

## Cardiovascular system

**\*Pericardium** : It is a sac-like structure with two thin layers of tissue that surround the heart to hold it in place and help it work. A small amount of fluid keeps the layers separate so there's less friction between them as the heart beats.

### **\*Post mortem examination of pericardium.**

- 1-adhesion present or not.
- 2-Content of the pericardial sac.
- 3-In death, the heart usually stop at diastole (Fill of blood).

### **\*Diseases or disorders or lesion of pericardium.**

#### **(A)Hydropericardium.**

There is excessive amount of watery fluid in the pericardial sac.

**\*Sequella or effects of hydro pericardium.**

- 1-When there is too much a mount of fluid lead to degeneration of mesothelial cells → regeneration in finger or papillary like projections.
- 2-Scarring → C.T proliferation.

#### **(B)Hemopericardium**

Excessive amount of blood accumulated in the pericardium.

#### **(C)Pneumo pericardium:-**

Too much air or gas in the pericardium, there from esophagus, fore stomach, lung → cardiac tamponate.

#### **(D)Pyopericardium:-**

Presence of pus in pericardium due to pyogenic bacteria.

### **\*Pericarditis**

Pericarditis is inflammation of the pericardium.

Types of pericarditis.

#### **A)Fibrinous Pericarditis.**

The exudates of inflammation is fibrin

\*Microscopically:-

1-Congestion of B.V.

2-Network of fibrin pink in color.

3-Inflammatory cells (neutrophils).

\*Grossly

Thin membrane and white in color.

### **B)Suppurative or purulent pericarditis.**

This type of pericarditis caused by pyogenic bacteria Ex. Staph, strept. These pyogenic bacteria reach in to the pericardium through penetration of the heart by foreign body (piece of wire or nail) which swallowed by the cattle and established in the rumen and reticulum and because of honey comb appearance of reticulum wall the foreign body penetrated into the heart and carrying the pyogenic bacteria and cause purulent or suppurative pericarditis so the disease called traumatic reticulo pericarditis (TRP).

\***Metabolic disease or disturbances of pericardium.**

#### **1-Serous atrophy of the fat**

Gelatinous yellowish materials on the coronary groove on the base of heart occur as a result of starvation because abnormal metabolism of the fat tissue on the coronary groove on the base of the heart.

**2-Obesity:** too much fat on the heart.

#### **3-Visceral gout.**

Due to deposition of uric acid and urates crystals on the pericardium. Its chalky material and it irritant and lead to granuloma.

\*Microscopically

Caseous necrosis contain the foreign body, giant cells, macrophages and lymphocytes.

\***Myocardium**

\*Degeneration

### 1-Hyalin degeneration (zenkr's necrosis)

This type of necrosis caused by decrease vit. E and selenium. The muscles fiber become white, so called white muscle disease, mostly common in skeletal muscles and myocardium.

### 2-Fatty change:

Deposition of fat droplets in the myocardium due to starvation, in which abnormal metabolism of fat tissue and there is oxidation of unsaturated fatty acid.

### 3-Lipofusceinosis (brown atrophy of the heart)

Deposition of Lipofuscein pigment which initiated from abnormal metabolism of fat in case of starvation in similar way of fatty change, these pigment deposited on the poles of the nucleus of myocardial fiber and which is atrophied so called brown atrophy of the heart.

### **\*Myocardial degeneration. (Infarction & thrombosis):-**

Myocardial degeneration. In human start following thrombosis of coronary artery which result in to blocking of blood supply to the myocardium, ischemia then acute coagulative necrosis which is infarction in the area of the heart or myocardium supply by the same thrombosis coronary artery.

### **\*Myocarditis**

Myocarditis is an inflammation of the heart muscle (myocardium). The inflammation can reduce the heart's ability to pump and cause rapid or irregular heart rhythms (arrhythmias).

\*Myocarditis may be suppurative or granulomatous or eosinophilic.

\*Eosinophilic Myocarditis.

This type of myocarditis characterized by excessive infiltration of eosinophil's in the myocardial muscle fiber . this type of inflammation may be initiated following the pathological condition.

- a. hypersensitivity or allergic reaction.

- b. Parasitic infection in the heart.
- c. Autoimmune disease (Rhumatic myocarditis).

\*Healing of myocardium:-

Healing by fibrous tissue proliferation called cicatrix or scar formation.

### **\*Endocardium**

\*Lesions of the endocardium.

(1)Mineralization.

Its not specific lesion it seen in the C.T of endocardium appear as whitish solid material or as a chalky material and during cutting it produce gritty sound.

**\*Microscopically:-**

Calcification appear as purple color material but by special stain (van kossa stain) it take black color.

**\*Endocarditis.**

Its inflammation of endocardium , Infective endocarditis is divided into the three categories of acute, sub acute, and chronic based on the duration of symptoms. Its cased by bacteria ex.staph or strept, corynebacterium.

**\*Microscopically**

(a)Mucoid blue faint and criss-cross arrangement of fibrils + C.T proliferation.

(b)Covered by intact endothelium.

**\*Congestive heart Failure.**

Mechanisms of C H F.

(1)For ward Failure (arterial or left side heart failure ).

Failure of the L. side due to mitral valve infection in this case few amount of blood pass to the L. ventricles → too much amount of blood in the L. Auricle → then back word to the lungs, in the lung there is pulmonary hypertension (decrease venous return from lung → pulmonary edema and congestion).

(2)Back ward failure (venous or right side heart failure ). Failure of the R. side due to stenosis of tricuspid valve few amount of blood pass to Right ventricles → too much of blood accumulated in the R. auricle → then pass to back ward to the vena cava & return back to the liver, Kidney, intestine, brain and causes generalized edema (anasarca)& excessive congestion & edema in all organs except lungs.

**\*Arteries:-**

\*Fibrinoid degeneration: it occur as result

1-Viral arteritis 2-Autoimmune disease

\*Microscopically

Eosinophilic homogenous material deposition on the arteriolar wall.

**\*Arteriosclerosis.**

Its induration or hardening of the B.V.wall due to increase of c.t in B.V.wall

**Type of arteriosclerosis.**

(A)Intimal sclerosis.

This most common in dogs over 5 years, it is a basic change because it starts in intima.

(B)Medial Sclerosis.

Seen in primates, there is C.T. proliferation and there is calcification

(C) Atherosclerosis:-

Its similar to intimal sclerosis because lesion starts in the intima and this deposition of fatty material in the intimal surface, these contain phospholipids, cholesterol, free fatty acid and triglycerides.

\*Microscopic App of Atherosclerosis.

1-Fatty material deposited on the intimal surface causing thickness of the intimal surface & Medial surface.

2-Infiltration of foamy cells (macrophages) in the intimal & Medial surface.

\***Arteritis**

Inflammation of the arteries.

1-Verminous or parasitic arteritis.

2-Viral arteritis.

\***Omphalophlebitis**: Inflammation of the umbilical vein.

\***Botryomycosis**: Granulomatous omphalophlebitis in new born foals.

\***Phlebectasia**: Over dilation of the vein lumen due to weakness of the wall

\* **varix or varicosity**: Phlebectasia in the hind legs.

**clot = thrombus or thrombosis :-**

Clot formed in the blood flow during the life.

Microscopic App. :-

1- Same component as clot + platelets.

2- Platelets adhere to each other and to the B.V wall to give amorphous pink or gray staining masses

3- Fibrin fibrils are heavy and thick.

**Gross App :-**

1- Friable with rough and stringy surface.

2- Color is mixture of red and grey .

3- clot attached to the blood vessels .

**Types of thrombus :-**

1- Occluding thrombus:- It closes the B.V lumen entirely.

2- Canalized thrombus:- It closes the B.V lumen but with one or more openings. The canals are lined by endothelium.

3- Obturating thrombus:- completely clogs the affected blood vessel (located in the veins)

**Causes:-**

Injury to the endothelium → release of thromboplastin → initiate the clotting and platelets adhere.

**Fate of thrombus :**

- 1- Lead to partial or complete obstruction to B.V.
- 2- Edema due to retarded out flow fluid from area drained by the thrombosis B.V .
- 3- Thrombus could be slowly liquefied by plasmin or enzymes of W.B.C
- 4- C.T. Organization :-thrombus replacement by C.T , it is permanent.
- 5- Calcification:- Ca replaces decomposed fibrin and dead cells.
- 6- C.T encapsulation .

**Emboli**

It is a foreign body floating in the blood.

Types :

**1- Simple emboli** = thrombus emboli = fibrinous emboli = piece of broken thrombus .

**2- Fatty emboli** : little of patient's fat circulate in his own blood. Stays as separate bodies .

Causes : of fatty emboli

A- Sudden release of fat from adipocytes ex. bone fracture.

B- Deficiency of cystine, methionine, cholinc → fatty change

**3-Gas emboli** :- there are air bubbles in the blood

Causes

A- Lowering of blood pressure.

B- Air sucked into venous circulation through gaping wound.

**4- Bacterial emboli** :- They comes from tissues heavily infected with bacteria .

Most frequent site of Bacterial emboli are liver, kidney and lungs, because flowing amount of blood and capillaries are high.

**4- Parasitic emboli** :-

These are fragments of adult parasites circulating in the blood. Ex. heart worms of dogs (*Dirofilaria immitis*) .

**5- Neoplastic cell emboli** :

Clumps of tumor cells carried in the blood .

**6- Spodongenous emboli** :

Are clumps of agglutinated R.B.C due to immunologic process

**7- other types** :

- Ex. foreign body ( piece of broken needle )
- Amniotic fluid emboli
- Hepatic emboli flowing trauma to liver .

## **Hemorrhage**

It is the escape of blood from a vessel .

Mechanism:

- 1- Hemorrhage by rhexis: escape of blood due to a break in the continuity of B.V.
- 2- Hemorrhage by diapedesis: Slow oozing of RBC and plasma through minute opening in B.V. wall ( erythrocyte lose one by one ) .

Types of Hemorrhage

- 1-Bruising: is an injury to the skin in which blood vessels are broken, leading to discoloration of the tissues from the presence of red-blood cells
- 2-Petechial: is a small, pinpoint area of bleeding.
- 3-Ecchymosis: is a bruise or purplish patch under the skin or moist tissues of the body due to bleeding



□ Bruises, petechia, or ecchymoses may appear spontaneously or following minimal trauma

5- Hematoma: blood escapes into the tissue producing tumor – like enlargement.

**causes:-**

1- Mechanical trauma = cutting of B.V

2- B.V wall necrosis ex ulcer.

3- Rupture of weakened B.V wall due to atheroma or aneurysm.

° Aneurysm: sharp bulging of B.V. wall due to weakening of its wall

° Atheroma: proliferative thickening in wall of large artery ( ex. aorta ) .  
there are layers to necrotic wall, ( cholesterol , lipids and C.T → thicker  
B.V → Hemorrhage.

4- Toxic injury to endothelium

**Fate Hemorrhage:**

1- Blood from Hemorrhage will be clotted .

2- Could lead to icterus ( jaundice ) .

3- Site of Hemorrhage is important. Ex. if brain → loss of vital function .

If pericardium → interference with heart function .

If trachea and bronchi → asphyxiation.

**Hyperemia and congestion**

Excess of blood in the vessel in a given part of organ due to too much blood brought in by artery or too little drained out by vein ( congestion )

Hyperemia: excessive arterial flow.

Congestion : interference with venous exit .

**Microscopic App:-**

1- Capillaries are dilated and filled with blood.

2- Capillaries look more numerous.

**Gross:**

- 1- The organ take bright red color .
- 2- During life: organ is warmer and painful .

**Edema**

It is excessive accumulation of fluid in inter cellular spaces and body cavity.

Types

According to the causes either general or local or inflammatory & non inflammatory

- 1- Inflammatory edema
- 2- Non inflammatory edema:- transudate. according to site
- 3- Localized edema:-is seen in most organs and tissue due to local causes.
- 4- Generalized edema ( Anasarca ): affects the body as whole but due to gravity it seen mostly in the ventral parts

**Microscopic App:-**

- 1- There is larger space between cells, fibrils and other structure of the organ
- 2- Space has a faint pink staining residue of precipitated protein ( albumin ).
- 3- Few R.B.C , WBC or fibrin threads are seen especially in inflammatory edema .

**Gross App:-**

- 1- Edematous part is swollen .
- 2- Edematous tissue is firm & doughy in consistency . it pits on pressure.
- 3- Cut surfaces pale yellowish fluid oozes.
- 4- During life, cool, painless & swollen .

5- Lungs, blood stained watery fluid exudes if lung is congested, the lung is distended & firm.

6- Serous cavities are distended with fluid.

7- Brain watery , flattening and swollen .

**Fate of edema : -**

- Fluid gets organized by C.T ( clotted first )
- Ascites :- accumulation of fluid in the peritoneal cavity.
- Hydro pericardium: accumulation of fluid in the pericardium cavity .
- Hydro peritoneum : accumulation of fluid in the peritone.
- Hydrocele : accumulation of fluid in the scrotal sac.