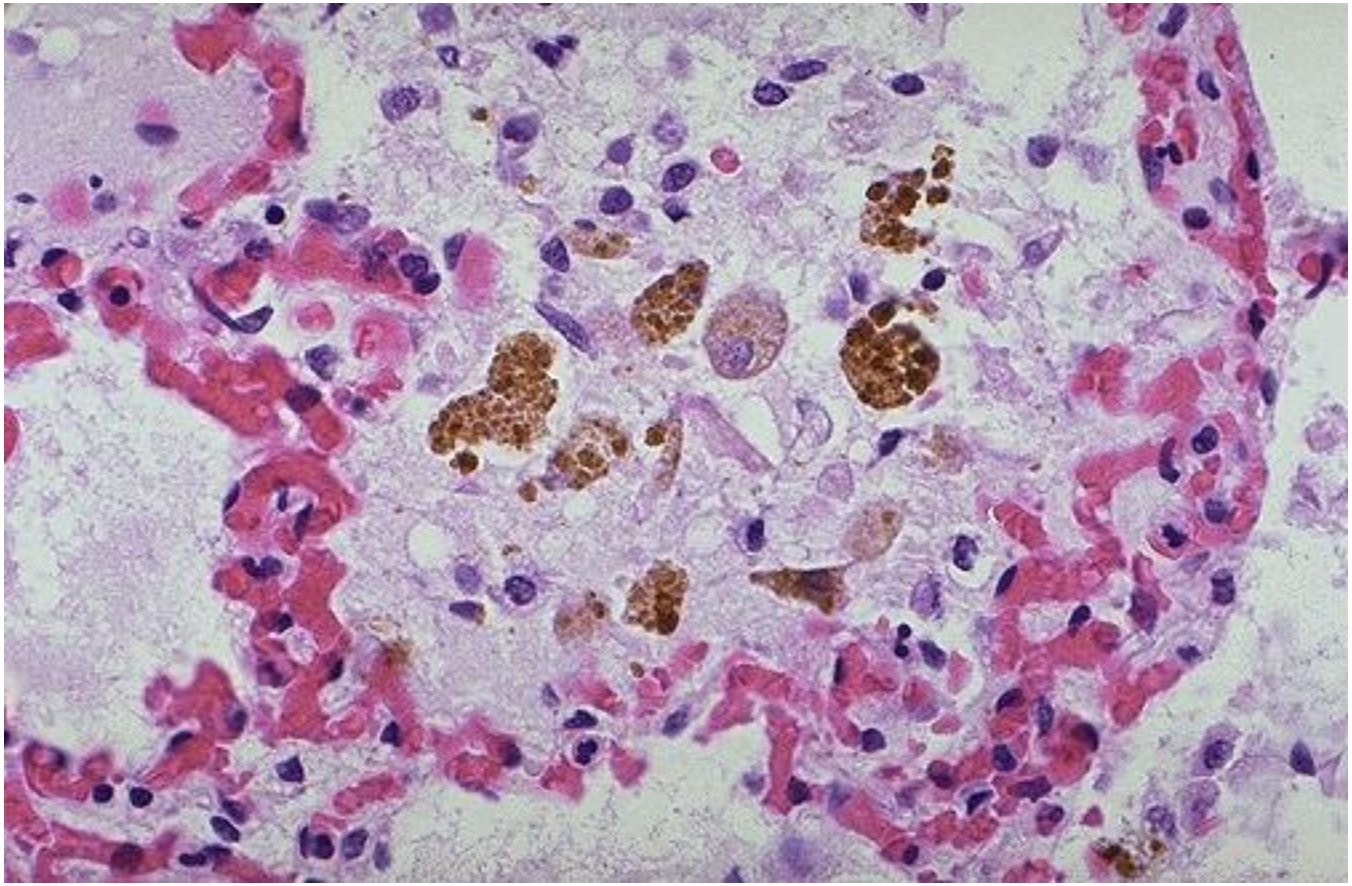
- Alveolar septa thickened
- Alveolar space edema, extravasation of red cells

- Heart failure cells and fibrosis

- BROWN INDURATION OF LUNG



At high magnification, the alveoli in this lung are filled with a smooth to slightly floccular pink material characteristic for pulmonary edema. Note also that the capillaries in the alveolar walls are congested with many red blood cells. Congestion and edema of the lungs is common in patients with heart failure and in areas of inflammation of the lung.

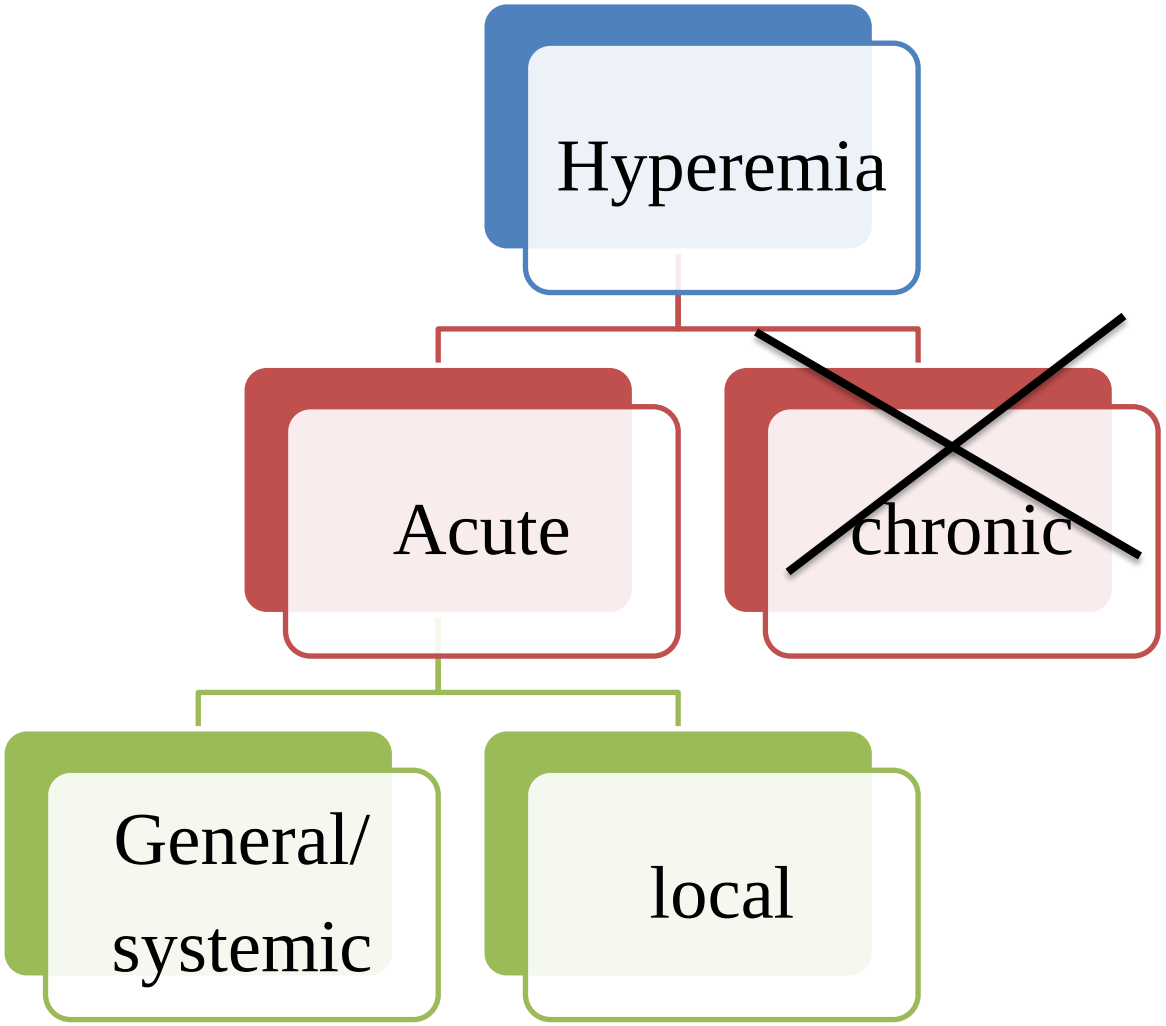


Pulmonary congestion with dilated capillaries and leakage of blood into alveolar spaces leads to an increase in hemosiderin-laden macrophages, as seen here. Brown granules of hemosiderin from break down of RBC's appear in the macrophage cytoplasm. These macrophages are sometimes called "heart failure cells" because of their association with pulmonary congestion with congestive heart failure.

CVC LIVER

- RIGHT SIDED HEART FAILURE
- Congestion of liver in centrilobular areas…..hypoxia….necrosis
- Peripheral areas have portal circulation so in later stages may develop fatty degeneration
- Cardiac sclerosis/ fibrosis

Hyperemia



Acute general (systemic) hyperemia:-

- It is increased amount of blood in the arterial system throughout the entire individual animal.
- **Etiology-**
  - Systemic diseases- Pasteurellosis, erysipelas, renal diseases etc.
  - Repeated intravenous medications with blood, plasma or electrolyte solutions thereby increases the total blood volume.
- **Gross appearance-**
  - arteries throughout the body are distended with blood,
  - organs and tissues have red appearance
- **Histological appearance-**
  - increased amount of blood within the arteries and capillaries.
- **Result-**
  - as soon as causative factor is removed, this type of hyperemia disappears and leaves no permanent alteration in the tissues.

Acute local hyperemia:-

- It is an increased amount of blood in arterial system within a local area of an individual.
- Most common type of hyperemia
- **Etiology-**
- Physiological-
  - in stomach and intestine following a meal
  - lactating mammary gland
  - in genital tract during estrus
  - in locomotory organs during exercise

Acute local hyperemia contd. :-

- Pathological-
  - associated with inflammation – when injurious agents (physical, chemical, thermal, viral, bacterial or parasitic) act up on the vessel wall there is dilatation of the arteries in that area.
- **Gross-**
  - affected part is enlarged, swollen, and heavier than normal
  - color is intense shade of red
  - blood vessels larger than normal and easily seen
  - on incising, blood flows freely from the cut surface of organs or tissues

Acute local hyperemia contd. :-

- **Histological appearance-**
- Arteries, arterioles and capillaries are distended with blood
- Active hyperemia is very difficult to detect in dead animal?-
  - as soon as heart stops beating, arterial walls contract and force the blood out of their lumen into the capillaries and veins. So very little blood is found in the arterial system in the dead animal.
- **Result-**
  - it is of great benefit in the area of inflammation.
  - It brings additional nutrients, oxygen,
  - removes, harmful chemical,
  - dilutes the irritant,
  - brings antibodies,
  - brings more leukocytes.
- No harmful or persisting effect.

Passive hyperemia/Congestion

- It is increased amount of blood in the venous side of the vascular system due to hindrance to the flow of blood from an organ or region. Also termed as congestion.
- General or local
- Acute or chronic

- Acute general passive hyperemia/ acute systemic congestion
  - Increased amount of blood in the venous side of the vascular system due to sudden obstruction to the flow of blood in the heart or lungs.
  - Persists for a short period of time
  - Involves entire venous side of the circulatory system
- Chronic systemic congestion
  - Increased amount of blood in the venous side of the vascular system that persists for a long period of time and results in permanent alterations in various organs throughout the body.

Acute Systemic Congestion

- Causes
  - degeneration and necrosis of the myocardium
  - Sudden myocardial infarction (from thrombus or emboli in coronary artery
  - Hydropericardium, hemopericardium, pyopericardium-
  - Pneumonia- passage of blood through the organ is retarded
  - Pulmonary thrombosis & embolism
  - Hydrothorax, hemothorax, pyothorax

prevents normal flow of blood through lungs and heart and cause it to accumulate in the venous system.

Acute Systemic Congestion

- Gross-
  - all organs appear bluish red (cynotic) in color
  - Veins distended with blood
  - Organs enlarged and heavier
  - On incision- blood oozes out freely
- H/P- veins and capillaries are distended with blood
- Result-
  - If mild changes and are quickly corrected- congestion disappears
  - If severe change- death
  - If not severe enough to cause death- chronic gen congestion

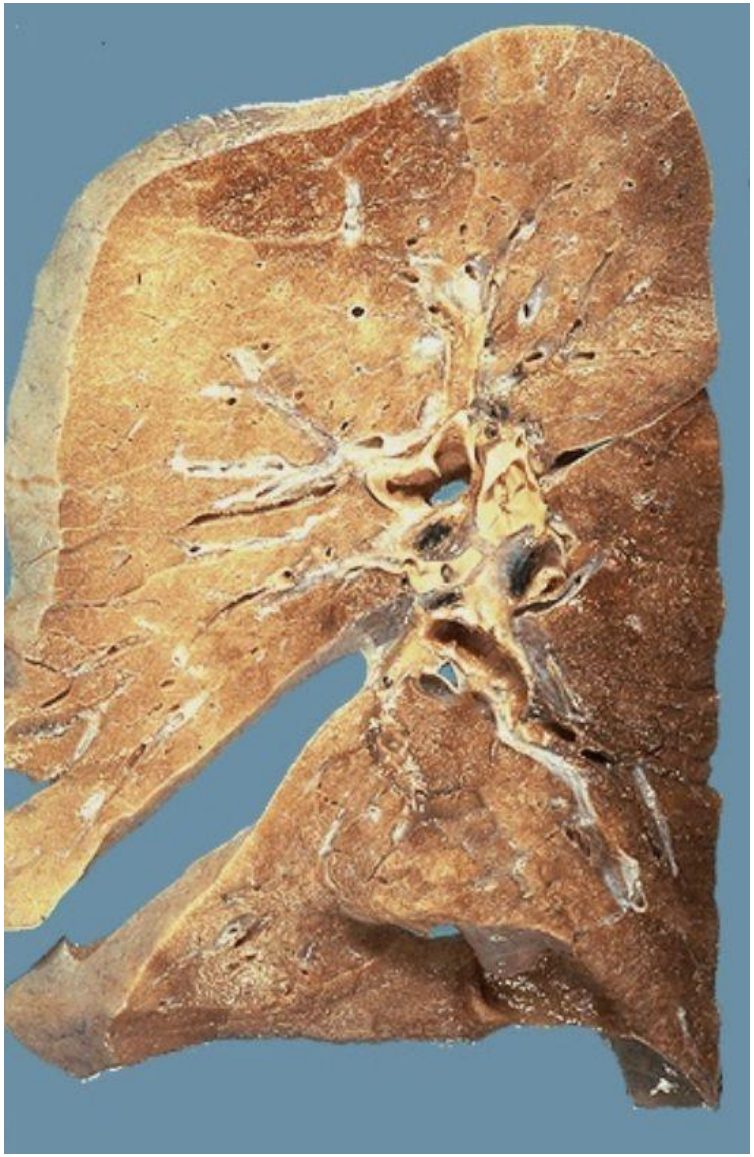
Chronic systemic congestion

- Causes-
- Lesions in the heart or lungs
- HEART-
- Stenosis of valvular opening (A-V valve)- infections diseases like valvular endocarditis- inflammation- septic valvular thrombi- stenosis (right a-v defect is more common in animals)
- Valvular insufficiency- valve not completely closed (thrombi, granulation tissue, firous scars)

- Myocardial failure- (cardiac muscles are injured)
- Anomalies- persistence foramen ovale, inter-ventricular defects, dextro-postion of the aorta- abnormal cardiac pressure
- Constrictive lesions of the pericardium and epicardium (traumatic pericarditis)- compress heart- normal function not maintained- blood accumulates in the venous system

- **LUNGS-**
- **Obliteration of blood flow** – retardation through right side of the heart- backpressure into the liver (pneumonia, pneumoconiosis, chronic alveolar pulmonary emphysema in horses)
- **Hydrothorax, hemothorax, pyothorax** – pressure on alveoli- atelectasis
- **Compression of major pulmonary vessels** by tumors, cysts, or abscesses.

- **Gross-**
  - veins throughout the body are engorged with blood, cynosis, edema, atrophy of organs, fibrosis, chronic hypoxia- degeneration and necrosis.
  - Lung liver and spleen develop the most noticeable changes
- **Lungs-** affected in the left side heart failure (lesion in mitral valve)
  - Injtra alveolar hemorrhages, - release of hemosiderin- phagocytosed by alveolar macrophages (hemosiderin laden alveolar macrophages are called “heart failure cells”
  - Alveolar septa enlarges due to edema and later fibrosis- brown induration of the lungs.



Liver

- Liver- affected in right side heart failure or lesions in lungs
- Liver- size and weight increases
- Sectioning- shows nutmeg pattern
- Central veins are prominent
- Centrilobular region is congested red blue.
- Surrounded by paler hypoxic peripheral regions, fatty change
- When central areas become fibrotic, cardiac sclerosis or cardiac cirrhosia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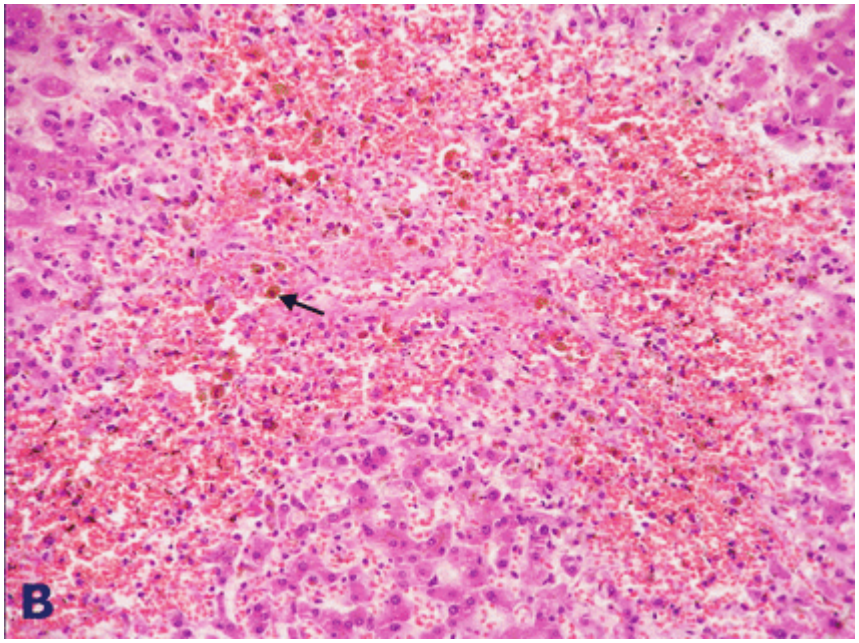
CENTIMETERS



Photomicrography of the liver showing centrilobular hemorrhagic necrosis associated with the deposition of hemosiderin (arrow) (HE-AO = 400X);

CVC Spleen

- Causes-
- Cirrhosis of liver with portal hypertension
- Right heart failure
- Portal /splenic vein thrombosis
- Elevated splenic venous pressure
- Enlarged reddish purple spleen
- Longer the congestion, more firm it becomes

Spleen

- Enlarged, cyanotic
- Sinosoids distended
- Atrophy of parenchyma and hyperlasia of the interstitial CT

CVC SPLEEN

MICROSCOPY

- Red pulp sinusoids filled with blood
- Fibrosis of the sinusoid walls , capsule and trabeculae
- Hemosiderin deposition
- Nodules of hemosiderin- + macrophages with calcium deposition + fibrosis = **GANDY-GAMNA nodules /bodies**

ACUTE LOCAL CONGESTION

Increase amount of blood in the veins of an local area due to sudden obstruction to the outflow of blood from an organ or region

Cause

Compression of veins due to malposition of organs

External pressure from ligature, torniquets, bandages, and rubber bands

- Gross
- Veins are engorged with blood
- If persist, hemorrhages
- Degenerative changes in surrounding tissues
- In intestine, putrifactive bacteria invade the dead tissue, gangrene

Microscoically

- Veins and capillaries are distended with blood
- Necrosis and suppurative inflammation
- Result
- If partial obstruction, no permanent change
- If obstruction persists, necrosis of tissue
- Atrohy and fibrosis

Chronic local congestion

- Increase in the amount of blood that persists for a long time in the veins of a portion and causes permanent changes, atrophy and fibrosis in the area.
- Cause, partial obstruction of the venous circulation
- Enlarging neoplasm, lymph nodes and abscesses
- Bandages, harnesses
- Thrombus within a vein

- Gross, affected organ enlarged and later atrophied, cyanotic
- h/p, distended veins and capillaries, edema, atrophy and fibrosis

Hypostatic congestion

- Accumulation of blood in the ventral portions of the body due to the influence of gravity
- Seen in cardiac injury, in recumbent, restrained, inactive animals, low b. p. And blood accumulates in the ventral portions e.g.lungs
- Result, it indicates the side of the animal that was ventral at the time of death