CHAPTER ONE

PATHOLOGY OF CARDIOVASCULAR SYSTEM

Introduction

Heart: The heart is located in the thoracic cavity between the lungs attached to mediastinum.

Function: It acts as the pumping station and pumps blood to different parts of the body.

Compensation: It is the ability of the heart to adapt to varying physiological needs and pathological abnormalities.

- e.g: whenever there is resistance to blood flow as in case of pulmonary fibrosis or chronic nephritis, the heart has to contract forcefully to force the blood through the blood vessels.
- Hence the heart muscles have to do more function and become hypertrophied.

- The hypertrophy of cardiac musculature is a compensatory mechanism.

Decompensation

- When the heart is unable to cope up with the demands and becomes fatigued and fails, the state of the heart is termed **decompensation**.

- The heart is unable to compensate for the ever increasing workload.

- The decompensation is a gradual process.

- The decompensate heart has dilated ventricles.

Causes of heart failure

Increased resistance to outflow: it occurs in case of:

- ♣ Hypertension
- ♣ narrowing of valvular orifice
- ♣ thrombosis and arteriosclerosis.

Alteration in the venous return: when the venous return is high or low continuously, the heart may fail at the end.

Impaired cardiac contraction: this occurs when the myocardial contractility is lost as in the case of myocardial necrosis due to coronary vascular insufficiency.

DEVELOPMENTAL ANOMALIES OF HEART

Anomalies from failure of closure of foetal cardiovascular shunts

- **Atrial septal defect**
- ♣ It could be failure of closure of the foramen ovale
- ♣ Foramen ovale is an inter-atrial –septal shunt that allows blood to bypass the lunges of the foetus
- ♣ It is usually closed in young animals
- ♣ Failure of foramen ovale to close leads to a condition called patent foramen ovale.

In foetal life,

- θ no partition in ventricles
- θ only one chamber which is divided into two right and left by inter ventricular septum.

- But when interventricular septum does not develop completely and due to defect in formation of complete partition, there is mixing of blood from both chambers.

- It is responsible for thickening of myocardium, roughening of

Ventricular septal defect

- It is a hole in the heart, is a common heart defect that's present at birth (congenital).

- The hole (defect) occurs in the wall (septum) that separates the heart's lower chambers (ventricles) and allows blood to pass from the left to the right side of the heart.

- Ventricular septal defect is failure of complete development of the inter-ventricular septum.

- This allows shunting of the blood between

- Normally, the right side of the heart pumps blood to the lungs to get oxygen; the left side pumps the oxygen-rich blood to the rest of the body.

- A VSD allows oxygenated blood to mix with deoxygenated blood, causing the heart to work harder to provide enough oxygen to the body's tissues.

- The clinical significance of VSD depends on its size.
- Larger defects remain patent (open) and significant left to right flow.
- overload of the right heart and pulmonary hypertension

  reversed flow of blood from the right into left ventricle cyanosis.

Patent ductus arteriosus

- Ductus arteriosus is a blood vessel in the foetus that connects pulmonary artery directly to aorta, thus by passing the pulmonary circulation.

- PDA is a condition wherein the ductus arteriosus fails to close after birth.

- ductus arteriosus, is a normal part of a baby's circulatory system before birth that usually closes shortly after birth.

- If it remains open, however, it's called a patent ductus arteriosus.

Early symptoms:

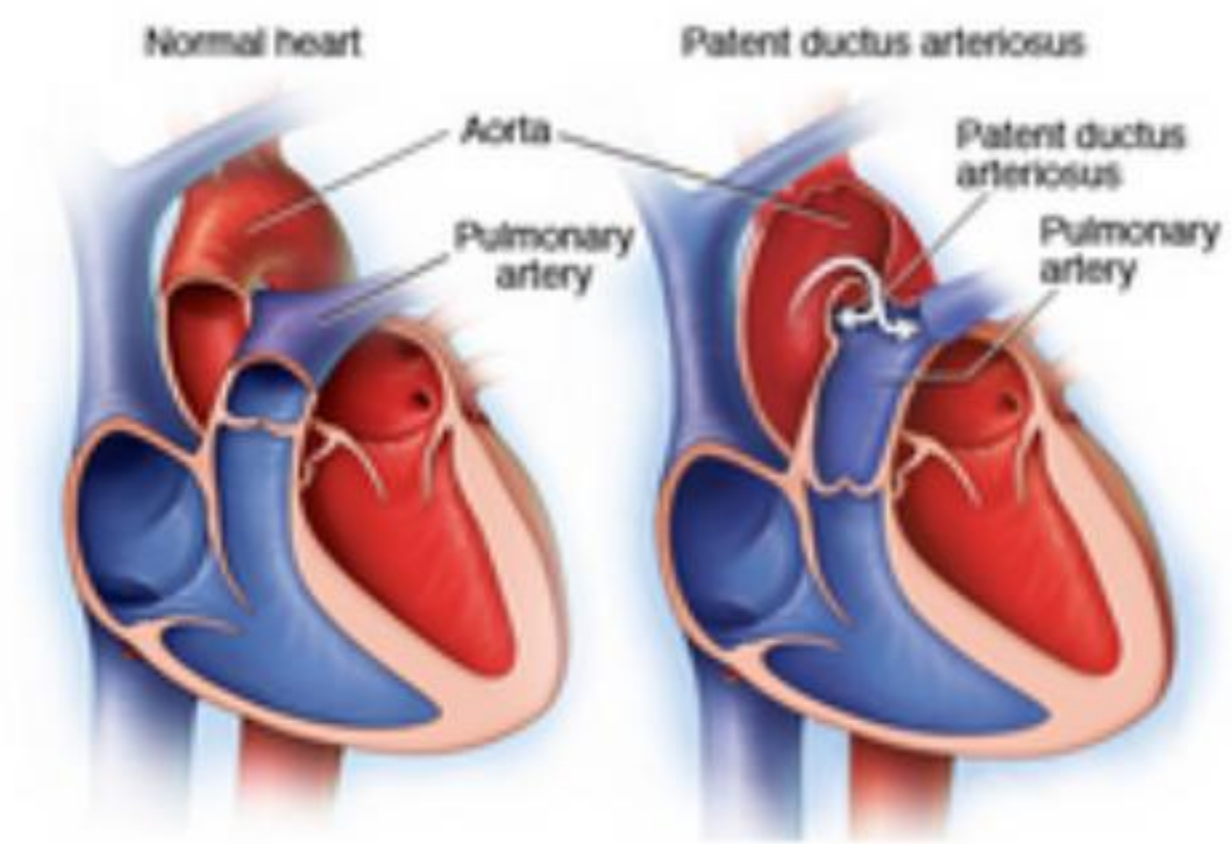
- increased 'work of breathing'
- poor weight gain
- congestive heart failure with increasing age
- irregular transmission of blood between the aorta and the pulmonary artery.
- hypoxia, high occurrence in premature newborns.

- The shunt connects the pulmonary artery with the aorta should obliterate within a few weeks after birth.

- If the shunt may be patent and hence blood might enter from aorta in the pulmonary artery causing increased pressure in the pulmonary artery hypertrophy of right ventricle

- The un oxygenated blood from pulmonary artery might also enter aorta causing mixing of oxygenated blood and hence the affected animals may be cyanotic.

- Blood is shunted from the left to the right ventricle (left to right shunt).
- This leads to pulmonary hypertension and



Patent ductus arteriosus

Coarctation of the aorta

- It also called aortic narrowing is a congenital condition whereby the narrowing of the lumen of the aorta

- Usually in the area where the ductus arteriosus (ligamentum arteriosum after regression) inserts

- The word "coarctation" means narrowing
- Other heart defects may also occur when coarctation is present, typically occurring on the left side of the heart.

- When a patient has a coarctation, the left ventricle has to work harder.

- Since the aorta is narrowed, the left ventricle must generate a much higher pressure than normal in order to force enough blood through the aorta to deliver blood to the lower part of the body.

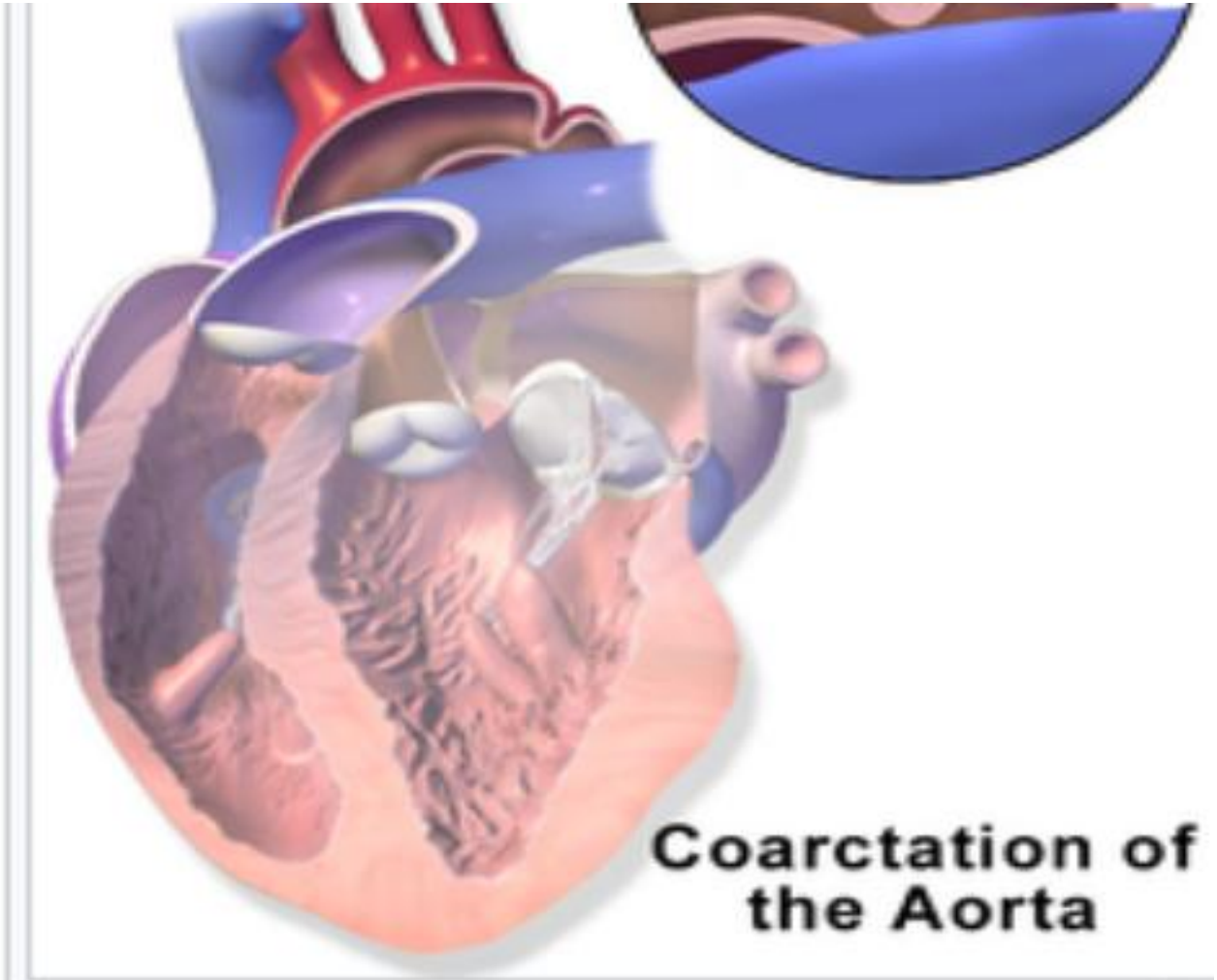


Illustration depicting Coarctation of the Aorta.

Multiple defects in the heart
Tetralogy of Fallot

- TOF is a congenital heart defect that is present at birth (four heart abnormality).
- This refers to four defects in the heart.
- They are Interventricular septal defect. Dextraposed aorta Stenosis of pulmonary valves and Hypertrophy of right ventricle.
- The affected animals are stunted and their mucous membranes are cyanotic, a heart murmur, and easy tiring upon breast feeding.
- In human beings, blue babies.
- The anomaly is characterised by four developmental defects of cardiovascular system and is also known as *tetralogy of Fallot*

Classically there are four defects:

- A ventricular septal defect, a hole between the two ventricles
- Pulmonary stenosis, narrowing of the exit from the right ventricle
- Right ventricular hypertrophy, thickening of the right ventricular muscle
- An overriding (Transposition of) aorta, which allows blood from both ventricles to enter the aorta.

Transposition of the great vessels

- Transposition of the great vessels (TGV) is a group of congenital heart defects involving an abnormal spatial arrangement of any of the great vessels:

- superior and/or inferior venae cavae
- pulmonary artery, pulmonary veins, and aorta.

- Due to abnormal development of the fetal heart, the large vessels that carry blood from the heart to the lungs and to the body are improperly connected.

- Essentially, the connections in the heart are "swapped."

Normally:

- oxygen-poor (blue) blood returns to the right atrium from the body, travels to the right ventricle, then is pumped through the pulmonary artery into the lungs where it receives oxygen.

- Oxygen-rich (red) blood returns to the left atrium from the lungs, passes into the left ventricle, and then is pumped through the aorta out to the body.

In transposition of the great arteries;

- the aorta is connected to the right ventricle
- the pulmonary artery is connected to the left ventricle

- Oxygen-poor (blue) blood returns to the right atrium from the body, passes through the right atrium and ventricle, then goes into the misconnected aorta back to the body.
- Oxygen-rich (red) blood returns to the left atrium from the lungs, passes through the left atrium and ventricle, then goes into the pulmonary artery and back to the lungs.

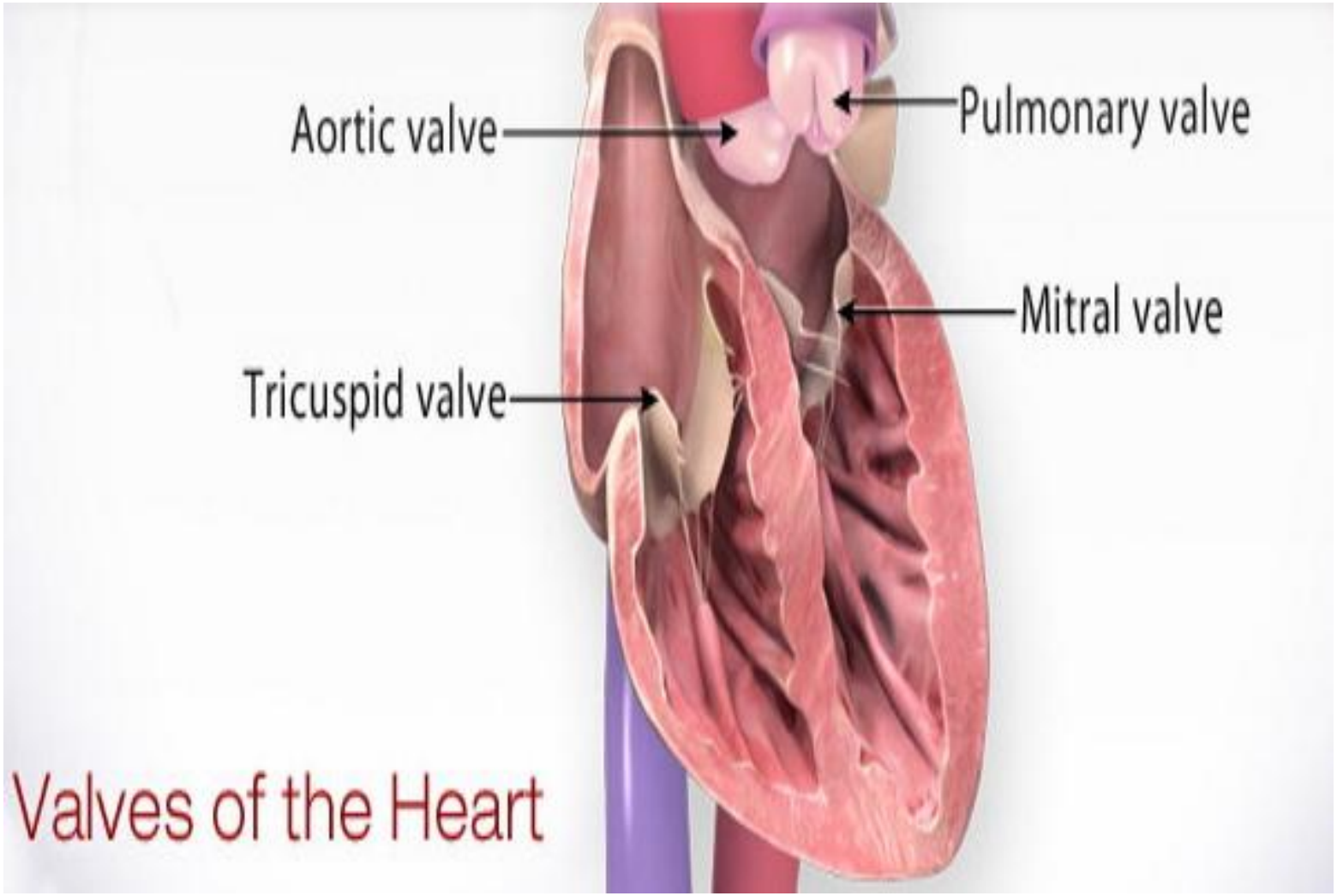
Anomalies from Failure of Normal Valvular Development

Pulmonic stenosis

- It is a congenital heart defect of the semilunar valve that is between the right ventricle and the pulmonary artery .

- The leaflets of this valve are thickened and/or partially fused together.

- This defect associated with ventricular septal defect, overriding aorta, subaortic stenosis).


Aortic valve
Pulmonary valve
Mitral valve
Tricuspid valve
Valves of the Heart

- In this condition the pulmonary valves fuse together resulting in stenosis.
- results in hypertrophy of the right ventricle.
- Congenital aneurysm of the aorta and pulmonary artery.
- causes pressure atrophy of the neighbouring structures.
- Fatal haemorrhage might also result from thinning and rupture of the

Subaortic stenosis

- It is an autosomal-dominant congenital heart disease
- characterized by a narrowing of the descending aorta.
- It consists of abnormal tissue below the aortic valve that creates an obstruction the heart
- Stenosis makes the heart work harder than normal hence heart muscle can become hypertrophied.
- The lesion causing septal hypertrophy and outflow tract tunneling fibrosis and obstruction.
- In this condition, a ring of fibrous tissue occurs just below the cusps of aortic valves.
- This causes stenosis resulting in hypertrophy of the left ventricle and finally its dilatation.

Valvular haematomas (Haematocysts)

- Usually seen on the atrio-ventricular valves of young ruminants.
- Lesions are blood filled cysts on the edge of the atrio-ventricular valves.
- They generally regress spontaneously when animals are several months of age and do not produced any functional abnormalities.

Other valvular developmental anomalies include:

♣ endocardial cushion defects (persistent atrio-ventricular canal)

♣ mitral dysplasia and tricuspid dysplasia

Other defects of the heart

- **Acardia:** a condition in which complete absence of heart. This condition is incompatible with life.
- **Ectopia cardis:** a congenital malformation in which the heart is abnormally located either partially or totally outside of the thorax usually in the neck region or abdominal cavity.
- **Endocardial fibroelastosis:** In this heritable disease the heart has white, thickened endocardium due to proliferation of fibroblastic tissue, usually left ventricle is affected.

- **Peritoneo-pericardial diaphragmatic hernias:** Occurs due to incomplete

Circulatory Disturbances

Haemorrhage

- The most common lesion of the epicardium, endocardium, and myocardium.
- Haemorrhage, vary in size and may be petechiae, ecchymoses, suffusion.

Cardiac failure

- It is the inability of heart to maintain adequate blood supply leading to death.

- It is the leading cause of deaths owing to high incidence of coronary vascular disease, particularly atherosclerosis, myocardial infarction.

PERICARDIAL DISEASES

Haemorrhages on pericardium

- Haemorrhage may be occurs in the form of petechiae, ecchymoses or extravasation.

Causes of petechiae

- Shock
- Toxaemia caused by toxins of bacteria and viruses
- Hypoxaemia
- Purpura haemorrhagica of horses
- Causes of ecchymoses and extravasations: Sweet clover poisoning

Abnormal contents of pericardium

- Pericardial sac may contain excess serous fluid, blood, pus or gas.

Hydropericardium

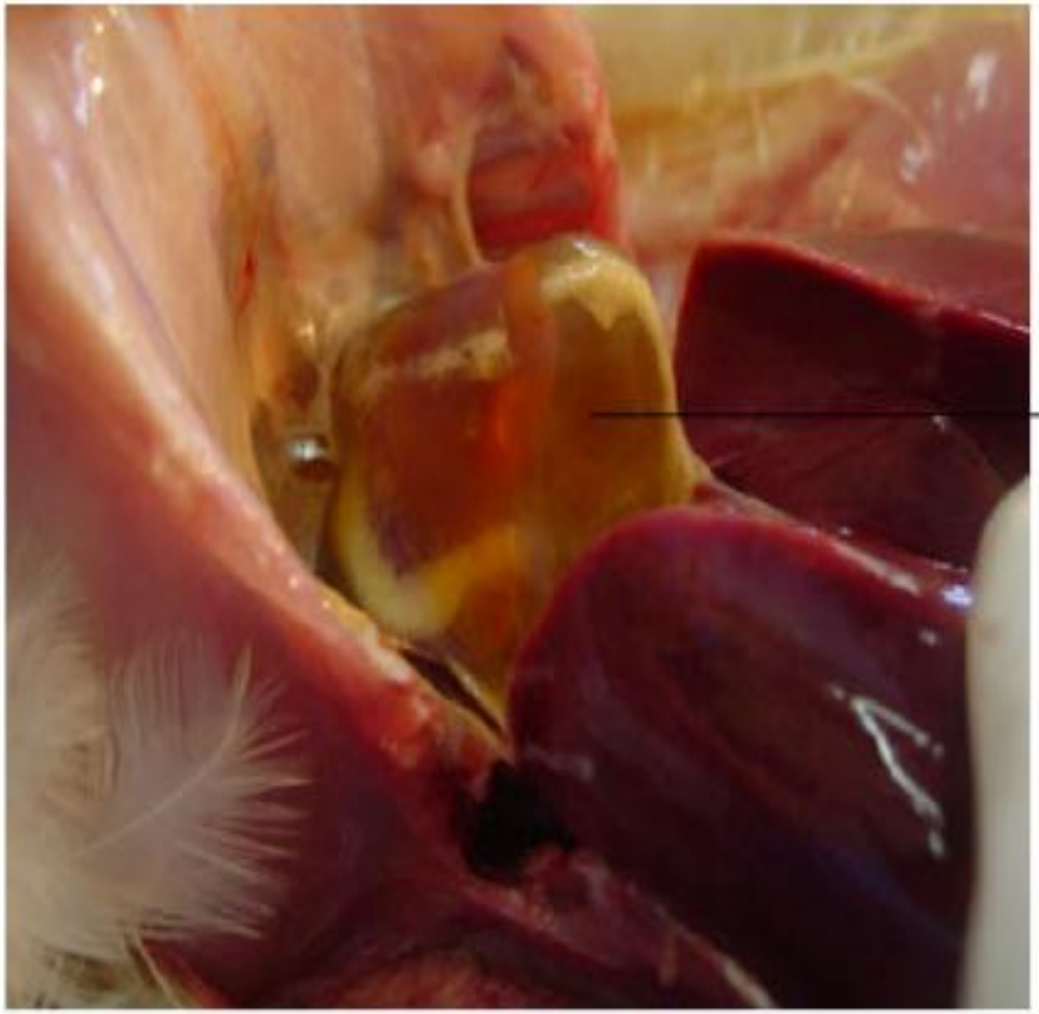
Definition: Hydropericardium means excess of serous fluid in pericardial sac.

Causes

- Cachexic diseases
- Congestive heart failure- leads to increased pressure in coronary veins and capillaries
- Liver insufficiency leads to stasis of portal circulation, hypoproteinaemia and renal disease
- Chronic stomach worm infection leading to hypoproteinaemia
- Anaemia especially haemolytic
- Many infections due to toxins
- Tumors in pericardium or myocardium and salt toxicity

Gross appearance

- The fluid is straw-coloured and clear
- In infections, the fluid may contain floccules
- This is due to damage of the capillary endothelium and much protein flows out into the exudates.
- If the fluid in the pericardial sac persists for a long time, it may become turbid and organized giving a shaggy (bun-butter) appearance to the pericardium and epicardium.



Hydropericardium - Broiler chicken

Hydropericardium

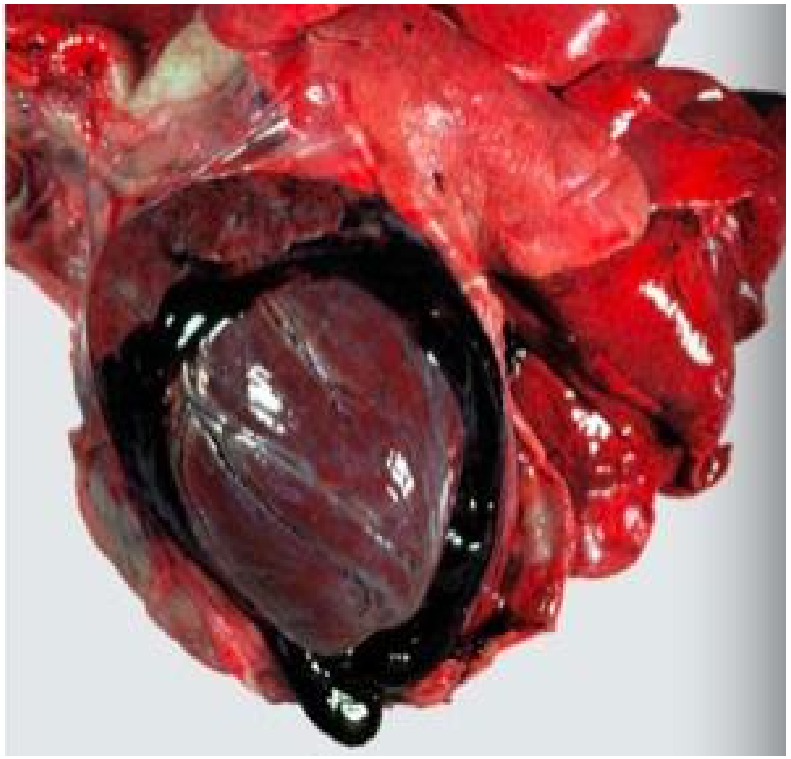
Hemopericardium

Definition: Hemopericardium means accumulation of blood in the pericardial sac.

Causes: Trauma to heart, Rupture of heart, aorta or coronary artery

Gross appearance:

If the blood clot completely encloses the heart, the condition is known as cardiac temponade.



Haemopericardium - J.Quail
(Due to Cardiac puncture during blood collection)

Hemopericardium

Pyopericardium

Definition: Pyopericardium means pus in the pericardial sac

Causes

- Rupture of myocardial abscess
- Purulent pericarditis
- Tuberculosis

Gross appearance: Pericardial fluid is turbid

Pneumopericardium

Definition: it means accumulation of gas in the pericardial sac

Causes

- Production of gas by gas producing organism which may enter the pericardium with a penetrating body.
- Gas may escapes into the pericardium in traumatic reticulitis
- Gas may enter into the pericardium often a lesion involving pericardium and lungs breaks down
- Gas may enter from outside in compound fracture of ribs.

INFLAMMATION

Pericarditis

Definition: Inflammation of pericardium is called pericarditis.

Pericarditis is a common condition in animals

Causes:

Chicken(Escherichia coli infection and salmonellosis);

Dogs (Leptospirosis and as a complication of distemper produced by secondary bacterial invaders);

Cattle(Pasteurellosis, coliform infection of new born and tuberculosis);

Routes of infection:

- Haematogenous: Occurs in septicaemic and other specific diseases
- Lymphogenous: From the inflammatory processes of neighbouring tissues- myocardium, pleura, bronchial or mediastinal lymph nodes caused by foreign bodies entering through reticulum.
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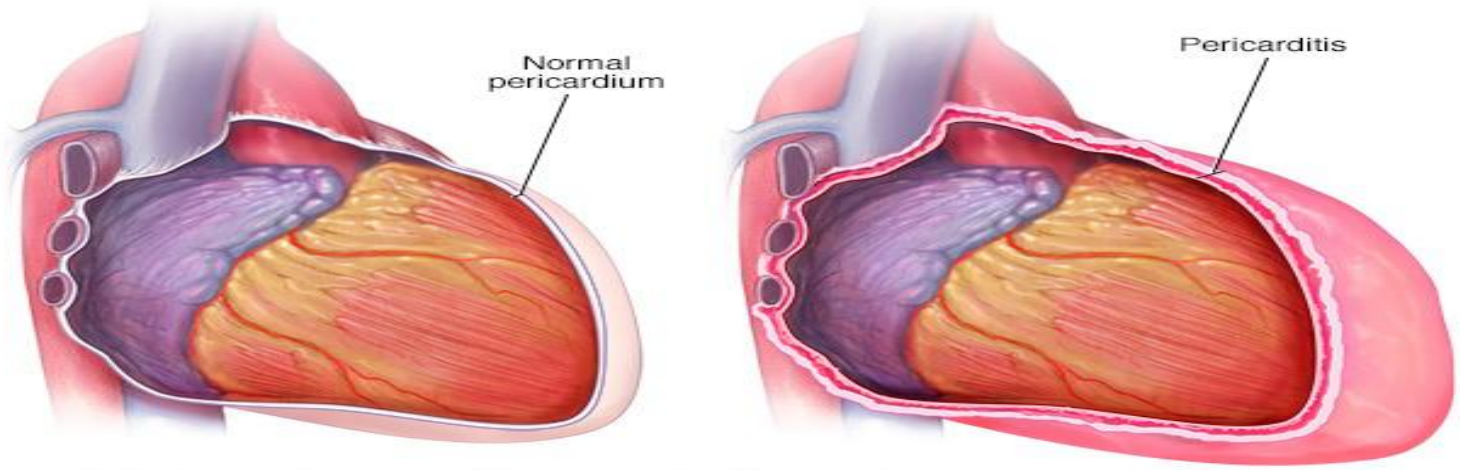
  b



Types of pericarditis

Based on the lesion or exudates classified as

¬ fibrinous pericarditis

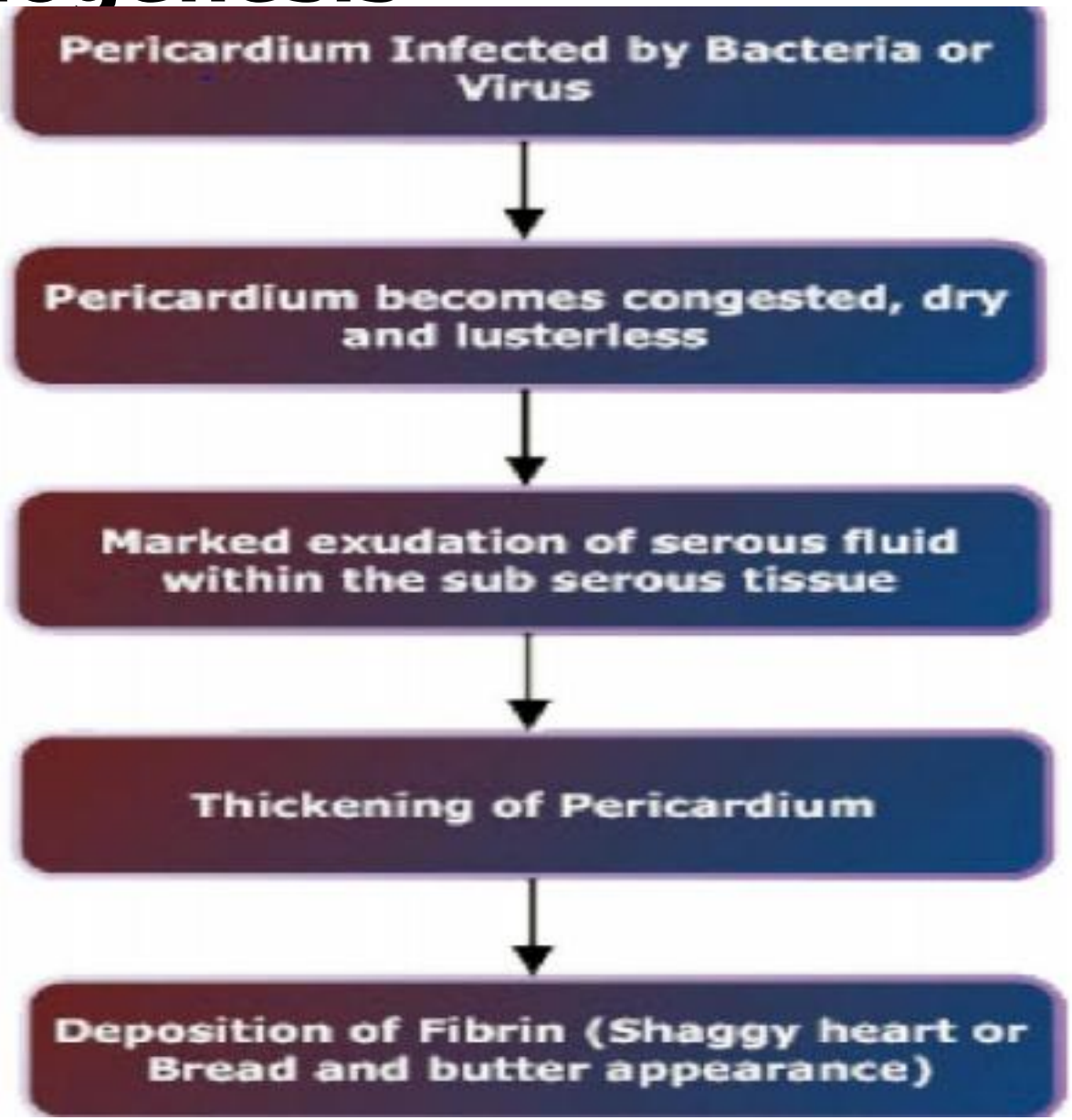
¬ suppurative pericarditis

¬ uric acid pericarditis

¬ serous pericarditis

- **Fibrinous pericarditis:** is inflammation of the pericardium, parietal and visceral, with fibrin deposits between the pericardial surfaces that can result in adherence.

Pathogenesis



Gross appearance

- Initially the pericardium is congested, dry and lusterless.
- Later becomes thickened with fibrin.
- contain increased serous fluid or have fibrinous exudate.
- The deposition of fibrin on the pericardium and into the sac gives the appearance of bread and butter - Such a heart is also called shaggy heart.

Microscopic features

- Desquamation or proliferation of mesothelial cells

Suppurative pericarditis

Definition: Inflammation of pericardium with accumulation of pus.

♣ Foreign bodies such as nails, pieces of wire that accumulate in the reticulum, occasionally penetrate the reticular wall and diaphragm and enter the adjacent pericardial sac and introduce infection.

Causes

- Salmonellosis in poultry
- Traumatic reticulopericarditis in cattle (“hard-ware disease”).
- Secondary to suppurative pleuritis and bronchopneumonia

Clinical pathology

- Blood shows severe leucocytosis with shift to left in traumatic reticulopericarditis in cattle
- Pericardial fluid contains more number of leucocytes

Gross appearance

- Pericardial sac is filled with pus
- Pericardium is thickened with fibrin on both the surfaces

Microscopic appearance

- Pericardium is thickened with fibrin and leucocytic infiltration especially of neutrophils.

Uric acid pericarditis:

- In fowls suffering from visceral gout
- the urate irritates pericardium and cause pericarditis.

Gross appearance

- The chalky white fine granules deposited on the pericardium gives the appearance of fine frost.

Microscopic appearance

- Pericardium contains needle shaped urate crystals surrounded by granulation tissue.

Serous pericarditis

Exudate - Plasma or thin watery fluid

Causes

- Moderate - severe irritant
- Chemical irritants applied on skin → "**BLISTERS"**
- Traumatic injury
- Viral infections – FMD

Gross appearance:

♣ Blister formation

♣ Clear, thin or watery fluid

♣ Sometimes mixed with fibrin gives a frosty glass appearance

Microscopically:

ϖ finely granular exudates

ϖ Stains pink with eosin (intensity varies with amount of protein in the exudates)

MYOCARDIAL DISEASES

Pathology of myocardium includes

- Hypertrophy
- Dilatation
- Cardiac failure
- Degeneration
- Necrosis
- Circulatory disturbances
- Inflammation
- Neoplasms

HYPERTROPHY

Definition: Hypertrophy of the heart muscle means increase in the size of the individual myocardial fibres.

Occurrence:

- Left side of heart is more often affected
- Ventricles suffer more frequently

Physiological hypertrophy: The ventricles become thicker due to greater strain on heart as in race horses and grey hounds.

Pathological hypertrophy

Etiology

Intracardial hindrances due to:

- ♣ stenosis or insufficiency of heart valves
- Stenosis or insufficiency of aortic valves leads to hypertrophy of left ventricle.
- Stenosis or insufficiency of mitral valve leads to hypertrophy of left auricle.
- Stenosis or insufficiency of valves of pulmonary artery leads to hypertrophy of right ventricle.

Extracardial hindrances

- Pulmonary emphysema
- Chronic interstitial pneumonia
- Pneumoconiosis

Types of hypertrophy

- Mere hypertrophy
- Concentric hypertrophy
- Eccentric hypertrophy

Gross pathology: -

- Heart is enlarged and walls become thicker,
- Hypertrophy of right side increases the width of the base of heart
- Hypertrophy of left side increases the length of the heart
- Bilateral hypertrophy causes the heart to be rounder and usually hypertrophy and dilatation

DILATATION

Definition: Due to deficient emptying during systole one or more chambers of heart may undergo enlargement.

Occurrence: Right ventricle is more commonly affected

Etiology

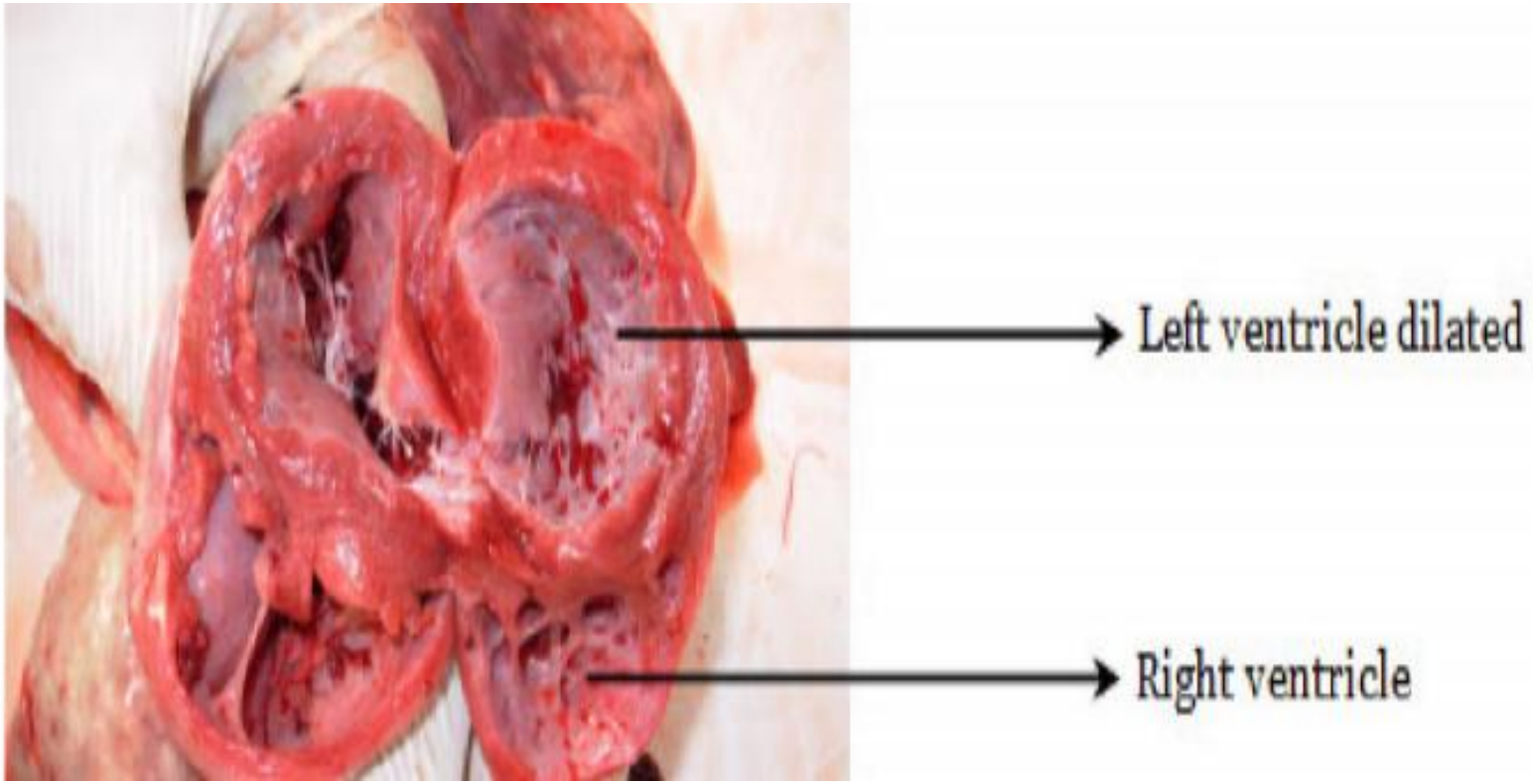
- Sudden acute dilatation occurs in severe acute intoxicating conditions and infections causing myocardial degeneration and myocarditis

- Chronic dilatation with hypertrophy in which it is a terminal lesion

- Dilatation of heart that is a sequel to

Gross pathology

- The heart is rounder and globular
- The walls are thinner
- Papillary muscles are attenuated



CARDIAC FAILURE

Definition: It is a syndrome of failing circulation in various organs due to:

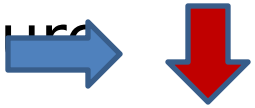
- decompensation
- loss of contractility.
- cardiac failure is usually bilateral (The failure of one side of heart leads to failure of the other side)

Left-sided heart failure

Etiology

- Aortic valvular disease
- Mitral valvular disease
- Nephritis in dogs
- Hypertension
- Congenital heart disease
- Myocardial degeneration
- Myocarditis
- Adhesive pericarditis

Pathogenesis

- Left sided heart failure  blood supply to various organs
- Anoxia of brain causes increased irritability, restlessness and in far advanced cases stupor and coma

- Renal anoxia causes impaired renal function.
- Salt and water are retained which causes increased blood volume and edema in dependant parts of the body.

- Diminished excretion of nitrogenous substances leads to prerenal uremia

- Pulmonary congestion leads to pulmonary edema.
- Edema fluid irritates the respiratory mucosa and causes cough

- Impaired exchange of gases. Hypoxia leads to

Clinical signs

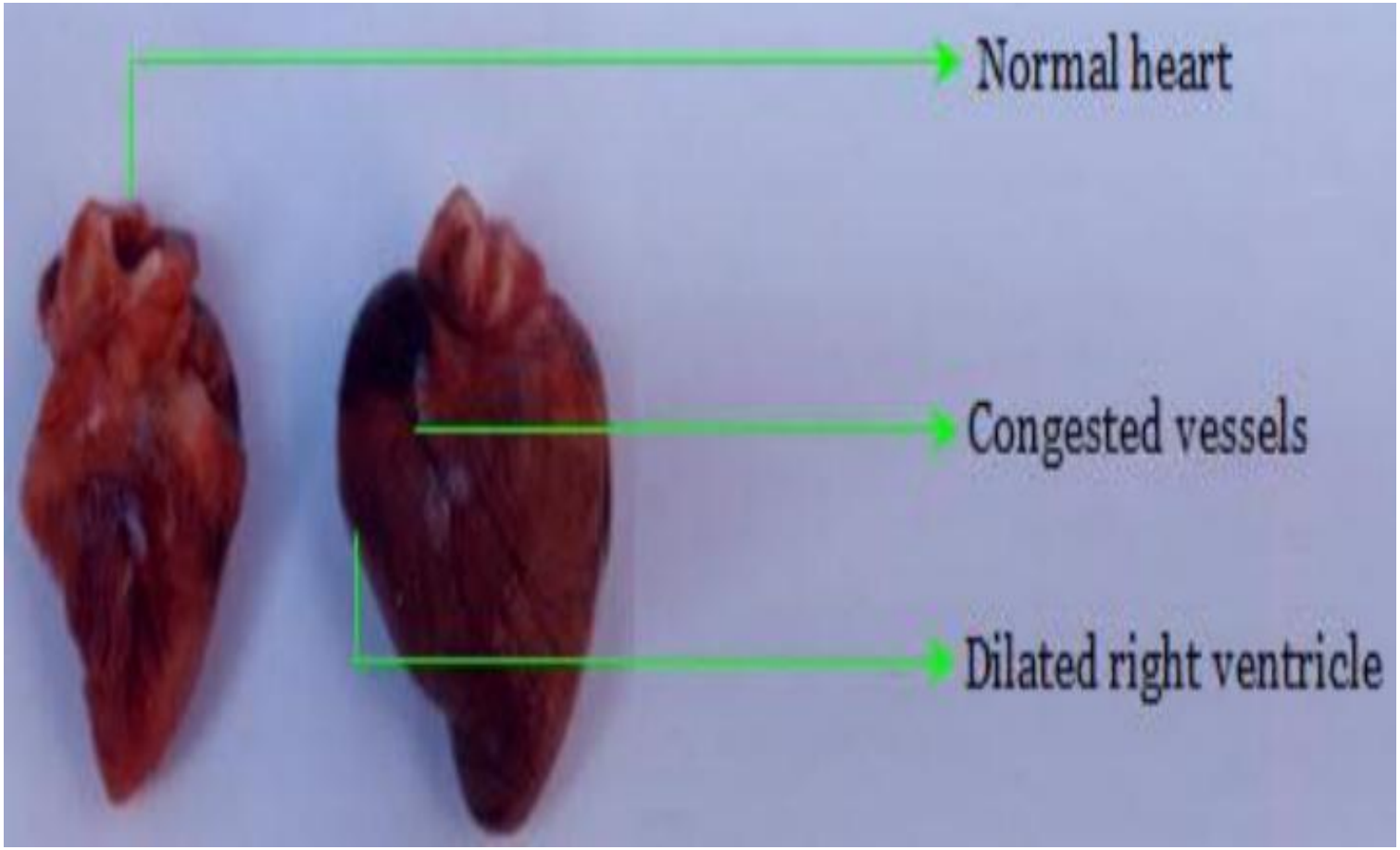
- affections of lungs, kidneys and brain
- Restlessness, Dyspnoea, Cough
- Edema in dependant parts of the body, coma

Lesions:

♣ Stasis in the pulmonary circulation is the reason for the pathology seen in left sided heart failure.

- lungs pulmonary congestion occurs, Because of alveolar congestion edema fluid accumulates in alveoli
- capillaries rupture leading to small haemorrhages in alveoli

Right-sided heart failure



- occurs along with left sided heart failure.
- Rarely right sided heart failure occurs in a pure form.

Etiology:

♣ Causes as those for left sided heart failure

Causes for the pure form of right sided heart failure

- Increased resistance to flow of blood in the lungs as in emphysema and chronic interstitial pneumonia
- Hydropericardium – As blood entering the heart is blocked
- Constrictive pericarditis - As blood entering the heart is blocked
- Endocarditis of tricuspid valves producing incompetence and stenosis
- Myocardial degeneration and infarction

Pathogenesis

- Pulmonary congestion ultimately affects the right ventricle and auricle
- damming back of blood in the systemic and portal venous circulation flow of blood into the left auricle from the lungs
- Venous stagnation produces interstitial edema
- Anoxia occurs
- glomerular filtration rate salt is reabsorbed and the retention pulls more water from the tubules which

Clinical signs: Cyanosis, ascites, pleurisy, edema, icterus, diarrhoea, epistaxis in horses.

Lesions: Stasis in the systemic circulation

Liver: Gross pathology; enlarged and congested

Histopathology

- Haemorrhages around the central vein
- Atrophy and necrosis of hepatic cords around the central vein
- Later in chronic stage fibrosis around the central vein occurs (Cardiac cirrhosis)

Kidneys: Congested

Spleen:; enlarged and congested

Histopathology

- Haemorrhages may be present liberating haemosiderin followed by fibrosis such areas may be calcified
- Metaplasia of reticulum to fibrous tissue causes hardening of the organ

DEGENERATIONS

cloudy swelling, fatty degeneration, fatty infiltration and hyaline degeneration.

Cloudy swelling

Etiology: Toxaemia, septicaemia, febrile conditions and autolysis

Gross pathology: Heart is enlarged, pale, friable and the myocardium has a “cooked up” appearance

Histopathology: Myocardial fibres, Slightly swollen, Cytoplasm: Granular, Cross striations.

Fatty degeneration

Etiology:

- severe irritant
- Prolonged infections
- Nutritional deficiency – Vitamin E, iron (Piglet anaemia),
- Toxaemia, Poisons – As, P, Chloroform,
- Pyometra, Purpura haemorrhagica in horses

Gross pathology: Heart

- Size: Enlarged
- Colour: yellowish – stripping of the endocardial surface especially on the papillary muscles (Tigering / Thrush – breast heart **)**

Histopathology:

Myocardial fibres contain fat droplets; the nuclei are degenerated.

Fatty infiltration

Definition: The fat of coronary adipose tissue infiltrated between the myocardial fibres

Etiology: Obesity

Histopathology:

Crowding of myocardial fibres

Sequelae: Heart failure

NECROSIS

- It is usually focal.

Etiology:

♣ Deficiency of vitamin – E in claves and lambs; thiamine in pigs,

♣ Virus – FMD in calves; equine viral arteritis and swine fever

Gross pathology: Heart contains scattered grayish spots.

Histopathology: Coagulative necrosis of myocardial fibres

Calcification: it is a dystrophic calcification occurring in necrotic myocardial fibres

Etiology

- Deficiency of vitamin – E in claves and lambs
- Hyaline degeneration is followed by calcification
- Excessive vitamin-D and calcium therapy in puppies

Histopatholo

Myocardium

CIRCULATORY DISTURBANCES

Haemorrhages

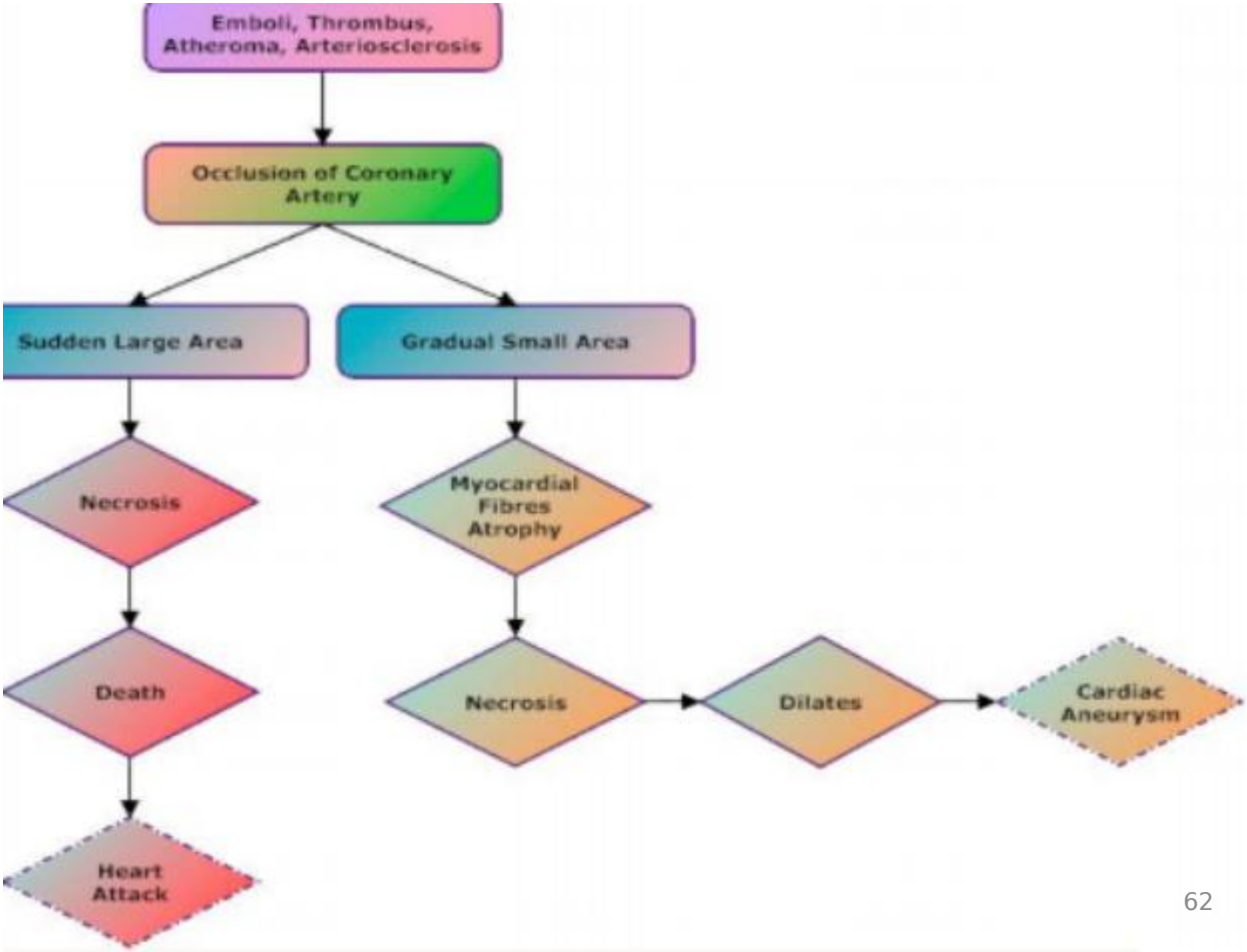
Etiology:

Toxaemia, septicaemia and death due to asphyxia

Gross pathology:

♣ shows petechiae, ecchymoses

Myocardial infarction



INFLAMMATION

Myocarditis:

- ♣ It is the inflammation of myocardium, the middle layer of heart.
- ♣ It may be suppurative, eosinophlic or lymphocytic depending on the type of the exudates.
- ♣ infections spread hematogeniously to the myocardium and occurs in various systemic diseases.

Etiology

- Toxins / Poisons, Bacterial and Virus, Parasites

Types of inflammation provoked by infectious agents include

- **Suppurrative myocarditis:** often originates from vegetative valvular endocarditis.

- **Necrotizing myocarditis:** is a frequent lesion of toxoplasmosis, a common disease of cats and dogs.
- **Haemorrhagic myocarditis:** occurs together with the haemorrhagic inflammation typically found on the skeletal muscle of cattle with blackleg.

SPECIFIC DISEASES OF MYOCARDIUM

- Tubercular myocarditis may occur from haemotogenous infection
- Actinomycosis may also affect myocardium

NEOPLASMS

- Primary tumours of the heart are uncommon
- Marek's disease may cause lesion in the heart of chicken.
- Secondary tumours are common e.g. Lymphosarcoma in cattle

ENDOCARDIAL DISEASES

Endocarditis: inflammation of the endocardium, the inner layer of heart.

- Occurrence: Common in animals – Swine are more frequently affected

Types:

- Inflammation of valves is common and is called valvular endocarditis.
- Inflammation of septal endocardium(wall) is called mural endocarditis

Sites of occurrence

Species	Frequent site
Horse	Aortic valve
Cattle	Right A-V valve
Dog and Pigs	Left A-V valve

Etiology:

- Bacteria (Erysipelothrix rhusiopathiae in swine,

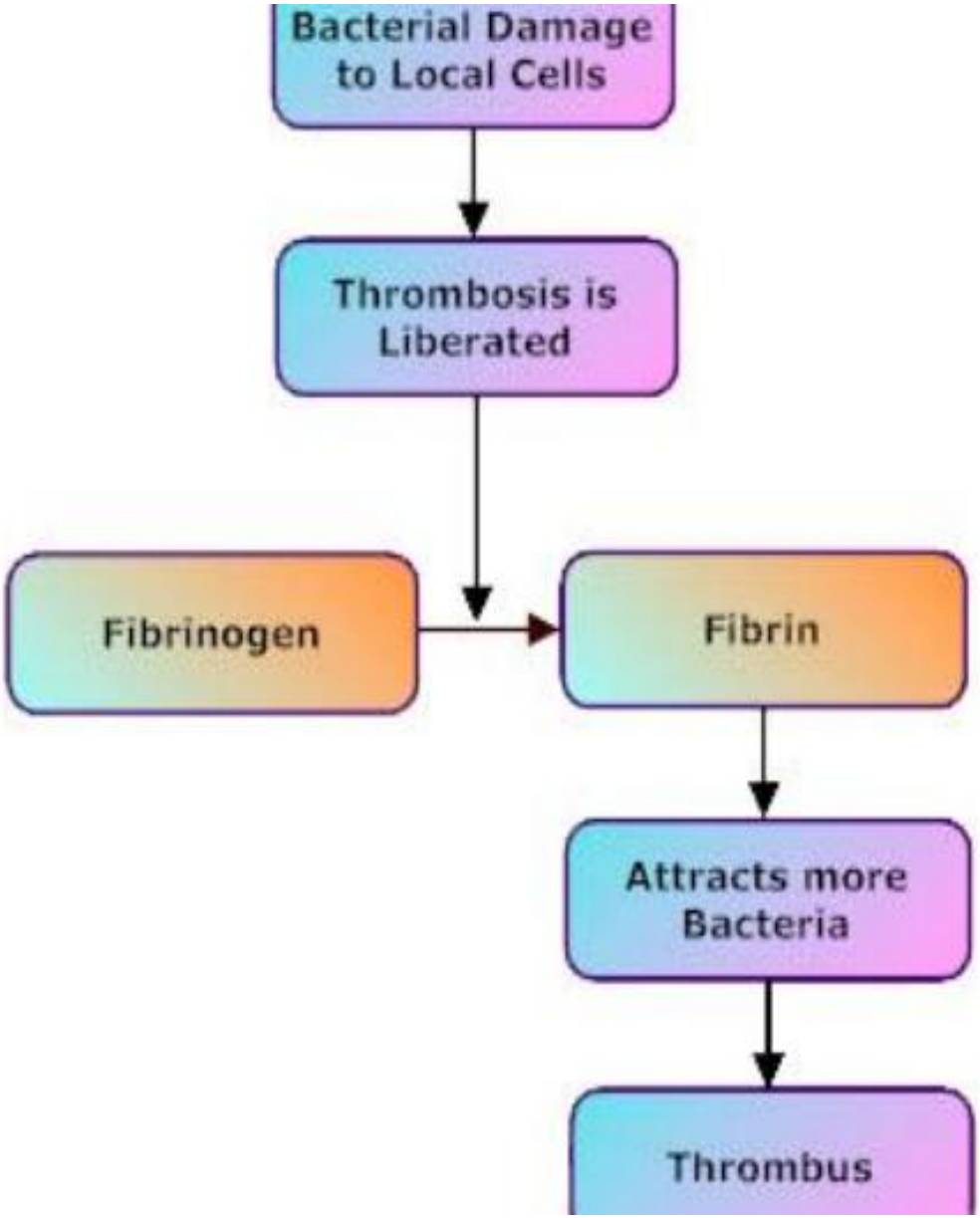
Streptococcus equi (Strangles in horses), Shigella equirulis,

Streptococci in cattle, swine and dogs,

Leptospirosis in dogs and Corynebacterium pyogenes in cattle).

- Parasites (Migrating larvae of Strongylus in horses)

Pathogenesis

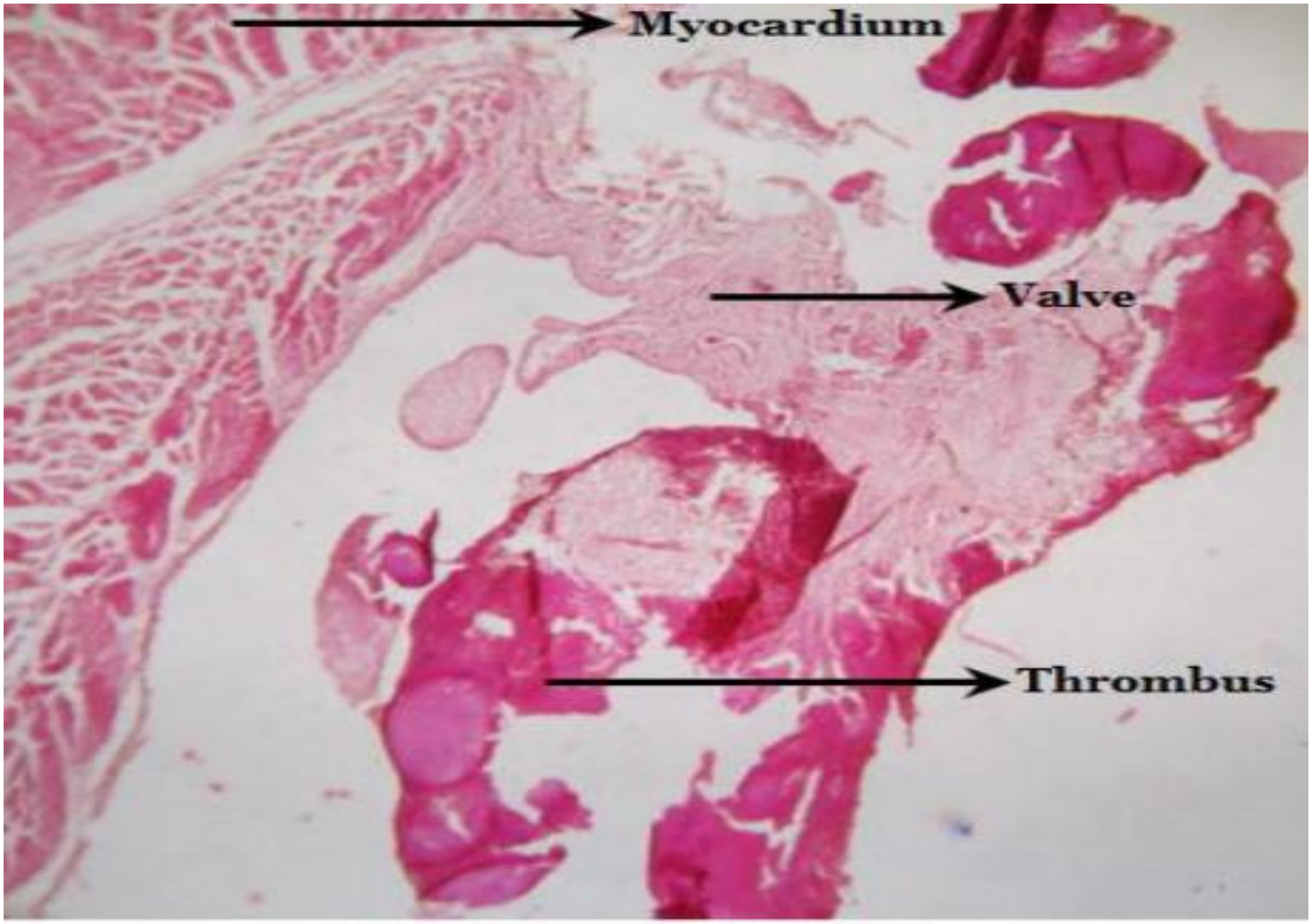


Gross pathology

- The thrombus is cauliflower like and friable and is called as vegetation.
- Endocarditis in which these vegetations are present is called vegetative endocarditis.
- roughening of left auricular endocardium
- In dogs with leptospirosis and uraemia, ulcerative endocarditis is common.
- Greenish ulcers are present in the left auricle and ventricle, pulmonary artery and aorta.

Histopathology

- thrombus with central bacterial clumps.
- Leucocytes are present in the intima.
- From the basal area of the valve fibrous tissue invades the thrombus.



Vegetative endocarditis -Duck

Degeneration

- it is associated with mineralization and fibrosis of the endocardium.
- Mineralization occurs from intake of excessive amounts of vitamin D and from intoxication of carcinogenic plants that contain vitamin D analogues.
- Fibrosis, with or without mineralization, occurs in chronically dilated hearts, in hearts of debilitated cattle with john's disease.

Grossly: the endocardium is white, rough (thick) and wrinkled.

VALVULAR ENDOCARDIOSIS (CHRONIC VALVULAR DISEASE)

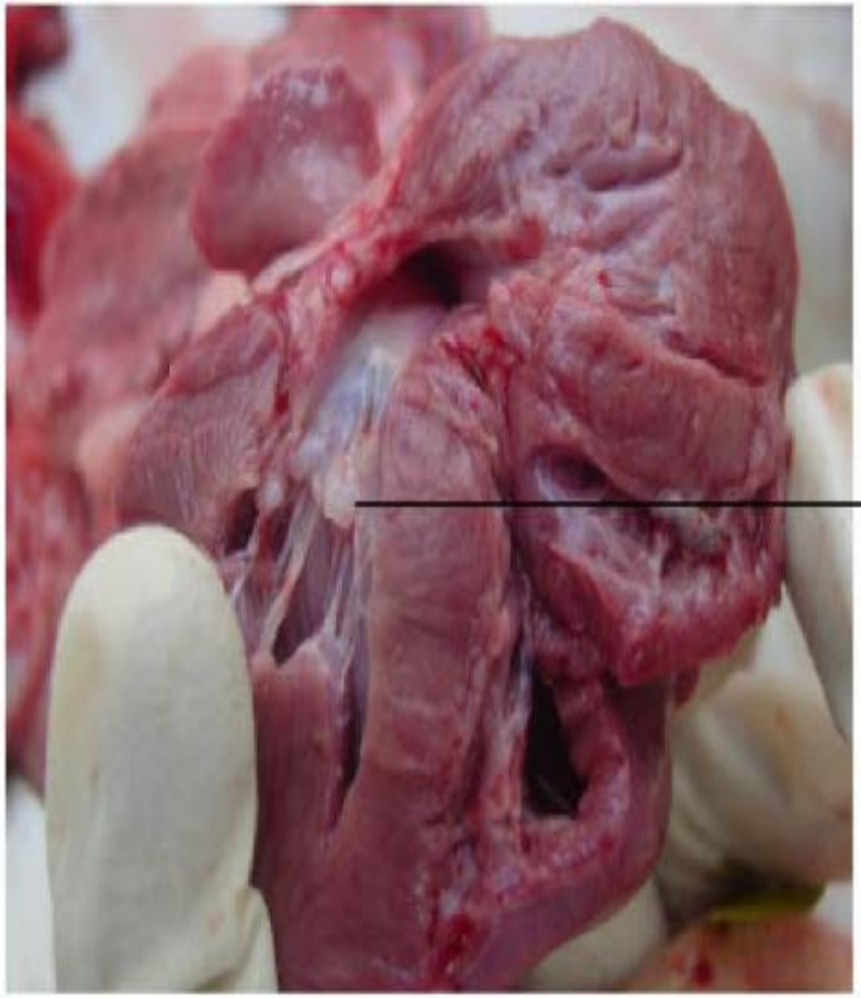
- It is associated with degeneration of valvular collagen.
- Site of occurrence: Mitral valve is commonly involved.

Gross pathology

- Valve – Thick, shrunken, nodular, distorted
- Chordae tendinae - Thick or ruptured
- Lungs – Acute pulmonary edema

Histopathology

Valves are thickened due to fibroelastic



Thick, shrunken and distorted mitral valve with nodular thickening on the borders

Endocardiosis - Bitch

Disease of the heart

Brisket disease of high altitude disease

- Brisket disease is a condition of slow cardiac failure, which occurs at 2500 meters sea level or above where pressure of air is low.

Etiology

- Low oxygen in environment
- Decreased atmospheric pressure of air
- In native cattle morbidity rate is only

Macroscopic and microscopic features

- Dilation of heart
- Hypertrophy of ventricular wall
- Chronic passive congestion in visceral organs
- Edema in sternal region in between forelegs.
- Nut meg liver due to chronic passive congestion
- Polycythemia
- Hypertrophy of muscle fibers in myocardium.

Mulberry heart disease

- It is characterized by firm contraction of heart and petechial hemorrhage on pericardium giving the appearance of mulberry.

Etiology

- Usually not know
- May be enterotoxaemia/ poisoning

Macroscopic and microscopic features

- Contraction of heart with petechial haemorrhage looking like mulberry "Mulbery heart disease"
- Hydropericardium, hydroperitoneum and pulmonary oedema
- Edema fluid has high protein content resulting in clot formation
- Congestion of fundic portion of stomach.
- Congestion on serosa of visceral organs.

Macroscopic features of Mulberry heart disease