

PATHOLOGY OF RESPIRATORY SYSTEM

- ⌘ The respiratory system that contains the air passage and the lungs is a site for exchange of gases.
 - ⌘ The smoothly gliding surface of the pleura and the negative thoracic pressure facilitate the gas exchange in this system.
 - ⌘ The respiratory system is the site for olfaction, organs of phonation and heat dissipation.
 - ⌘ It is intimately linked with the cardiovascular system the maintenance of the life.
-
-
- ⌘ infectious diseases of upper respiratory passage inflammation of mucosa nasal discharge
 - ♣ catarrhal

The infection may extend



lower parts of respiratory tract



reach in lungs



pathological alterations.

Injury to the respiratory system is due to:

- Constant exposure to air which containing microbes, particles, fibers, toxic gasses and Hematogenous.

Vulnerability of the respiratory system is due to:

- Extensive surface between respiratory system and inspired air
- Large volume of air passing continuously into the lung
- High concentration of noxious elements

Anatomy

Respiratory system is composed of:-

- ⌘ Conductive
- ⌘ Transitional
- ⌘ Gas exchange systems

✚ **Conductive system composed of:**

- Nasal cavity → pharynx → larynx → trachea
bronchi
- pseudo stratified ciliated columnar epithelium and have cartilage
- Secretory cells like goblet and serous cells are present

✚ **Transitional:-**

- Contains proximal and distal bronchioles
- Lack goblet cell and cartilage
- The proximal part has cilia
- It lack goblet cells but have Clara cells (highly metabolic, detoxification of xenobiotics).

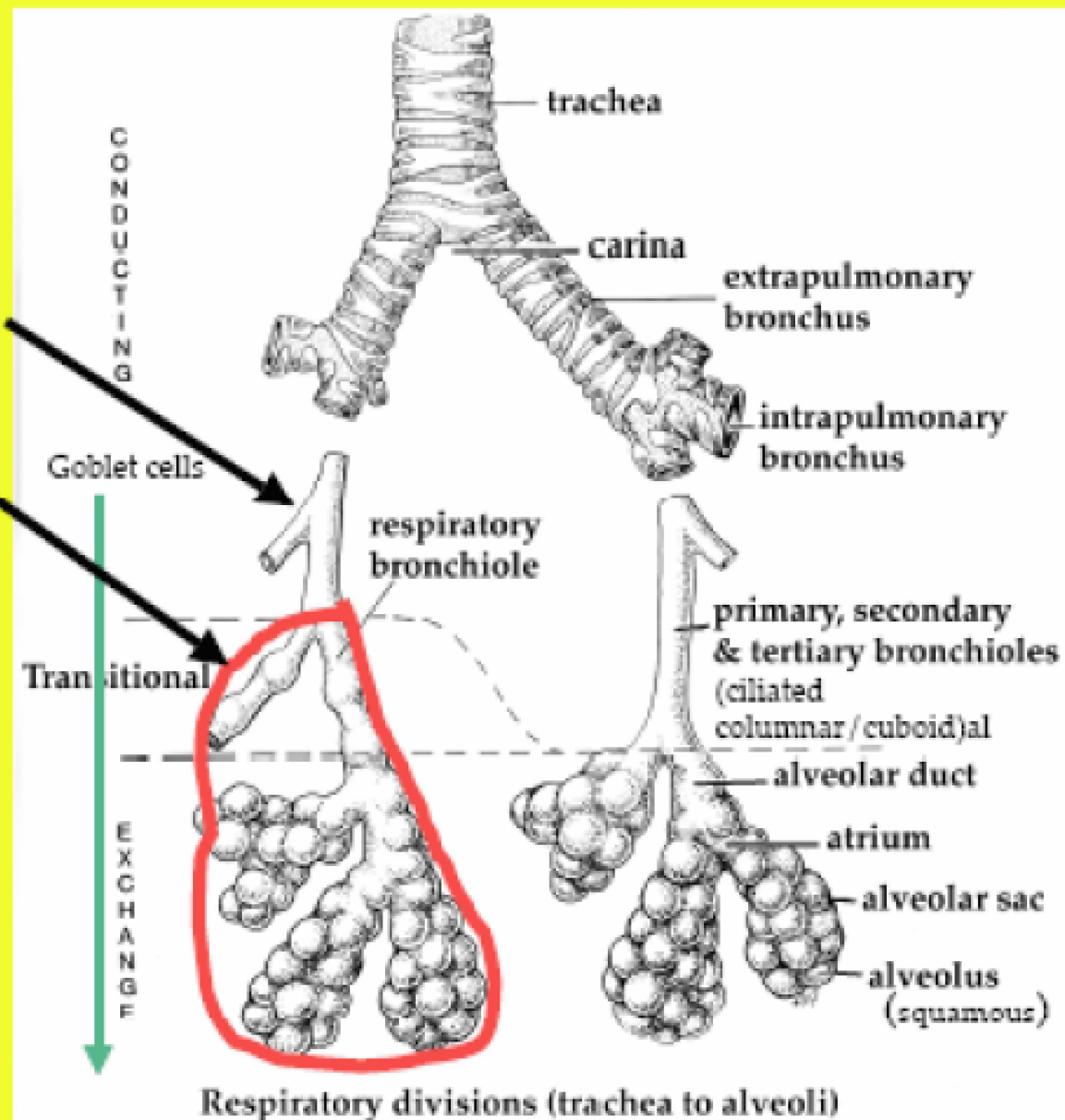
Gas exchange: -

Contains millions of alveoli which made of **two** types of epithelial cells;

- Pneumonocytes type I (membranous)
- Peumonocytes type II(granular)

Bronchioles

Respiratory
Portion



Defense mechanisms of the respiratory system

Anatomic configuration of the conducting system

Generally enhancing deposition:

Deposition-particles of various sizes and shaped are trapped(inertial or gravitational sedimentation)

- Coiled arrangement of nasal conchae (turbulence particles of $>10\mu\text{m}$ in diameter) on nasal mucosa.
- Tracheal and bronchial bifurcation-abrupt changes in the direction (particles of $2-10\mu\text{m}$ in diameter)
- Particles ($<2\mu\text{m}$ in diameter) come into contact on mucosa (sedimentation/

Clearance

- Process by which deposited particles **are destroyed, neutralized and removed from the mucosal surface.**
- Sneezing, coughing, mucocilliary transport and phagocytosis.

The conducting system (nose to bronchi) is covered by

- ♣ Pseudo-stratified ciliate epithelium
- ♣ Each ciliated cells has 250 cilia (6 μ m in length), beating 1000 strokes/minute with a longitudinal movement of 20mm/minute
- ♣ Numerous goblet cells
- Particles trapped in mucus are expelled (mucociliary movement).

- Only particles $\leq 2 \mu\text{m}$ reach the transitional and

Phagocytic defense mechanism:

- Occurs in the exchange system (lack cilia and gobletcells)
- They engulf bacteria, dust, pollen, spore, carbon and RBC(IgG opsonization)
- In ruminants, cleared of circulating bacteria or particle by pulmonary intravascular macrophages (***resident within pulmonary capillaries***).
- Catalase, and vit E involve in protection against peroxidation

Retention

- | Indicates particles remaining the respiratory system after clearance
- | Indicates abnormal conditions
- | Increased deposition/ Decreased clearance/ or the combination of the two

Impairment of defense mechanisms in the respiratory system

- Viral infections BHV-1, PI-3, BRSV in cattle; influenza virus in pigs; canine distemper virus in dogs. **Result in:**
 - Reduce and destruction of mucociliary blanket
 - Mucociliary clearance
 - Impair the phagocytic function of alveolar macrophage
- Toxic gases (H₂S, NH₃):-Impair defense by destruction cilia /impaired pulmonary bacterial

- Uremia, endotemia, acidosis, hypoxia, pulmonary edema decreased phagocytosis
- Dehydration increased viscosity of mucus decreased mucociliary action.
- Starvation, hypothermia and stress reduced humoral and cellular immunity.
- Anesthesesia cillio stasis.
- Immunodeficiency (acquired and congenital)

Patterns of injury and host responses in the conductive system

Pseudostratified ciliated epithelium:

- Cell degeneration, exfoliation, ulceration (mitosis and repair are seen in viral infections).

Goblet cells:

- Hyperplasia and squamous metaplasia in case of chronic damage.

Olfactory epithelium:

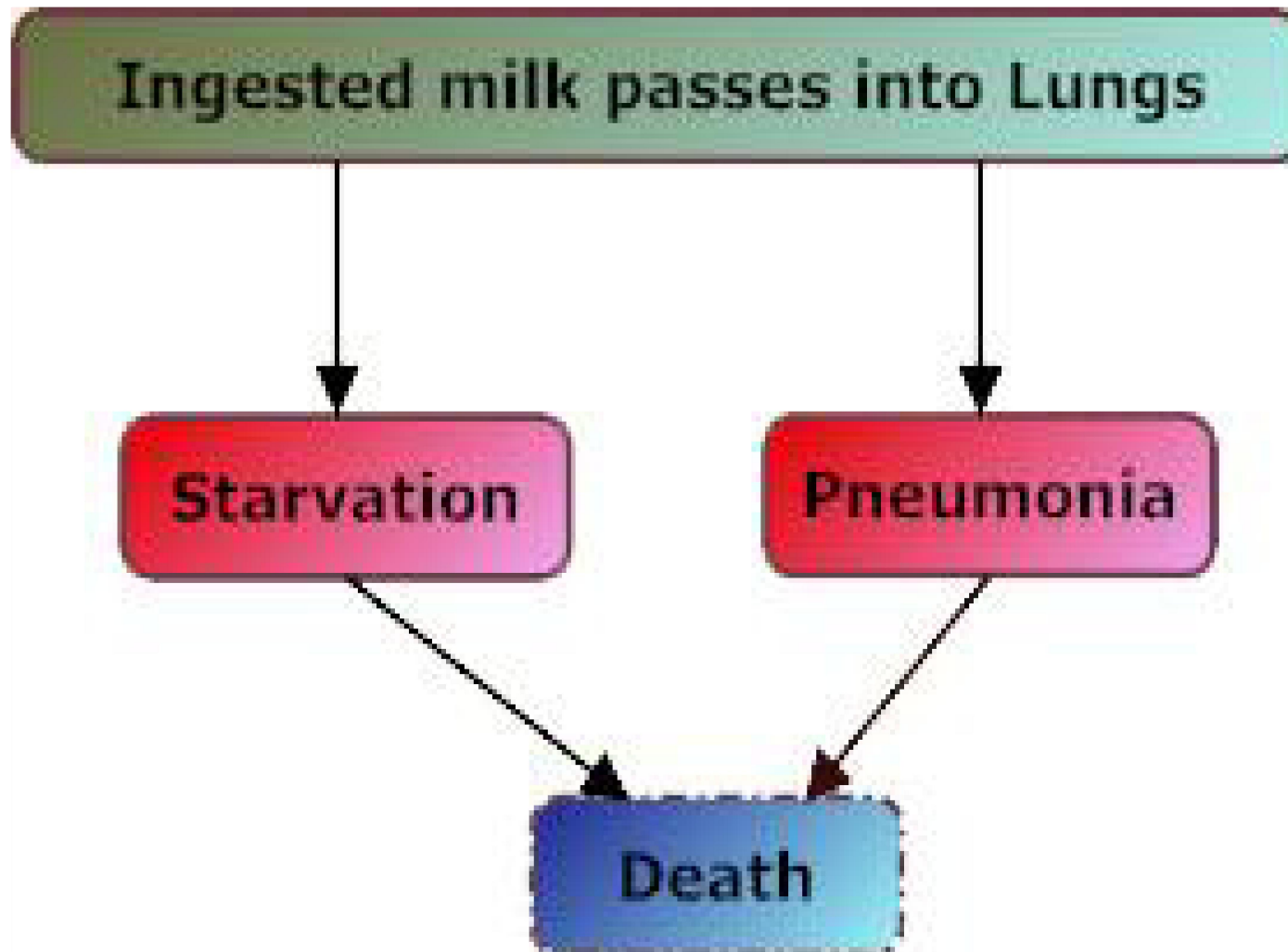
- degeneration, exfoliation and inflammation in extensive damage
- it is replaced by **goblet cells** or by squamous cells or by **fibrosis**.

Disease of the nasal cavity and sinuses

Cleft palate:

- Abnormal connection between the **nasal cavity** and the **mouth**. It is also called **palatoschisis**.
- Fairly common defect seen in newborn animals.
- Affected animals do not survive long.
- Characterized by *lack of hard palate*
- Communication between **the nasal and oral cavity** Causes **aspiration pneumonia** from

Sequelae



Clefted lips and palate



Nasal Congestion / Hyperemia

Causes

- Physical -compression as in case of overlay in piglets.
- Environmental stress
- Exposure to cold air (To warm the breathed air blood vessels in the nasal passage dilate).
- Pathological condition
- Inflammation (Rhinitis).
- Nasal congestion and hemorrhage are commonly seen in animals exposed to irritant gases (ammonia, H₂S, NO₂, etc.), shock, bloat, and of course in rhinitis.

Epistaxis

θ **Synonym:** Nosebleed

Occurrence: Infrequent in animals

Aetiology

- Physical
- Trauma- Violent exercise induces pulmonary haemorrhage in horses
- Bacterial disease: Anthrax
- Parasites: *Eimeria canis* in dogs; *Oestrous ovis* in sheep

Clinical signs

└ Bleeding may be unilateral or bilateral

Sinusitis: Inflammation of one or more paranasal sinuses

Etiology: Could be consequence of **rhinitis** (inflammation of the mucus membrane of noses).

- Bacteria - *Haemophilus paragallinarum* in chicken.

Route of entry

- Through **the wound produced by improper dehorning (cattle), and tooth infections** in horses.
- **Rhinitis and Sinusitis** are clinically characterized by **nasal discharge (unilateral or bilateral)**.

Gross pathology

- The head will be swollen
- The eyelids may be closed
- **The subcutis contains edematous fluid**
- The sinus **contains mucus or cheesy material**

Sequelae: Spread to **eustachian tubes** in human¹⁷

Rhinitis

Definition: Inflammation of the nasal mucosa.

Classification: Primary or Secondary.

- **Primary rhinitis** - occurs independently.
- **Secondary rhinitis** - partial manifestation of some of the acute and chronic infectious diseases.

Based on the nature of the exudates rhinitis classified as:

Serous rhinitis :

- ♣ It is the mildest form of inflammation and is characterized by hyperaemia and increased production of watery fluid.
- ♣ Mild irritants or cold air causes it, and it occurs during the early stages of viral infections and upper respiratory tract infections and / or in mild allergic reactions.

Catarrhal rhinitis

- ⌘ It is a **slightly more severe process** .it occurs in the early stages of several animal diseases .
- ⌘ The mucosa is **reddened swollen** and covered with **serofulvous exudates** .E.g. canine distemper (in dogs).

Purulent rhinitis

- ⌋ It occurs due to **more severe injury on the nasal mucosa** which is accompanied by **mucosal necrosis and secondary bacterial infection**.

Fibrinous rhinitis

- ♣ Following nasal injury there is **exudations of plasma fibrinogen**, which **coagulate into fibrin**.

Based on etiological agent:

- ▶ *Physical*, Irritants – Dust, pollen
- ▶ Foreign bodies – rice chaff, insects, flies; Injuries; *Chemical* -Irritating gases, Formalin vapour
- ▶ **Ammonia gas** arising from deep litter in poultry and biological agents (bacteria, virus, fungus(*Aspergillus fumigat*
- ▶ *Cryptococcus neoformans* in cats, *Rhinosporidium seeberi* in cattle;
- ▶ *Actinobacillus lignieresii*, *Actinomyces bovis*, *Mycobacterium tuberculosis* –

- Cattle, *Pasteurella multocida* – Pasteurellosis in cattle and swine, *Pseudomonas mallei* - glanders; *Streptococcus equi* – strangles in horse, *Haemophilus paragallinarum*(Infectious coryza), *Mycoplasma galliseptium* –chicken.
- Parasite (Sheep – *Oestrus ovis* larvae, Dog – *Linguatula serrata*, Cattle – *Schistosoma spindale*).

Viral:

- Human - Common cold virus
- Cattle -Infectious bovine rhinotracheitis (IRBT), bovine malignant catarrhal fever and rinderpest,

Predisposing Factors

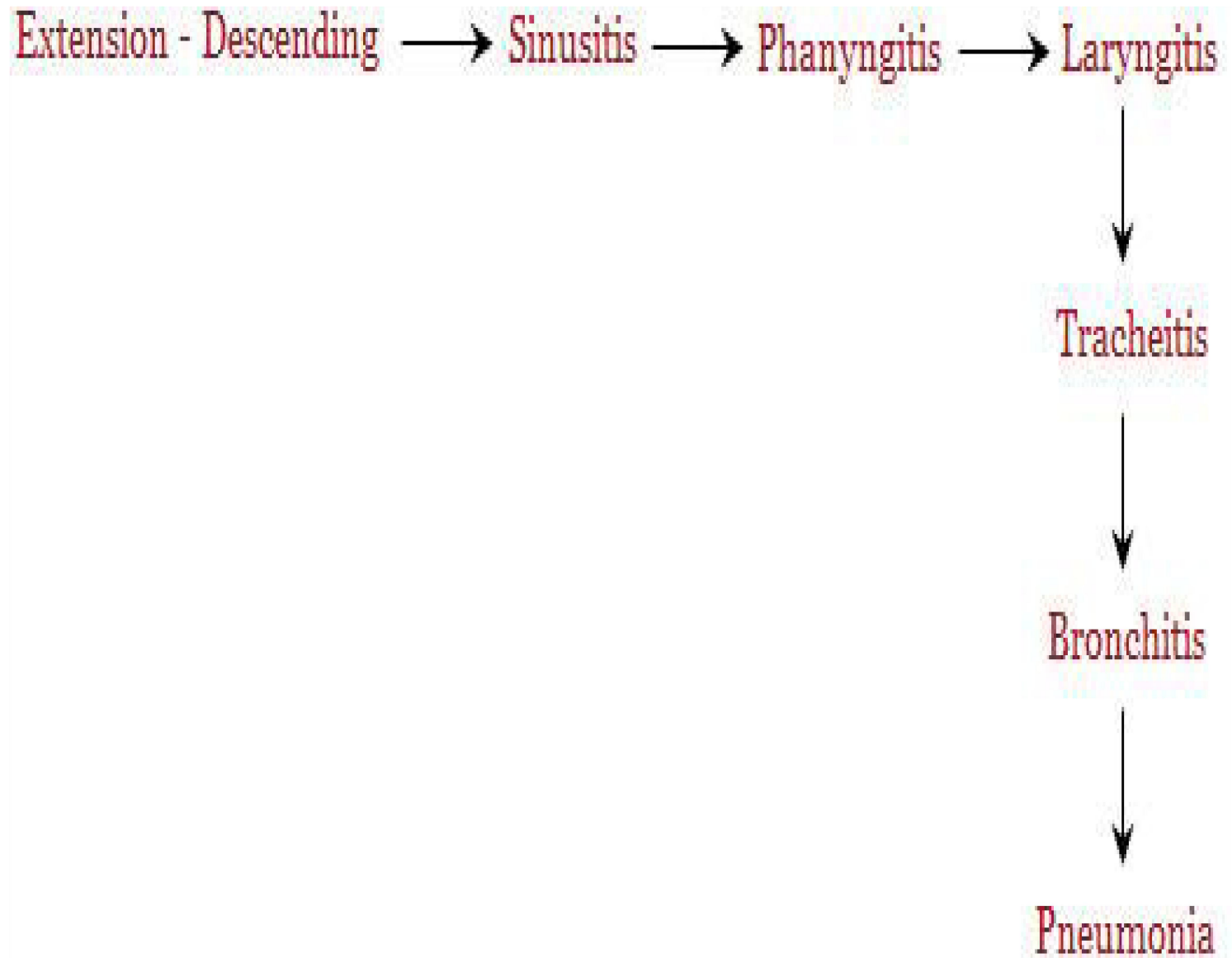
- Environmental changes
- Stress
- Immunosuppression
- Prolonged antibacterial therapy

Route of infection

→ Inspired air

Sequelae

Rhinitis might extend to cause bronchitis and pneumonia



Based on the age of lesion Rhinitis is classified as acute and chronic rhinitis.

Acute rhinitis

Definition: Acute inflammation of the nasal mucosa

Causes:

- Physical:- Irritants – Dust, pollen, Foreign bodies – chaff, insects, flies
- Chemical irritants
- Infectious agents

Gross lesions

- Mucous membrane:- Colour: Congested, Thickness: Swollen, Moisture: Dry /moist / exudates

Histopathology

- Lumen: contains inflammatory exudate with inflammatory cells
- Mucosa: Epithelium shows hydropic degeneration
- Lamina propria: Hyperaemic, infiltration with inflammatory cells.

Chronic granular rhinitis

Clinical signs: Nasal discharge - Mucous or mucopurulent, Nasal pruritus.

Gross pathology: Tiny nodules – cobblestone appearance.

Histopathology

- **Mucosa:** Many closely packed tiny polyps covered by acanthotic squamous epithelium projecting into the lumen.
- **Lamina propria:** contains oedema, engorged capillaries, fibroblasts, eosinophils, mast cells and plasma cells.
- **Ducts of mucosal glands:** Metaplastic

Bovine nasal granuloma

Definition: Granulomatous inflammation of the nasal mucosa.

Aetiology

- Bacterial - Actinobacillosis.
- Parasite - Blood fluke – Adult parasite of *Schistosoma nasale* causes snoring disease in cattle.

Signs

- Interference with normal respiration (snoring sound is heard).
- Profuse nasal discharge – sometimes mixed with blood.

Gross changes

- ♣ Lumen is occluded by granulomatous growth.
- ♣ Nasal mucosa contains minute ulcers.

Histopathology

Feature resembles that of **pseudotubercle** characterised by:

- central schistosome egg surrounded by eosinophilic rays of dead cells (actinobody).
- Around the actinobody cellular infiltration consisting of **lymphocytes, neutrophils, eosinophils**

Diagnosis

- Nasal discharge – characteristic boomerang shaped ova with spine at one end is characteristic of *Schistosoma nasale*.

Bull nose

Synonym: Rhinohyperplasia.

Definition: Slowly developing condition of nasal mucosa with enlargement of nose seen usually in young pigs.

Aetiology

- Infectious (Bacteria- *Fusobacterium necrophorum*, *Staphylococci*, *Streptococci*, *Pseudomonas aeruginosa*, *Corynebacterium pyogenes*).

Clinical signs: Dyspnoea, difficulty to respiration

Gross changes

- **Nose:** swollen and enlarged due to edema; Bones of nasal cavity, nasal mucosa
- **Skin adjacent** to the nares show areas of suppuration or caseous necrosis
- **Maxillary and nasal bones** – distorted; Sinus: occluded with exudates; Lymphadenitis.

Histopathology: Edema seen in early lesion;
Fibrosis seen in chronic inflammation.

Nasal polyps

 Polyps are non neoplastic masses that resemble tumours.

Species affected: Occurs following chronic rhinitis mostly in horses, also recorded in cats and sheep

Site: Nasal passage or nasopharynx.

Origin: Fibrous tissues of submucosa protrude into the lumen of the nose.

Signs: Respiratory distress.

Gross pathology: Seen as a growth or mass

- Shape: Ovoid
- Surface: Smooth and glistening
- Consistency: Soft and slimy
- Covered by: Nasal mucosa

Histopathology: Nasal polyp has a core of well vascularised stromal tissue along with infiltration of lymphocytes, macrophages and eosinophils.

Neoplasm of the nasal cavity

The most common **nasal stromal tumors** are:

- Fibrosarcoma
- Osteosarcoma, and chondrosarcoma

The most common **epithelial tumors** are:

- Carcinoma/adenocarcinoma.

Nasal tumors often bleed causing epistaxis or become infected causing a nasal discharge (exudate) that may be mistaken for a simple bacterial or mycotic rhinitis.

Biopsies or cytological (to identify the cell origin and arrive at a final diagnosis).

Pathology of pharynx, guttural pouches, larynx, and trachea

Anomalies: are very rare.

Brachiocephalic airways syndrome-

common in brachiocephalic dog (bulldogs, boxers). It is characterized by stenotic external nostrils

- **Hypoplastic** epiglottis
- Tracheal agenesis and hypoplasia
- **Guttural pouch mycosis:** usually caused by *Aspergillus fumigatus* and other Spp.
- Fungi can invade blood vessels and cause thrombosis, aneurysm and epistaxis.

Grossly: Fibrinonecrotic exudates (diphtheritic), epistaxis due to involvement of the internal carotid artery

Microscopically- necrotic inflammations in mucosa & submucosa, with vasculitis and fungal hyphae are found

Roaring

Definition: Roaring is **impaired sound** due to **laryngeal hemiplegia in horses**.

Etiology

- Injury and degeneration of the left recurrent laryngeal nerve or
- secondary nerve damage by repeated trauma by pulsation in the aorta,
- lead poisoning, pressure on the nerve by aneurysms, enlarged lymph nodes, abscesses, tumours, oesophageal diverticula and other traumatic conditions.

Pathogenesis

- ✿ **Hyaline degeneration and fibrosis of the left doesal and lateral cricoarytenoideus muscle atrophy**

- ✿ A noise is heard by brushing of air with the arytenoid cartilage and the noise is called roaring.

Gross pathology: Affected muscle is pale and atrophic.

Histopathology:

- Left recurrent laryngeal nerve –
Demyelination and wallerian degeneration,
- Atrophic changes of muscle fibres (neurogenic atrophy).

Laryngitis

inflammation of the **laryngeal mucosa**.

Aetiology

- Extension of infection from **nasal cavity and pharynx** in infectious diseases
- Canine distemper in dog
- Infectious laryngotracheitis in poultry
- Irritant vapours of chemicals.
- Mechanical injury by kicks, bites, grass awns;
- Excessive barking.

Specific diseases – calf diphtheria, tuberculosis, glanders and

Gross pathology

- Mucosa of larynx is swollen.
- The mucosa is haemorrhagic and dry at first
- Later becomes coated with mucus or mucopurulent discharge

Histopathology

- Mucosa is covered with exudate - mucus, blood or necrotic material
- Lamina propria is infiltrated with leucocytes

Necrotic Laryngitis (Calf diphtheria)

Etiology: Fusobacterium necrophorum
(trauma or viral infection (i.e., IBR))

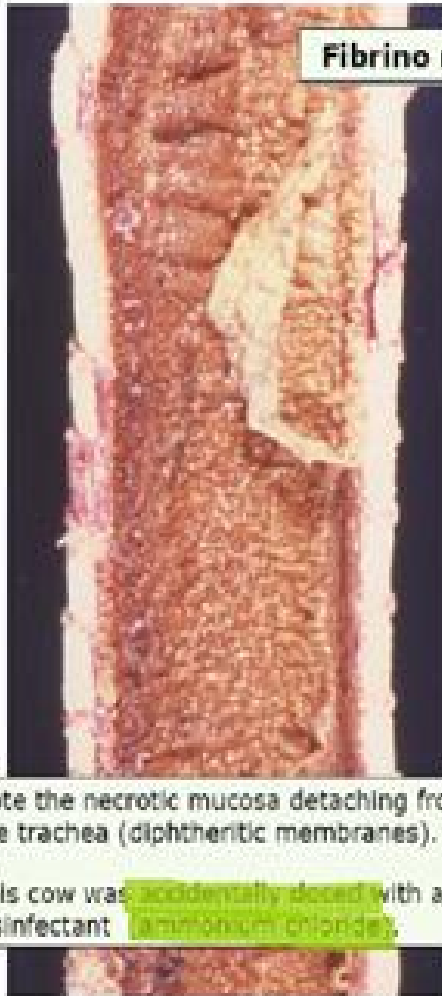
Gross lesions

- ‖ Necrotic mucosa detaching (diphtheria)
- ‖ Well demarcated, dry, yellow-gray, necrotic area
- ‖ deep ulceration
- ‖ Exudates can be aspirated and cause aspiration pneumonia

Microscopic lesion

- Necrosis surrounded by hyperemia, band of leukocyte, granulation tissue and

Fibrino necrotic (Diphtheritic) Tracheitis



Note the necrotic mucosa detaching from the trachea (diphtheritic membranes).

This cow was accidentally dosed with a disinfectant **ammonium chloride**.



Note the fibrino-necrotic exudate on tracheal mucosa (diphtheritic membranes).

This steer died of **IBR**.

Cornell Vet Med

Tilaye Demissie (DVM, MVSC)

Tracheitis

Definition: inflammation of the trachea.

Causes

-  Bacteria: *Escherichia coli* and *Mycoplasma gallisepticum*
-  Virus: Infectious bronchitis virus and infectious laryngotracheitis virus
-  Parasite: *Syngamus trachea*.

Gross pathology: Lesion depends on the agents involved.

- ♣ Absent/ catarrhal/hemorrhagic (virus)
- ♣ Mucopurulent (severe or bacterial involvement)
- ♣ Enlargement of tonsils and regional lymph node
- ♣ Tracheal mucosa is congested

Histopathology: The mucosal epithelium is denuded and infiltrated with leucocytes

Acute tracheobronchitis

Occurrence: Usually encountered along with upper respiratory disease and pneumonia.

Route of infection: Aspiration into trachea, Extension from pharynx and sinuses

Causes

- Faulty drenching of medicaments.
- Bacterial – Pasteurellosis.
- Viral – Infectious bovine rhinotracheitis,
- Parasites - Lung worms.

Gross pathology

- ✚ The mucosa is covered by exudates (catarrhal, fibrinous or purulent).
- ✚ The mucosa is thick and reddish.
- ✚ In gangrenous bronchitis, there is extensive necrosis of the mucosa which becomes sloughed.

Histopathology

- Lumen contains mucus, leucocytes, dead epithelial cells, lung worms
- Lamina propria - Congested and infiltrated with inflammatory cells of which neutrophils predominate.

Pathology of bronchi and bronchioles

Bronchostenosis

Definition: Narrowing of the bronchial lumen due to **obstruction or peripheral pressure.**

Aetiology

- ◆ Aspiration of foreign bodies.
- ◆ Accumulation of exudates and infiltration in to the wall **causing reduction of diameter of the bronchus.**
- ◆ Parasites within the lumen.
- ◆ **Pressure from outside the bronchial wall by abscesses, enlarged lymph nodes, tumours**

Bronchiectasis

It is pathologic and permanent dilatation of bronchus due to accumulation of exudate in the lumen and Partial rupture of bronchial walls.

Aetiology and pathogenesis

- Due to chronic inflammation of the bronchus.
- Due to destruction of the elastic tissue of the bronchial wall, contractile power of the bronchus is lost and so the bronchus dilates.

Clinical signs: Persistent cough, Debilitation.

Gross pathology

⌘ **Cylindrical form of bronchiectasis:** It is more common in cattle and **cause uniform dilatation of the bronchus.**

- Large segment of bronchus is involved.

- ⌘ **Saccular form:** characterized by
 - ⌘ thin walled, circumscribed out pouching of bronchial or bronchiolar walls due to focal necrosis
 - ⌘ occurs in lung worm infections in cattle and sheep
 - ⌘ Destruction affects only a ***small localized portion*** of the bronchial walls.

Gross lesion of bronchiectasis

- Dilated and filled with purulent exudate
- Dilated bronchi give a ***honey combed*** or ***cystic appearance***
- tenacious and rubbry, dehydrated

Histopathology

- Destruction and disappearance of the elastic tissue, cartilage of bronchus
- Mucosa: disappearance of lining epithelium
- Lung: collapsed and carnified; pleural adhesions may develop

Bronchitis

Definition: inflammation of the **bronchial mucosa**.

Acute bronchitis- can be *catarrhal, purulent, fibrinonecrotic*.

Chronic bronchitis- can be chronic purulent, chronic catarrhal. Goblet cell hyperplasia → excess mucus → chronic obstructive bronchitis.

Causes: Viral – canine tracheobronchitis and infectious bronchitis in fowls.

Gross Pathology

- Trachea is congested and contains mucus exudate
- Bronchial lumen is obstructed by yellow



→ Mucous exudate over the congested tracheal mucosa

Histopathology

- Bronchial mucosa is thickened due to edema and cellular infiltration.
- Bronchial lumen may contain neutrophil or heterophil rich exudates

Pathology of the transitional system (bronchioles)

Bronchiolar epithelium is very vulnerable to injury due to:

- Higher vulnerability to oxidants and free radicals
- The presence of clara cells (rich in oxidases, which locally generate toxic metabolites)
- lungworms
- Respiratory viral infections
- Bronchioles are affected the alveolar walls and structures of the lung.

Bronchiolitis

- It is inflammation of bronchiole.
- Occurs as extension of **bronchitis, or pneumonia.**
- Caused by viral infections, pulmonary toxicity.
- viral bronchiolitis

Goblet cell metaplasia: normally goblet cells are absent in the bronchioles.

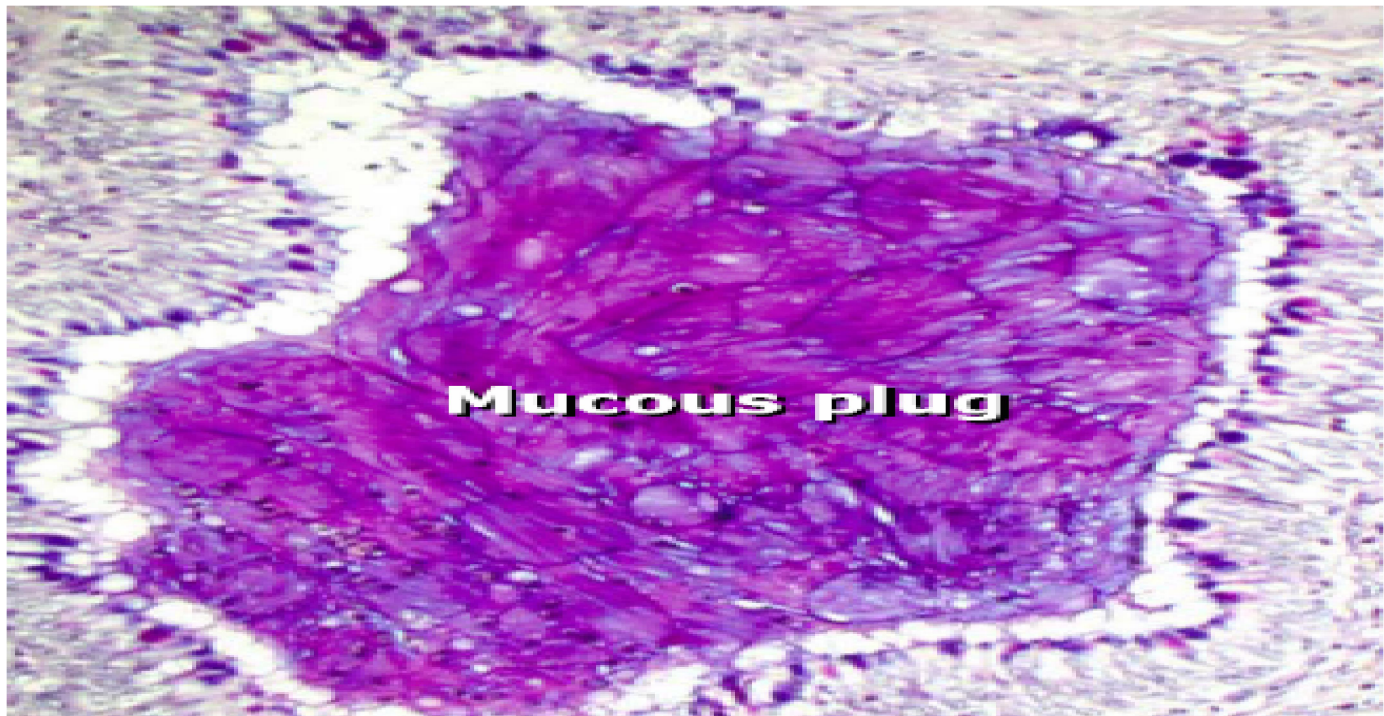
- Goblet cells can be seen in the bronchioles in mild and persistent injury.
- These cells produce tenacious and viscid secretion leading to plugging
- Obstruction of the distal airways, and hence induce chronic obstructive pulmonary diseases.

"Heaves" / Chronic Obstructive Pulmonary Disease (COPD) or Recurrent Airway Obstruction (RAO)

- It is Equine disease where the pulmonary lesions are centered in the bronchioles.
- Mild injury and **recurrent inflammation** induces goblet cell **metaplasia** in bronchioles.
- Bronchioles plugged with mucus → leads to alveolar emphysema.

Grossly: pulmonary lesions are not

Microscopically: bronchiolar goblet cell
Metaplasia,
♣extensive mucus obstruction of small airways
(bronchioles)



Pathology of lungs

Abnormalities of inflation (atelectasis and emphysema)

→ Atelectasis (incomplete distension of alveoli)

Definition: Failure of alveoli to open and contain air or absence of terminal dilatation

Types: Congenital and Acquired.

⊗ **Congenital atelectasis:** In congenital atelectasis, animal is born dead and has not breathed.

Causes

- Obstruction of the bronchi by – mucus
- Damage to the respiratory center that may occur in injury to the brain.

Gross pathology

- **Lungs:** colour - reddish blue (due to dilatation of alveolar capillaries),
Consistency - firm, Density: Sink in water (lack of air).

Histopathology

- Lung: Alveoli - collapsed or may contain fluid; alveolar epithelium - cuboidal.

Acquired Atelectasis

- Obstructive atelectasis: Airway obstruction such as exudate, parasites, food particles
- Compressive atelectasis: Large intra-thoracic masses such as abscesses, tumors, pericarditis, and external trauma.
- Collapsed alveoli, loss of alveolar spaces.

Gross lesions in atelectasis:

→ Collapsed lungs, dark, firmer texture

Colour: Dark or reddish blue in colour.

Surface: Affected part depressed from the level of surrounding healthy lung.

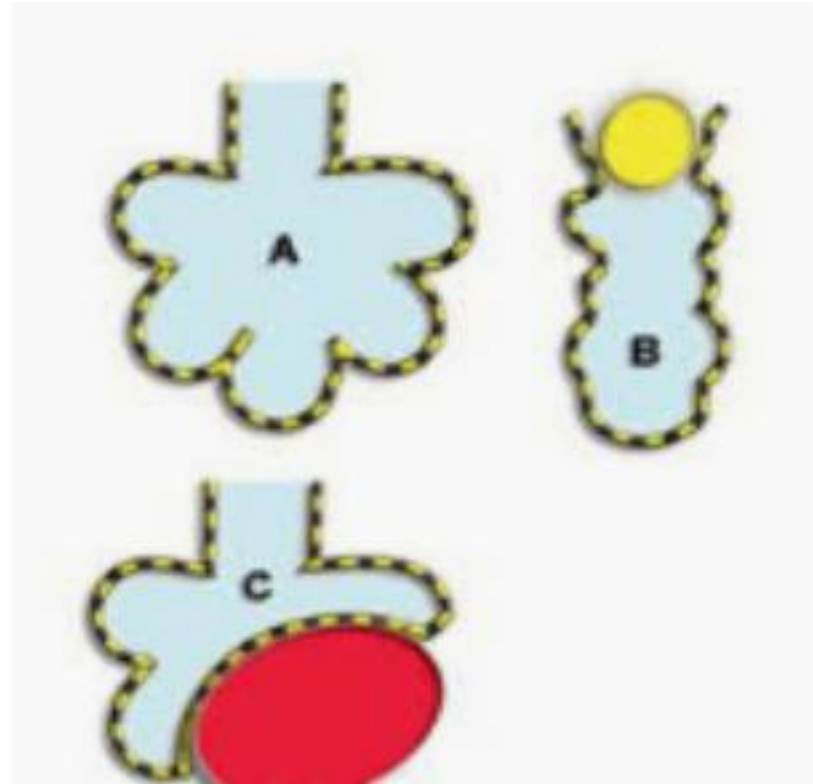
Density: Sink in water.

→ **Pleura-** Thick, Surface: wrinkled.

Histopathology

- Alveoli appear as small or elongated clefts
- Alveoli are devoid of air.
- **Epithelium:** Desquamated
- **Capillaries:** Dilated and engorged with blood.
- **Interlobular septal tissue** – proliferate, later (fibrosis).

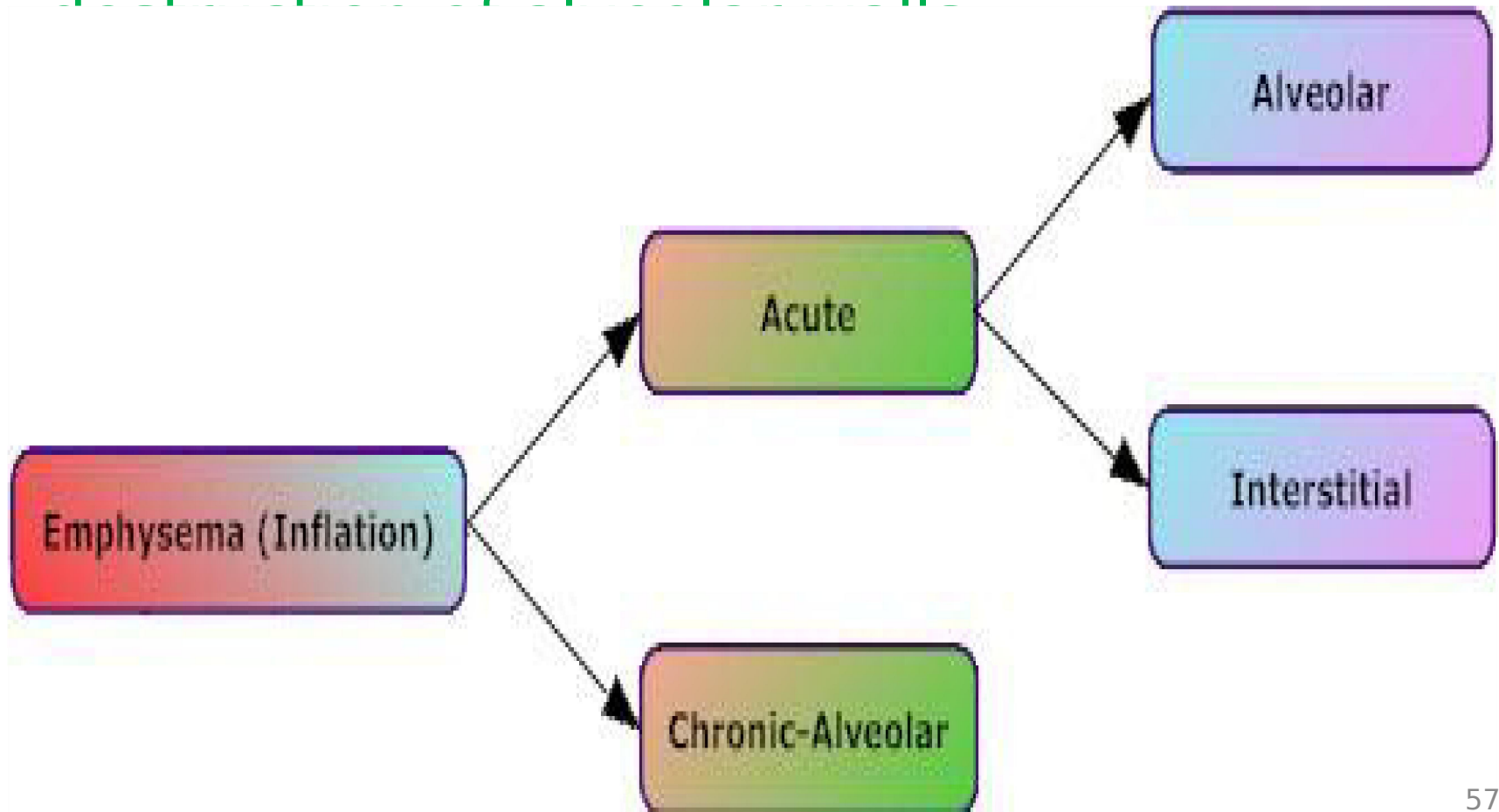
Gross lesion of acquired atelectasis



- a. Normal lung
- b. Obstructive atelectasis
- c. Compressive atelectasis

Emphysema

Definition: Increased air in the lung. It is an abnormal and permanent enlargement of airspaces distal to terminal bronchioles ← destruction of alveoli



The common types of emphysema found in domestic animals are:

- Alveolar emphysema
- Interstitial emphysema
- Bullous emphysema

Alveolar emphysema: Equine Heaves is an important disease causing alveolar emphysema in horses

Interstitial emphysema:

- Characterized by distention of interlobular septa and pleura with gas.
- caused by violent respiratory movements (agony) in bovines.

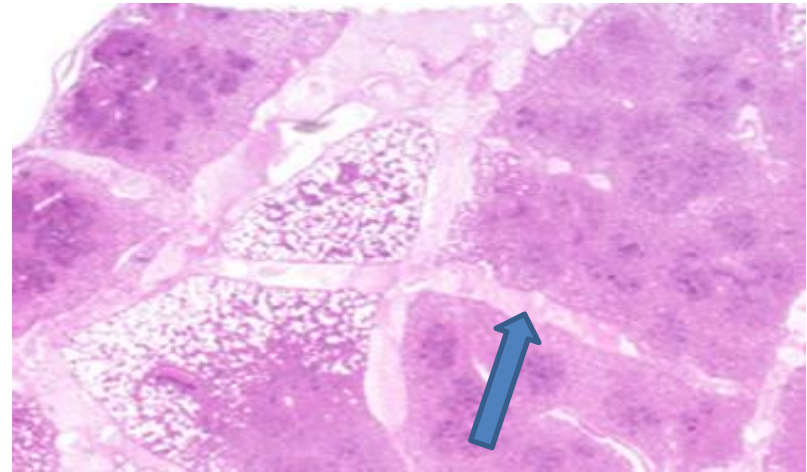
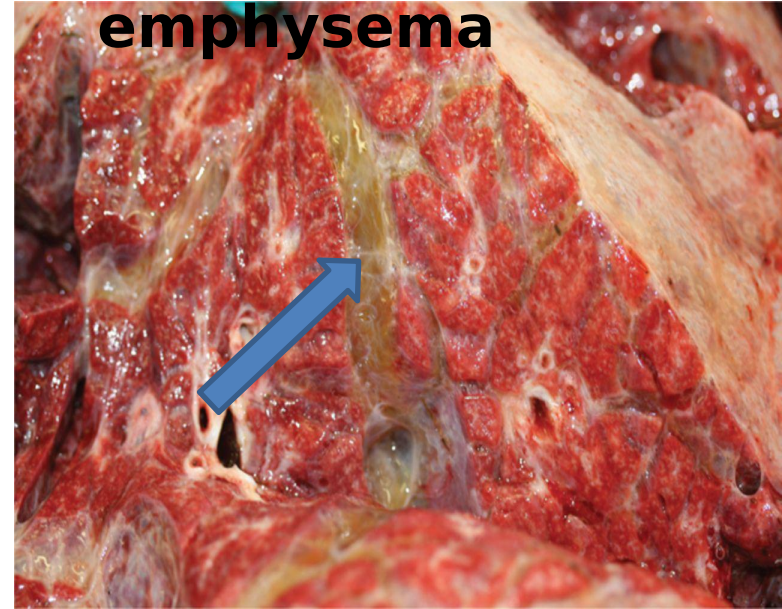
Bullous emphysema:

- ↳ it is a large focal accumulation (pocket) of air (bulla) in the lung.
- ↳ Large bulla form when there is rupture of

Gross lesions of pulmonary emphysema on the cranio-ventral area

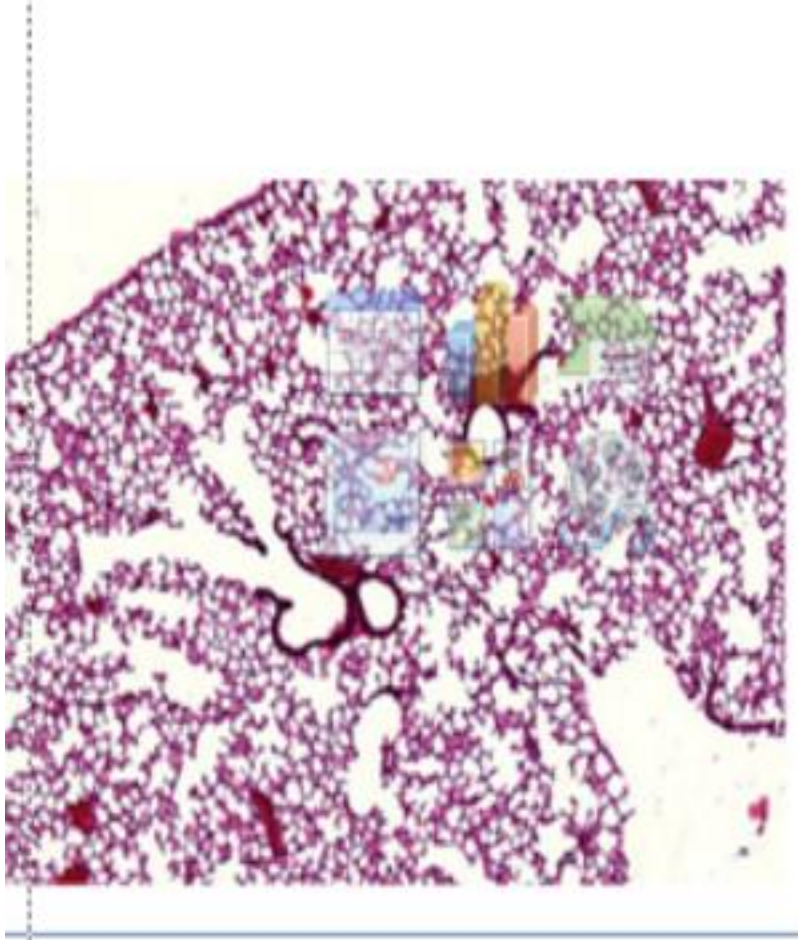


Outbreaks of bovine interstitial emphysema

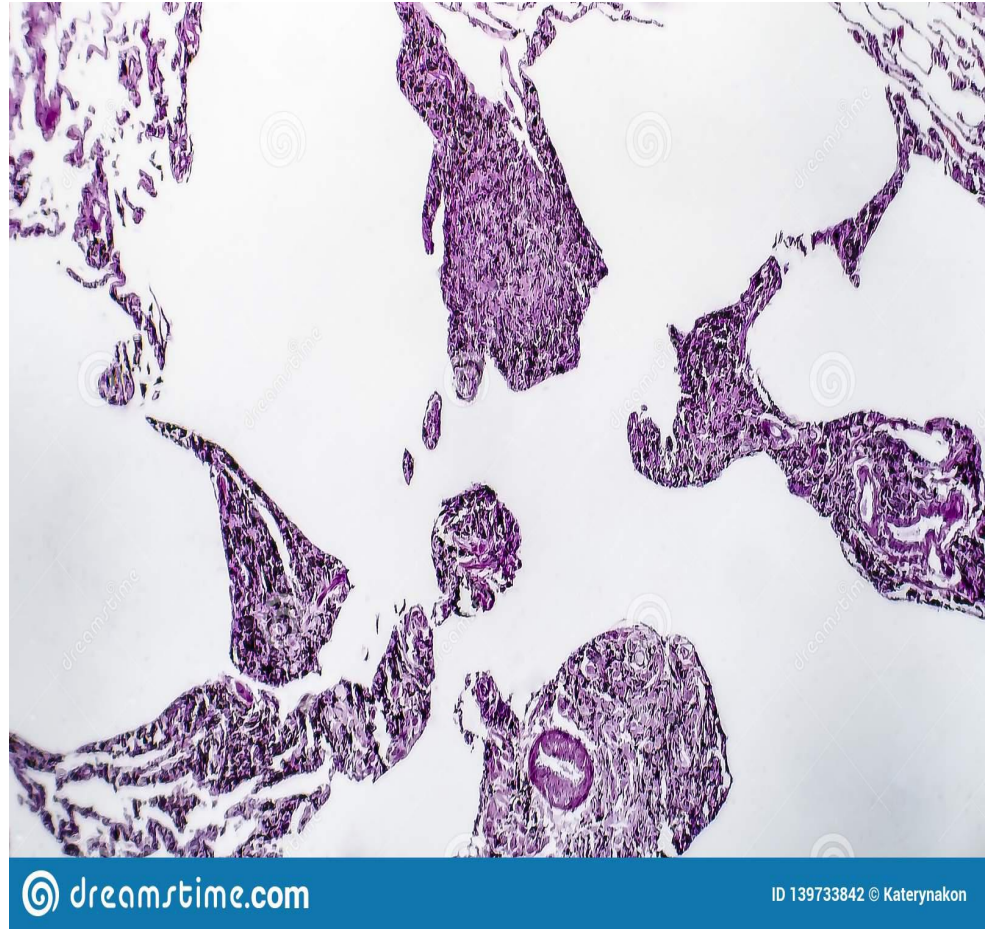


Microscopic image of interstitial emphysema

Histopathology of normal versus alveolar emphysematous lung



Normal lung



Alveolar emphysematous lung

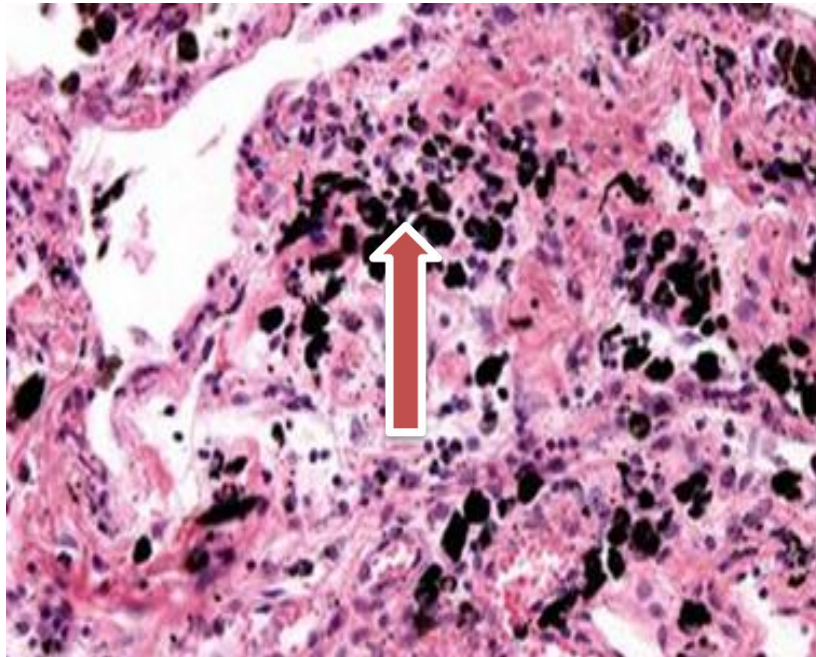
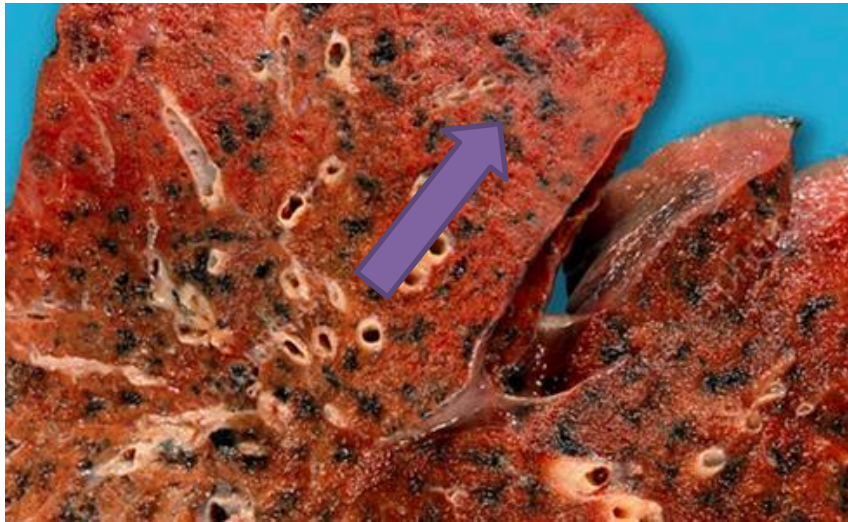
Abnormal Pigmentations of the Lung

- **Pneumoconiosis** is a general term used to describe **pulmonary diseases** characterized by **deposition of inhaled particles in the lung**.
 - carbon (anthracosis)
 - silica (silicosis)
 - asbestos (asbestosis)

Anthracosis

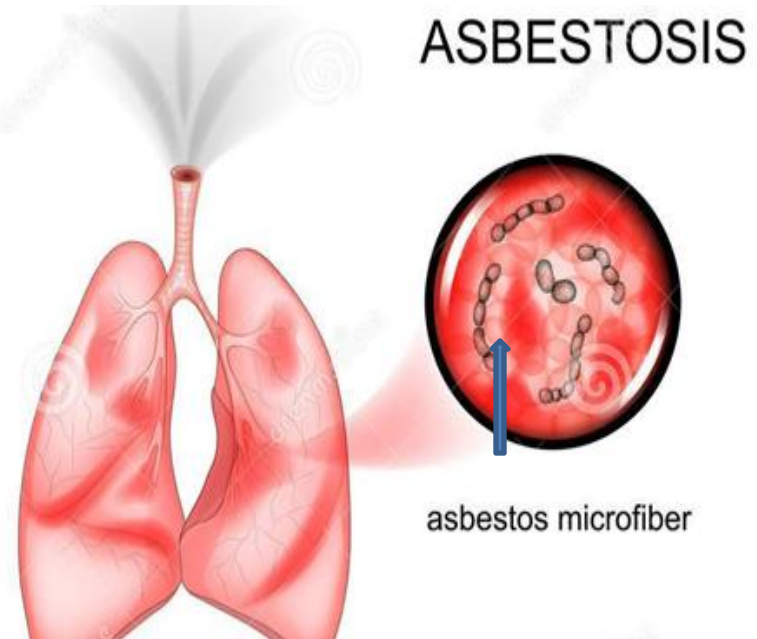
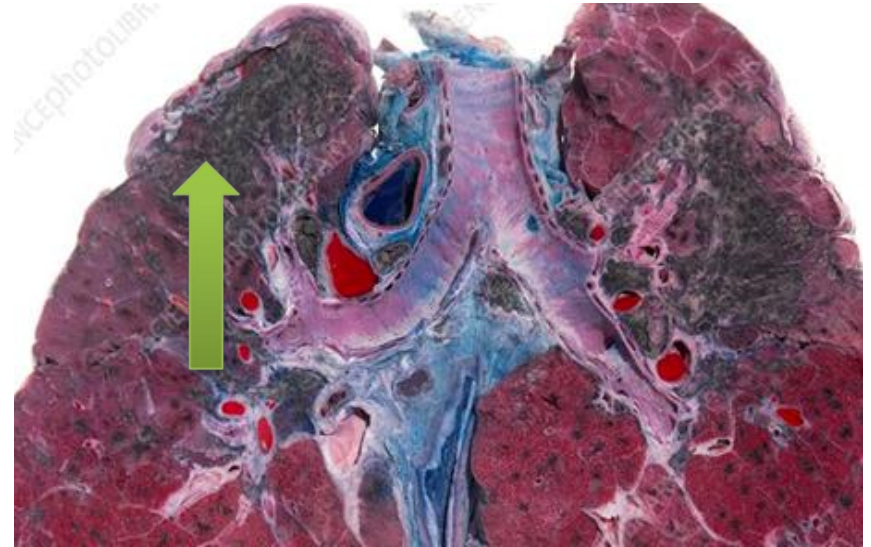
- **Inhalation of carbon particles** in animals living in highly polluted areas lead to the deposition of carbon particles in the lung.
- Carbon particles are found in the lungs of animals living in highly polluted areas.

Anthracoosis of the lung



Histopathology of anthracosis

Lung silicosis



Circulatory disturbances of the lung

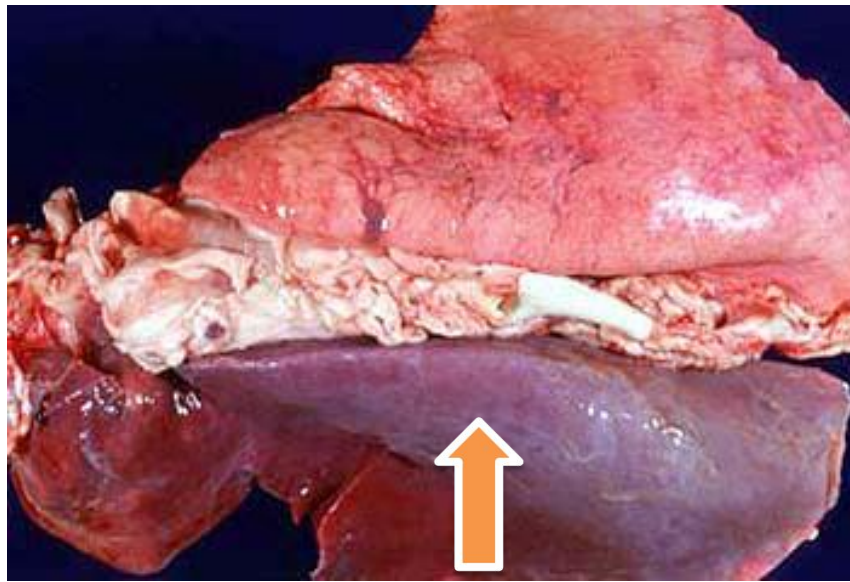
Congestion (passive accumulation of blood):

- Associated with congestive heart failure (left, uncompensated).
- It can progress to lung edema and intra-alveolar hemorrhage with erythrophagocytosis ("heart failure cells").
- "Wet and heavy lungs" with red patchy discoloration.

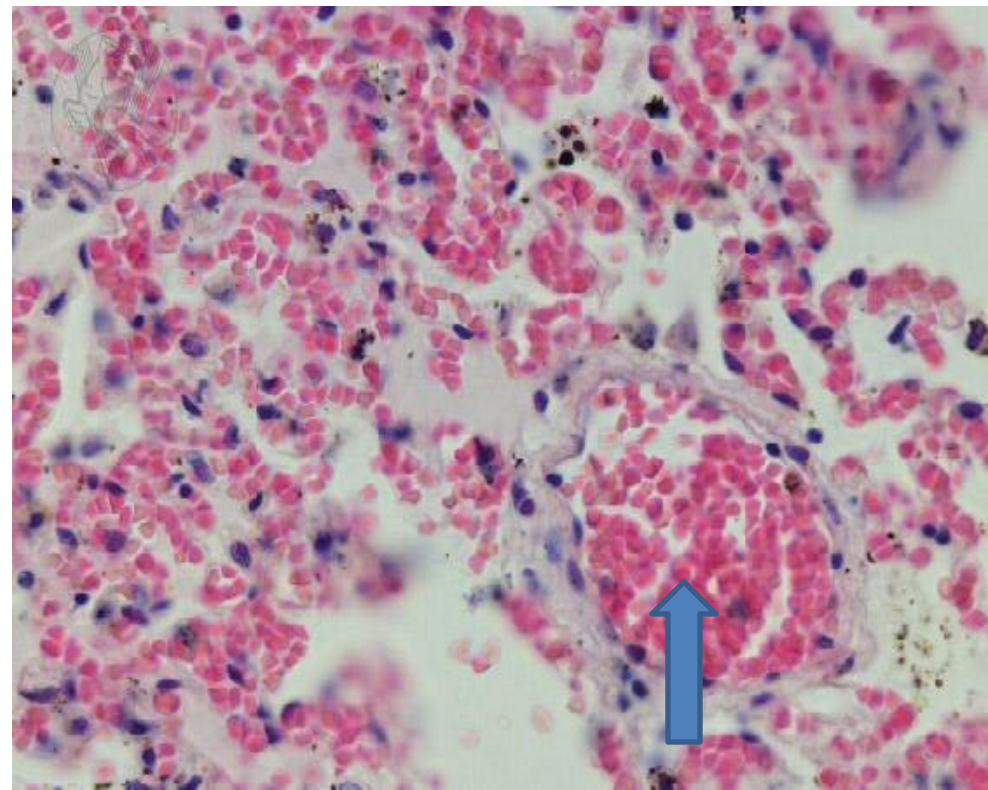
Hypostatic congestion

Etiology; Animals in moribund or recumbent condition.

♣ The lung is dark purple in the posterior



Congested lung

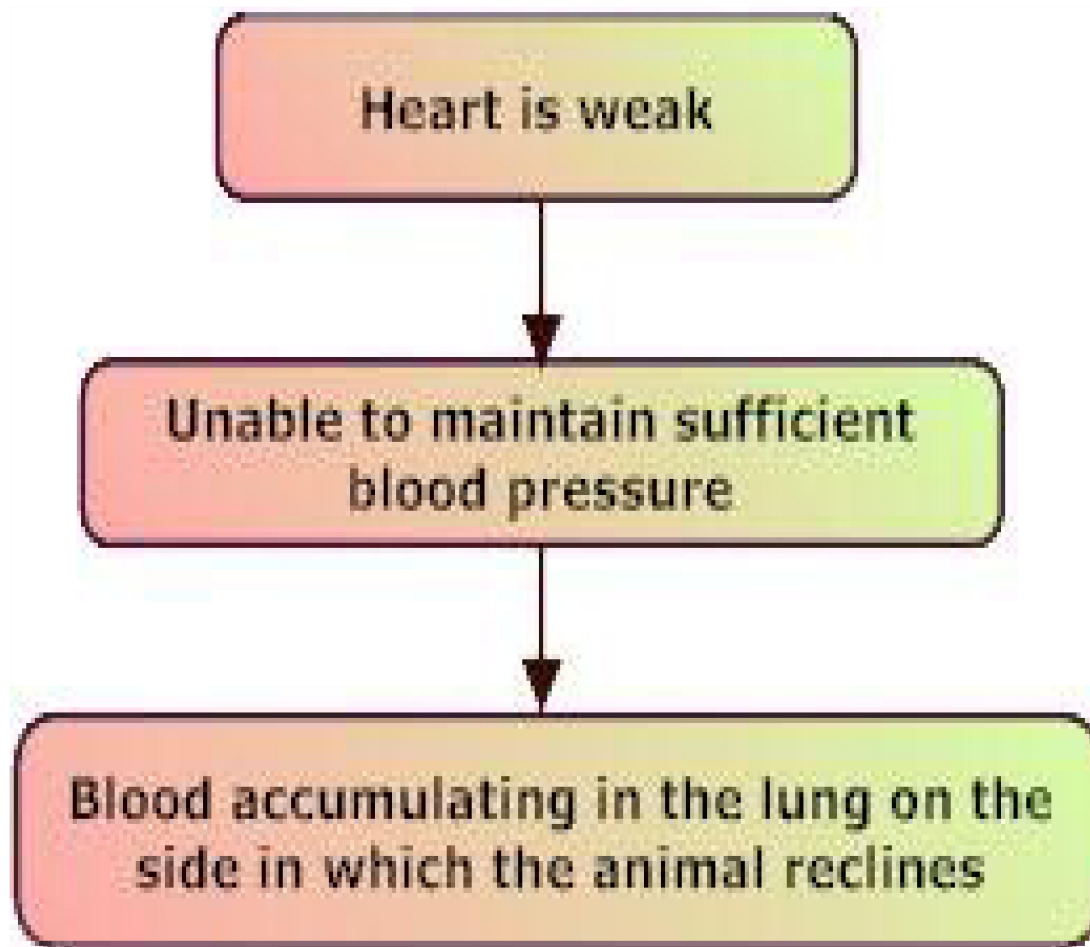


Histopathology of
Pulmonary congestion



Hypostatic congestion in lung

pathogenesis



Passive congestion

Occurrence: Occurs generally in older animals.

Etiology: Cardiac lesion - Chronic pericarditis, myocardial weakness or lesions in the mitral valve; Extra-thoracic lesion - Bloat;

Gross pathology of lungs:

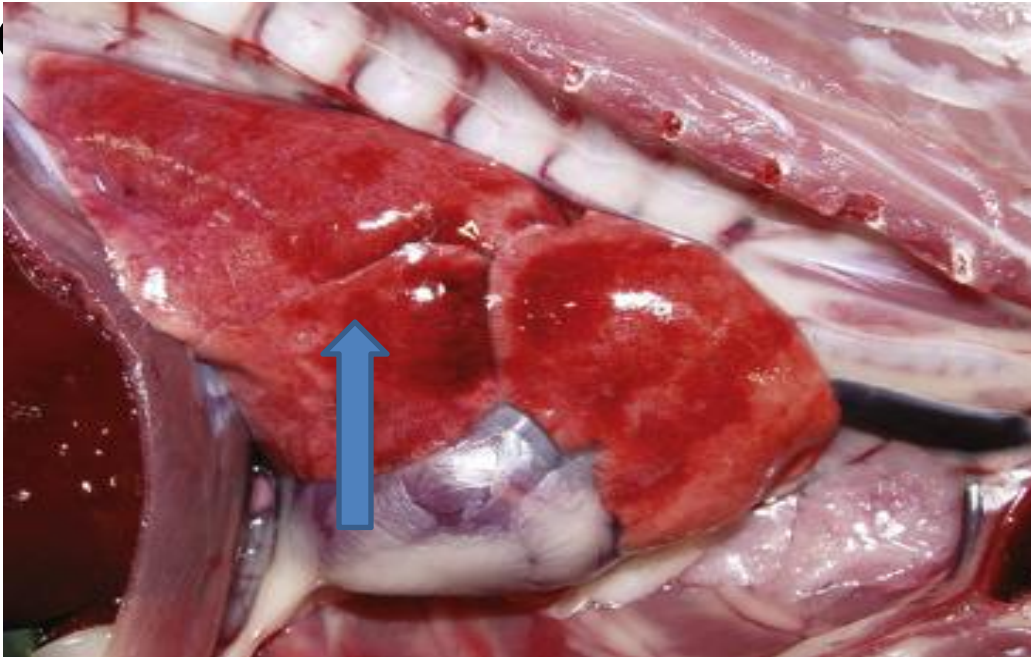
- ♣ Colour: Dark red
- ♣ Size: Larger
- ♣ Consistency- Firm
- ♣ Cut section: Blood oozes out.

Histopathology: Capillaries in the alveolar wall are distended with RBCs; Alveolar lumen: Contains RBCs / macrophages that have engulfed RBCs (heart failure cells).

Hyperemia and pulmonary haemorrhage

Hyperemia (active):

- ♣ seen in acute pulmonary inflammation (inflammatory mediators) → exudation.
- ♣ Hyperemic lungs are heavy with a deep red color.
- ♣ Blood



Hyperemic lung

Pulmonary Haemorrhage

Aetiology:

- Injury gun shot wounds, sharp objects piercing the thoracic cavity.
- Fracture of ribs (external injury, automobile accidents).
- Extreme over exertion as in young horses (Exercise induced pulmonary haemorrhage).

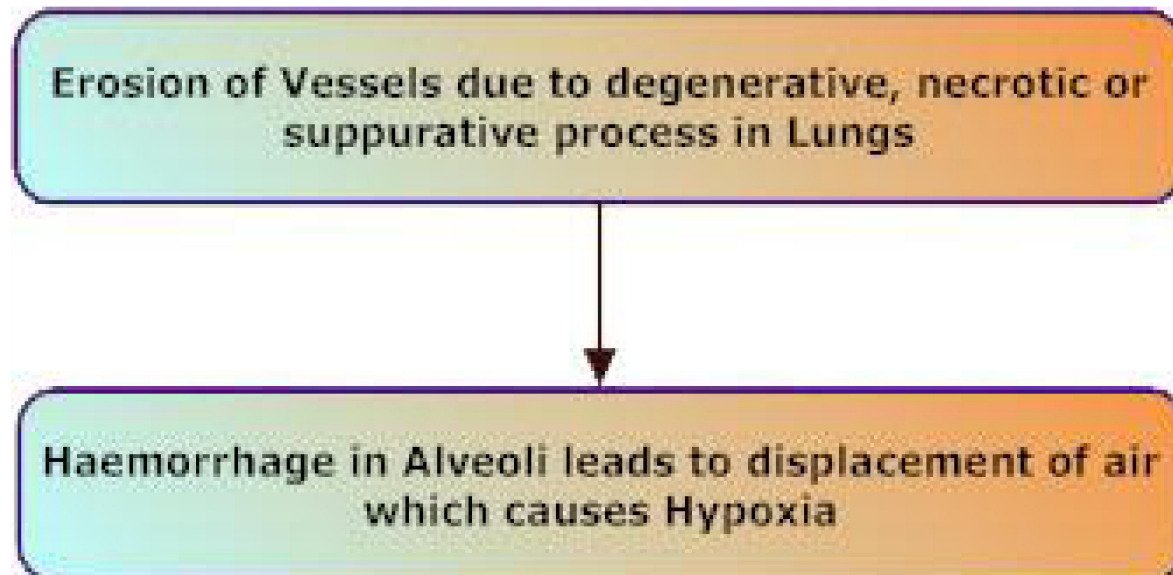
Pathological: Erosion of blood vessels and rupture into a bronchus,

Growing abscess in the lung of cattle, extreme cardiac action as in death due to asphyxia, bracken fern poisoning.

Biological: Bacteria disease – anthrax, pasteurellosis or leptospirosis; Viral disease: Hog cholera, african swine fever; Toxins: Uremia (injury to capillary endothelium occurs).

Signs: Haemoptysis (Blood in sputum due to pulmonary haemorrhage).

Pathogenesis



Gross pathology

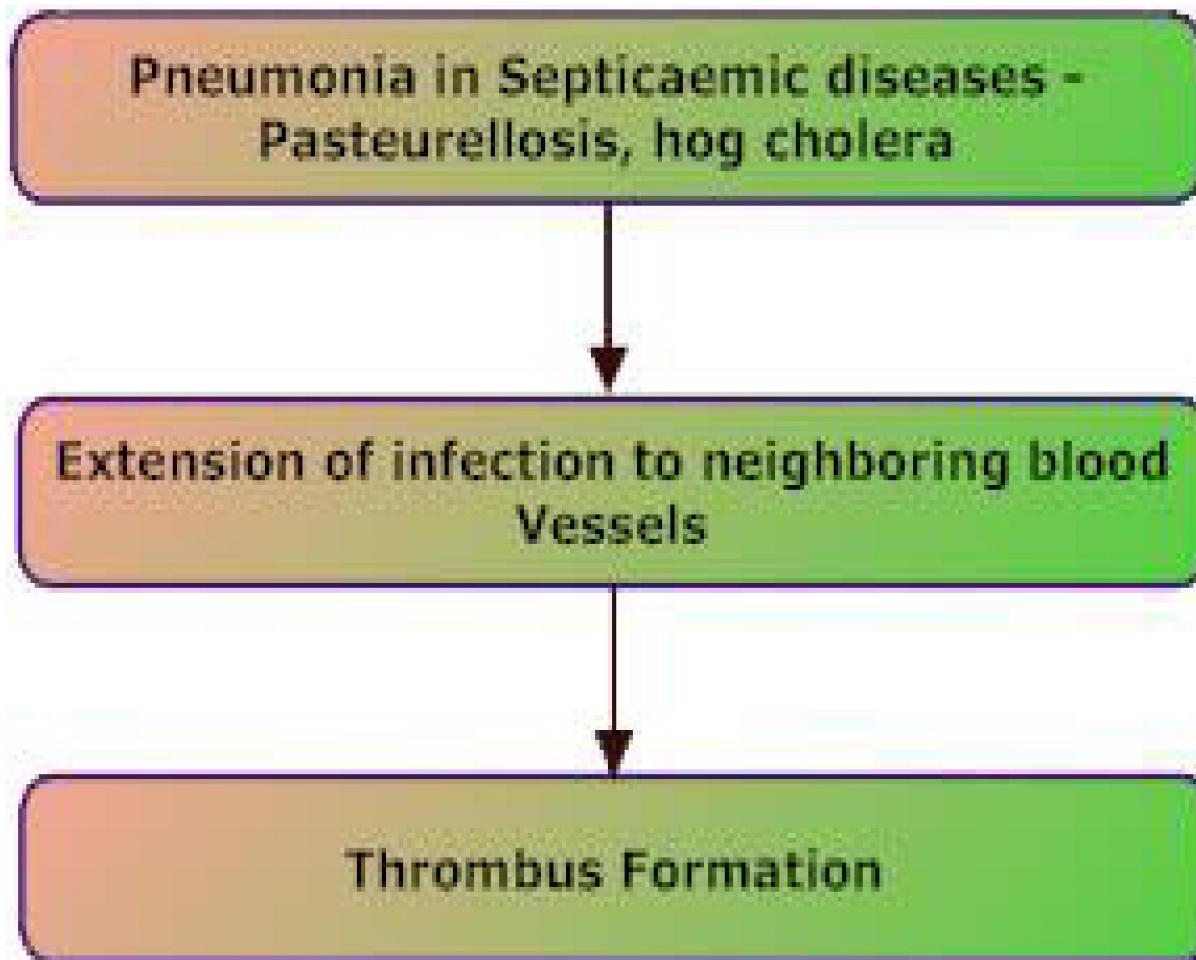
- petechiae, ecchymoses or hematocyst.
- Appearance: Mosaic pattern of red discolouration.
- contain foamy blood.

Histopathology:

└ RBCs in bronchi, bronchioles and alveoli

Thrombosis and embolism

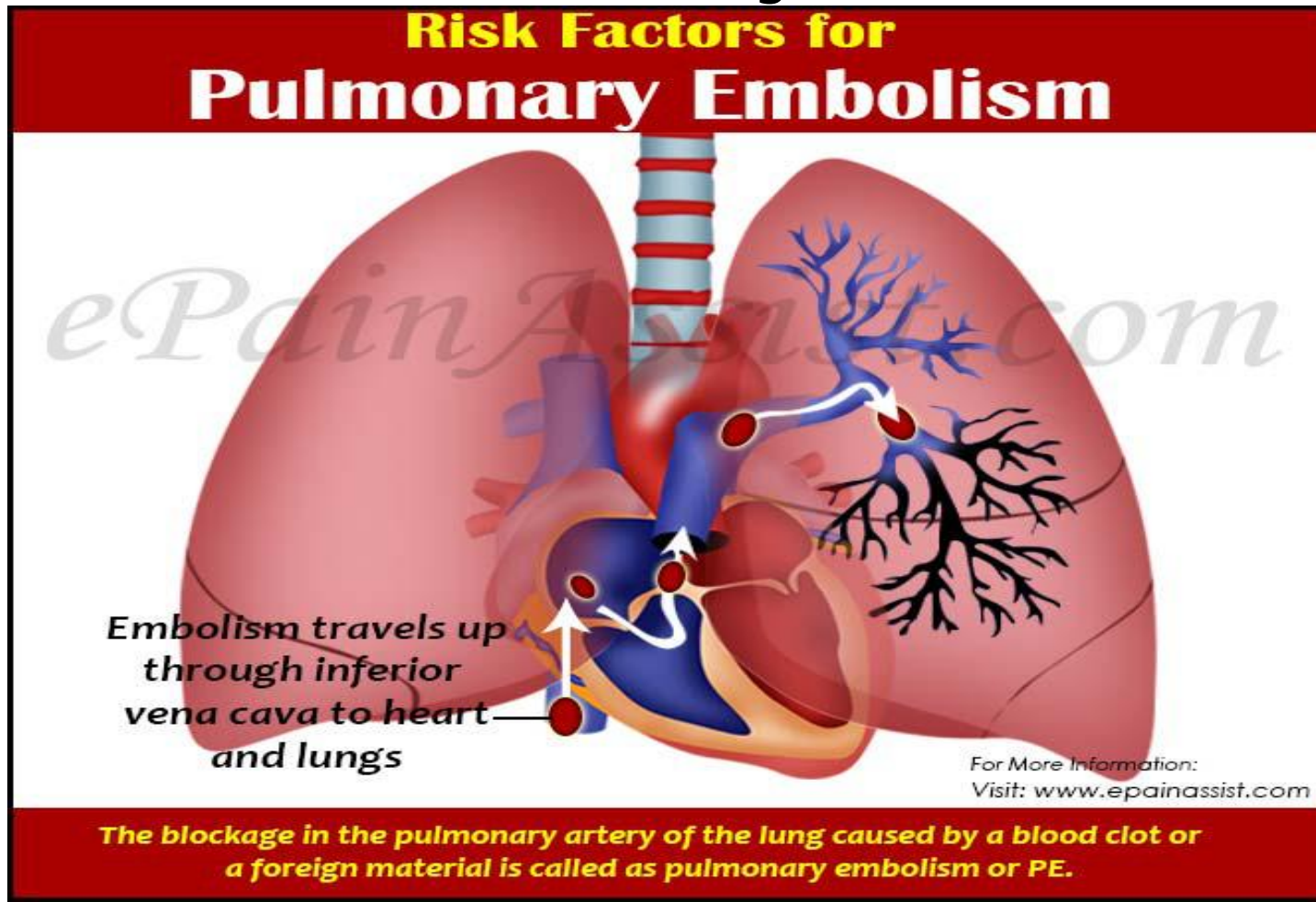
Thrombosis



Embolism

Aetiology: Emboli may emanate from

- Thrombosis: Heart worm infection in dog, mesenteric veins in horse by *Strongylus vulgaris*
- Fat – due to fractures of large bones



Oedema of lung

↳ excess **fluid accumulation in the lung.**

Cause

- Congestive heart failure (cardiogenic edema)
- Impaired lymphatic drainage (tumor invasion of lymph vessel)
- Decreased osmotic pressure in blood(hypoalbuminemia)

Gross lesion of edema

- Wet heavy lung
- Fluid oozes out from the cut surface of edematous lung
- Lung; Size: Enlarged; Consistency: Firm; Cut surface: Oedematous fluid drips – Clear, yellow frothy fluid.

Microscopic lesion of edema

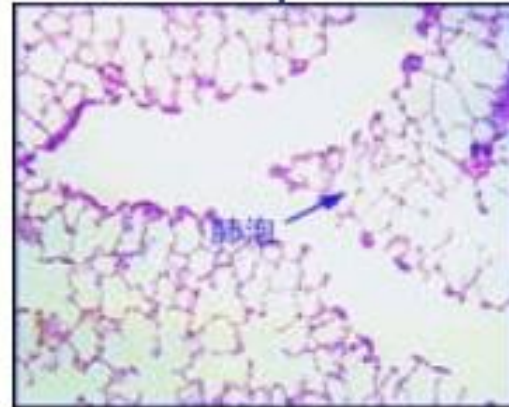
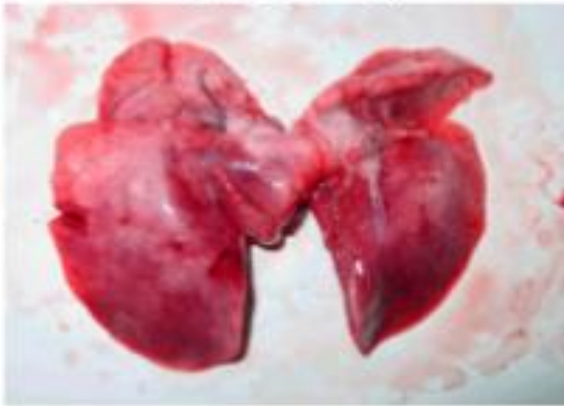
- Alveoli, interstitial tissue and interlobular septa contain edema
- Bronchi and alveolar lumen contain **a pink**

Pulmonary Edema

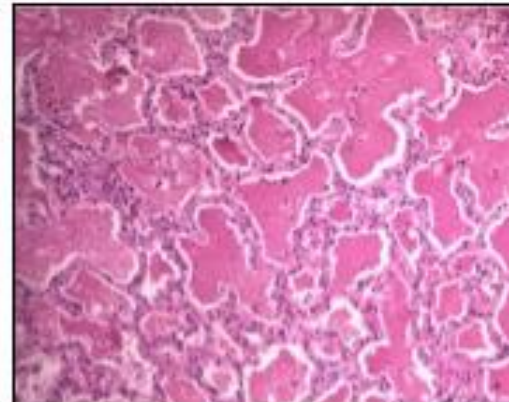
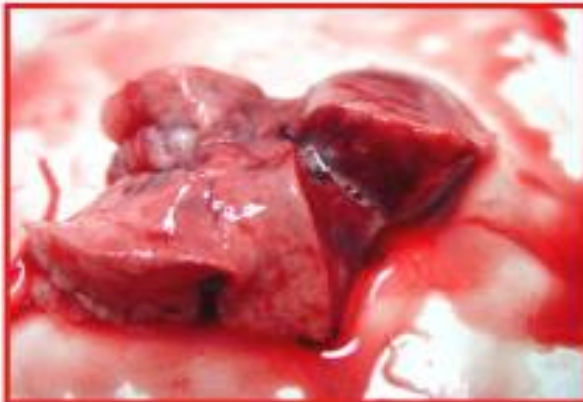
Gross view

Microscopic view

Normal



Edema



Inflammation of lungs

Pneumonia

- Inflammation of lungs with **copious exudates filling the alveoli.**
- It involving **alveolar parenchyma.**

Routes of infection

- Through **respiratory passage** (bronchogenous)
 - Bacteria: *Staphylococcus*, *Streptococcus*, *E. coli*, *Corynebacterium pyogenes*; Fungus: *Aspergillus fumigatus*;
- **Blood (Hematogenous)** – Bacteria – *Pasteurella*, *Salmonella*; parasitic larvae (*Strongylus vulgaris*)
- **Through exterior:** Penetrating wounds – Contaminated bullets and knives; Through abdominal cavity: Foreign bodies penetrating rumen -----> Diaphragm ---->lung

Aetiology: Physical – irritants; Solid – Dust, pollen or foreign bodies; Gas – smoke, hot and

Classification of pneumonia

Pneumonia is classified as follows **based on the extension of lesion and etiology**

- ▶ Lobar pneumonia
- ▶ Bronchopneumonia
- ▶ Interstitial pneumonia
- ▶ Aspiration pneumonia
- ▶ Verminous pneumonia
- ▶ Mycotic pneumonia

Lobar pneumonia

Cause: *Bacteria (Diplococcus pneumonia*
– Man, *Pasteurella multocida* - Cattle
sheep swine; Contagious
pleuropneumonia - cattle and goat.

Pathogenesis:

- ◆ inhalation of bacteria bronchiolitis
- ◆ Bronchiolitis leads to obstruction of bronchiole and hence the flooding exudates infect the surrounding parenchyma.
- ◆ terminal bronchiole alveolus may be affected.
- ◆ Spread of infection is rapid via blood

Gross pathology

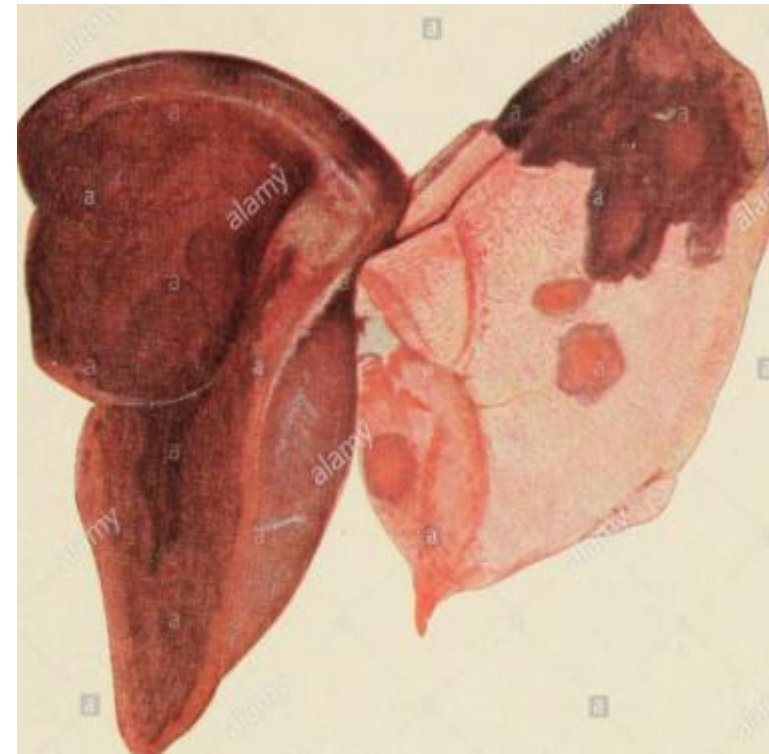
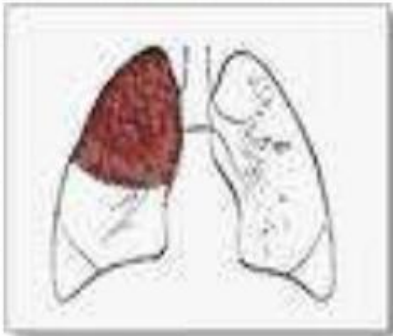
- Apical, cardiac, intermediate and anteroventral portion of diaphragmatic lobe is affected
- Lung appears marbled and Interlobular septa prominent widened.

Histopathology

- Alveolus: Exudate – Fibrinous (croupous) - less in animals
- Inter lobular septa: Distended with plasma and fibrin

Lobar pneumonia

- Lobar pneumonia is acute bacterial infection of a part of lobe the entire lobe, or even two lobes of one or both the lungs.



Bronchopneumonia

Synonym- Lobular pneumonia or catarrhal pneumonia.

It is the commonest type of pneumonia found in animals.

Aetiology:

- ♣ *Bacteria* (*Rhodococcus equi* – foal (may also be a complication of strangles)
- ♣ *Virus* (Parainfluenza –3 virus, adenovirus, reovirus, respiratory syncytial virus in calves and sheep

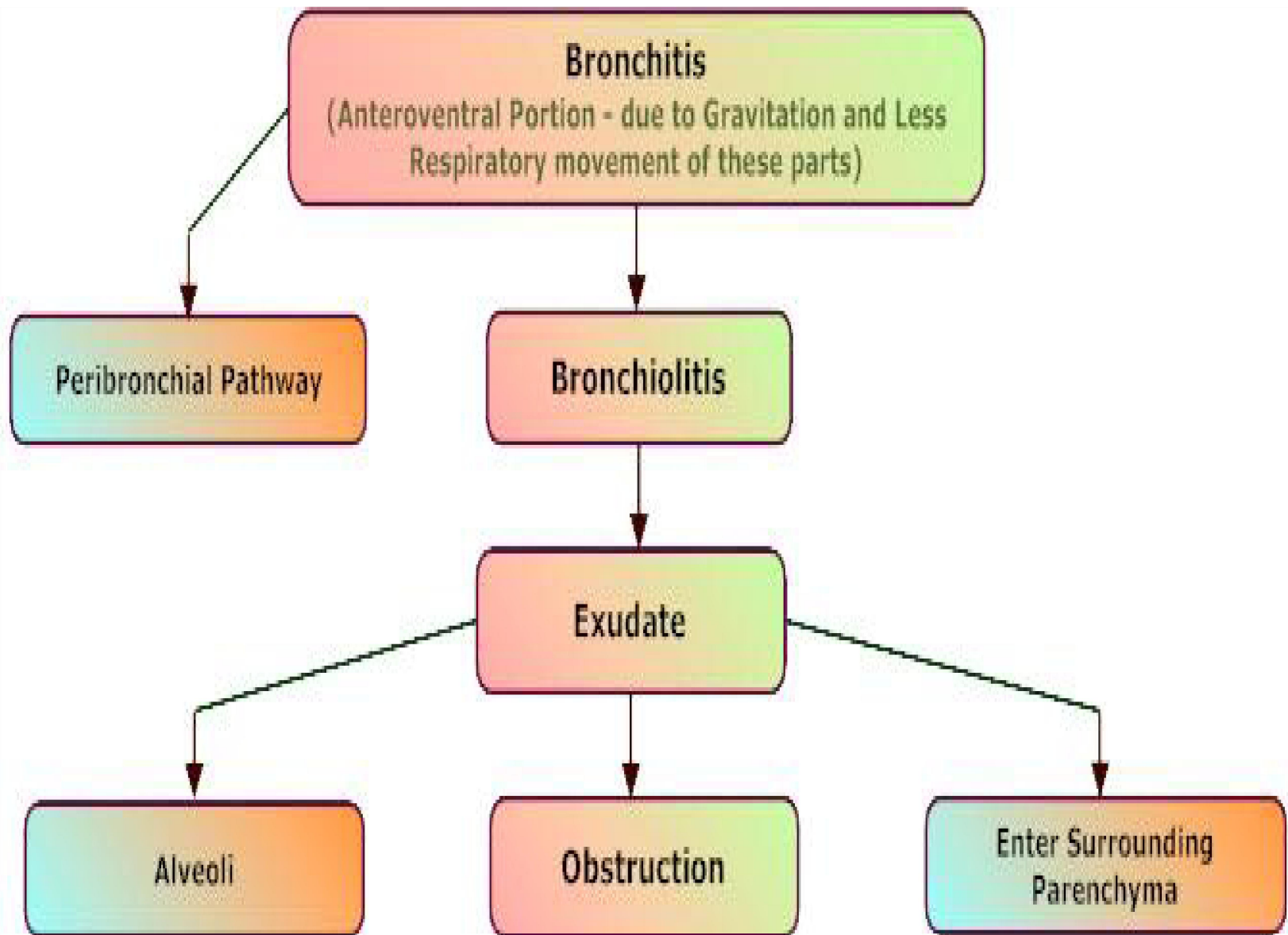
Gross pathology

- Colour: Red
- Consistency: Firm
- Density: Sink in water
- Lymph nodes: Size – Swollen

Histopathology

- ⌘ Bronchial lumen contain catarrhal exudate or leucocytic exudates and Alveolus: leucocytic infiltration

Pathogenesis



Interstitial pneumonia (Pneumonitis)

Definition:

- ♣ the inflammatory changes takes place in the **alveolar wall and alveolar interstitium.**

Gross lesions:

involving all lobes but common on the

dorsocaudal aspect

Meaty appearance of the cut surfaces with the absence of exudates

Histopathology:

→coexist with **edema, emphysema or bronchopneumonia**, Thickening of alveolar walls, proliferation of type II pneumonocytes

Aspiration pneumonia

Synonym:

- Foreign body pneumonia, dipping pneumonia, drenching pneumonia, mechanical pneumonia, inhalation pneumonia, necrotic pneumonia and gangrenous pneumonia
- It is a common and serious disease of farm animals

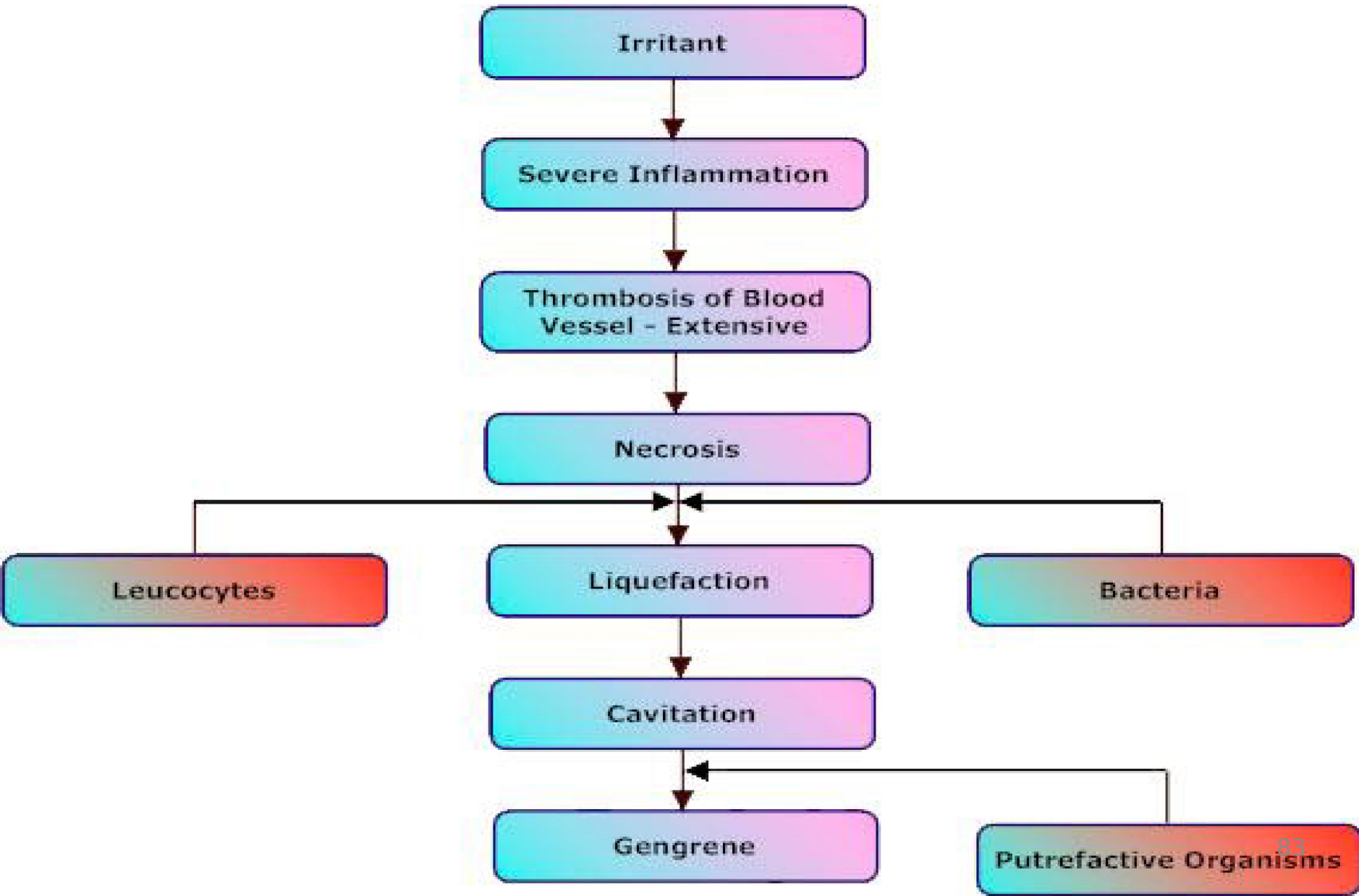
Predisposing factors

- ♣ Drenching of animals when the tongue is drawn out or when the head is held high or when the animal is coughing or bellowing
- ♣ Vagal nerve paralysis; Tumours of pharyngeal region; Cleft palate

Etiology

- ⊗ Drugs, food, foreign body and oil drench which reaches in lungs through trachea.
- ⊗ Paresis of throat predisposes the animal for

Pathogenesis

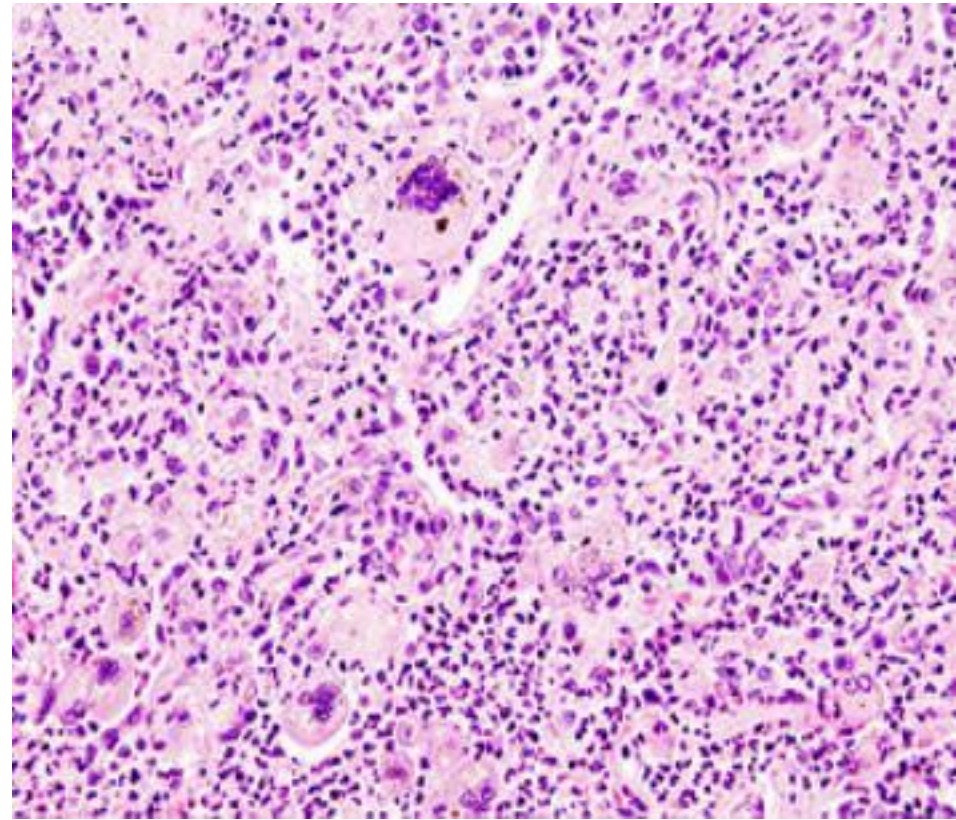


Macroscopic and microscopic features

- ▶ **Congestion and consolidation** of lung.
- ▶ Affected part becomes green/ black in colour, moist gangrene, Presence of foreign body,



**Macroscopic features
Aspiration pneumonia**



**Microscopic features
Aspiration pneumonia**

Verminous pneumonia

- ♣ It is **caused by parasites**
- ♣ characterized by the presence of lesions of **broncho-pneumonia along with parasites or their larva.**

Etiology

- ➡ *Metastrongylus apri* in pig.
- ➡ *Dictyocaulus filariae* in sheep and goat
- ➡ *D. viviparus* in cattle
- ➡ *Capillaria aerophila* in dogs and cats.
- ➡ *D. arnfieldi* in horse and donkeys.

Macroscopic and microscopic features

- Multiple petechial haemorrhage in lungs at the site of parasite penetration.
- Mature worms in alveoli, bronchioles and bronchi.
- Mucopurulent exudate in alveoli/ bronchi.
- **Pulmonary oedema, -emphysema.**

Verminous pneumonia, macroscopic features in lung

Dictyocaulus in the lung (PM)



Mycotic pneumonia

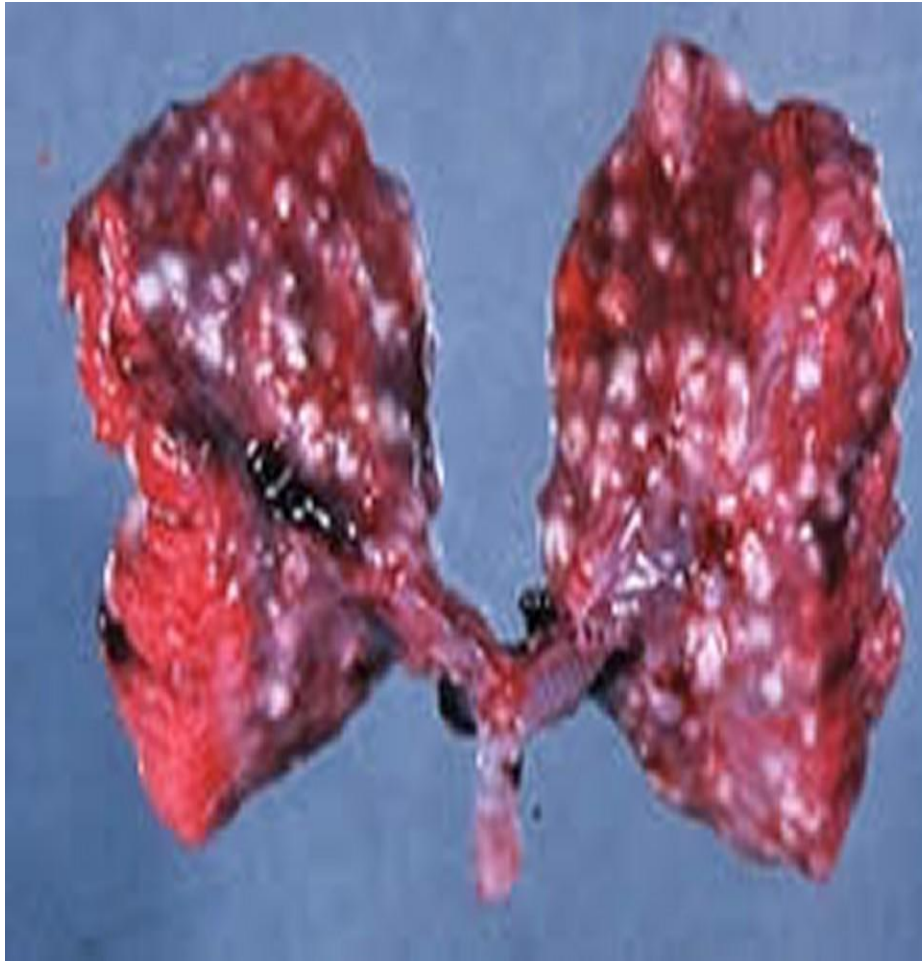
- caused by a variety of fungi and characterized by the presence of chronic granulomatous lesions in lungs.

Etiology

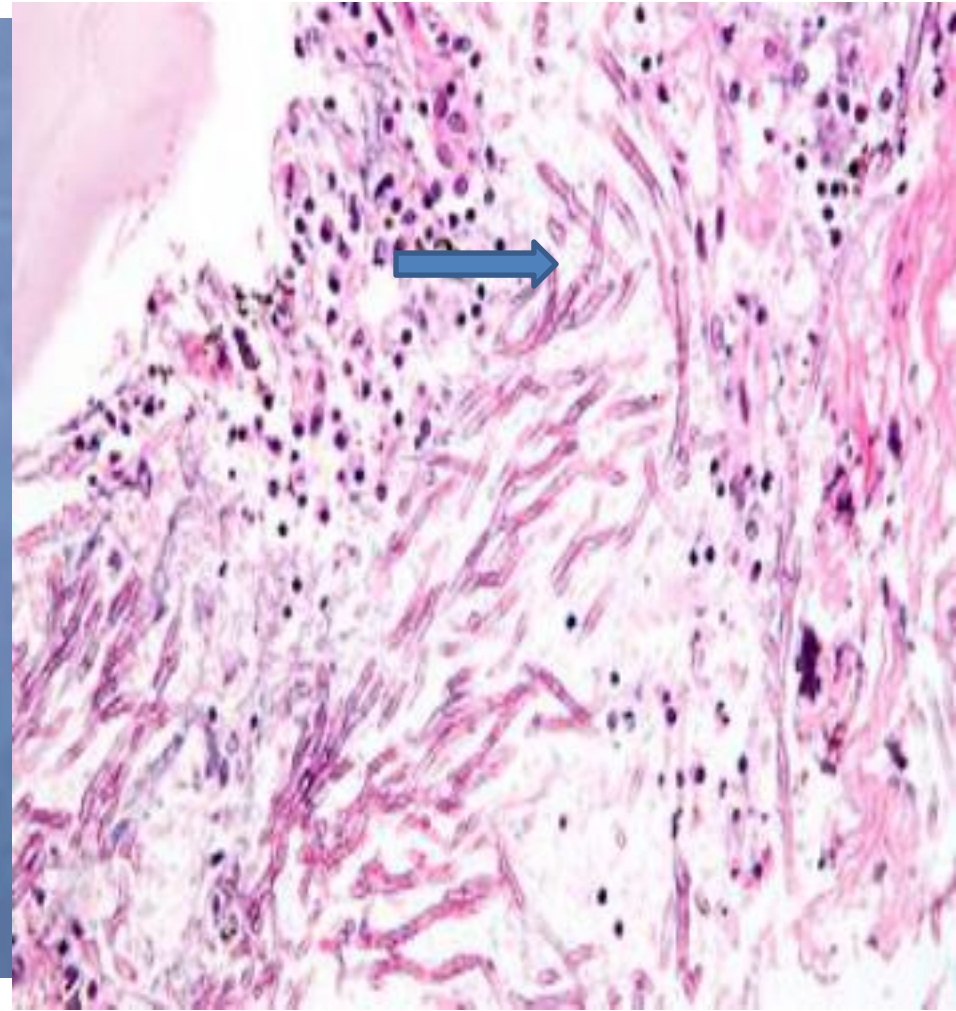
- *Aspergillus fumigates*
- *Cryptococcus* sp.
- *Coccidioidomyces immitis*
- *Blastomyces* sp.
-

Macroscopic and microscopic features

- › Nodules in lungs, cheese like causative mass comes out from nodules.
- › Caseation involves bronchiole, alveoli, trachea, bronchi and airsacs.
- › Presence of granulomatous lesions i.e. causative necrosis, macrophages, epithelioid cells, lymphocytes, giant cells, fibroblasts.
- › Presence of branched hyphae of fungi in the necrotic area.



Histopathology of fungal pneumonia



Fungal hypha in mycotic pneumonia

Pathology of pleura

- Vascular disturbance
- Congestion
- Edema (hydrothorax)
- Abnormal contents
- Air in pleural cavity: Pneumothorax
- Pus in pleural cavity: Empyema
- Inflammation: Pleuritis
- Pleural congestion

Cause: Passive congestion, Acute poisoning ,
Abnormal contents

Hydrothorax

Definition: Excessive fluid accumulation in thoracic cavity

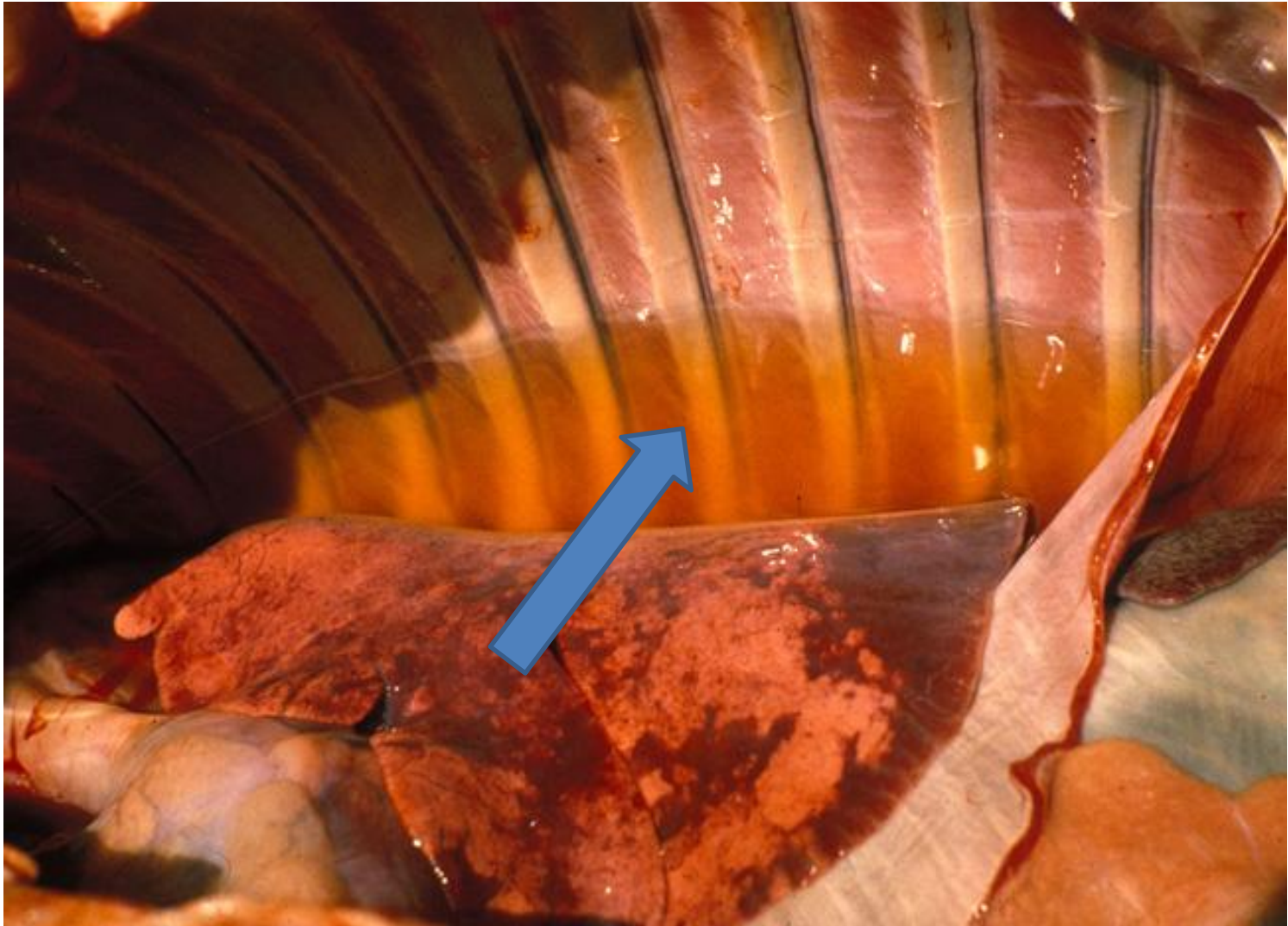
Cause

- Passive congestion
- Acute poisoning
- General dropsy conditions
- Chronic cardiac diseases
- Interference with lymphatic circulation – tumours and lymphadenitis

Gross pathology

└ Pleural cavity contains serous fluid

Hydrothorax



Pneumothorax

Definition: Presence of air or gas in the pleural cavity

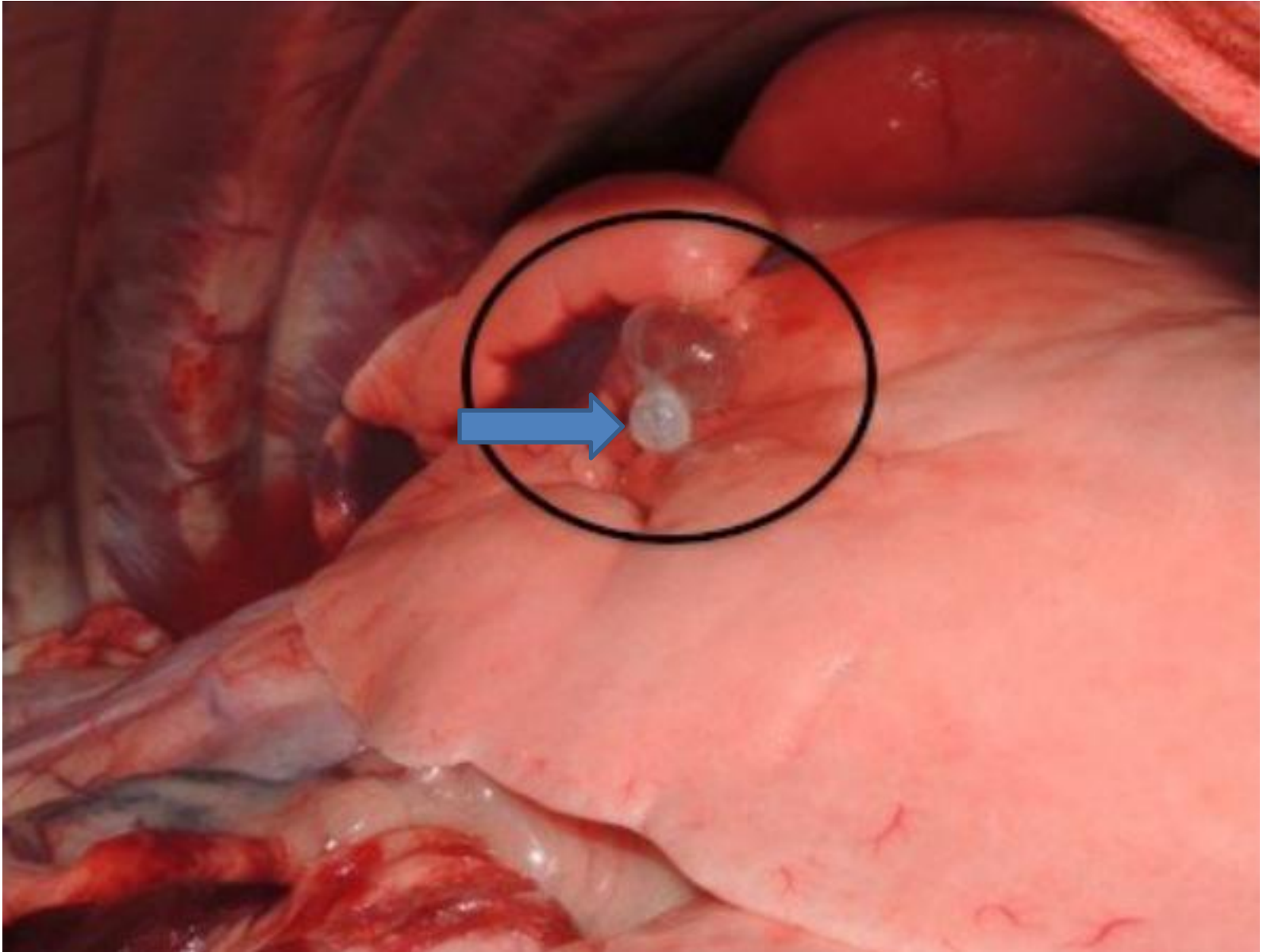
Etiology

- Internal - Rupture of bullae in lung
- External - Chest wall - by piercing sharp objects
- Physical injury to the chest wall
- Bacterial - gas forming organisms introduced through a septic wound.
- Pathological - Rupture of lung tissue as in tuberculosis, infarct, lung abscess and emphysema

Gross pathology

- } Pleural cavity: Contain gas or pus mixed with gas
- } Lungs: Collapsed

Pneumothorax



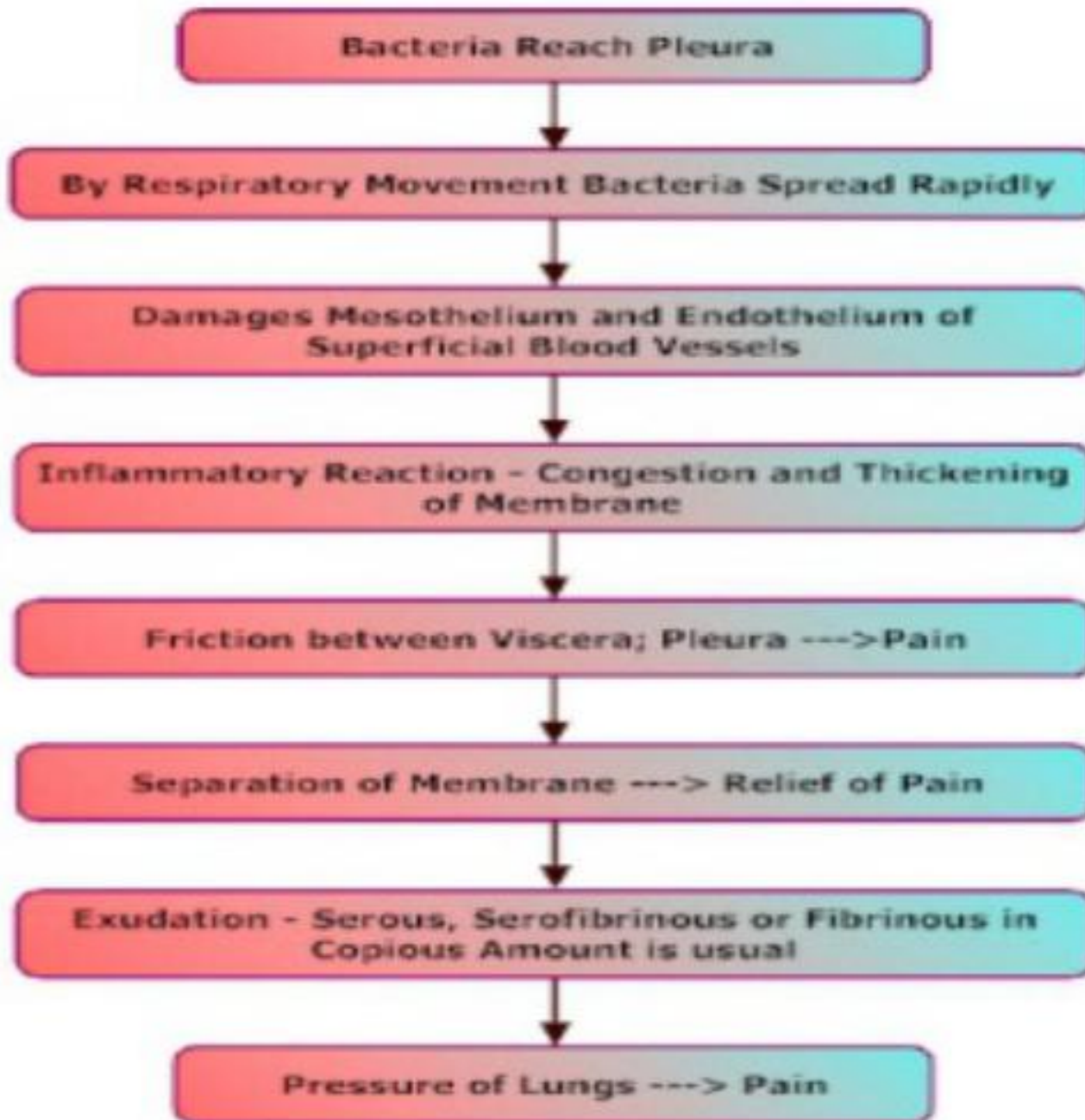
Haemothorax

Definition: Accumulation of blood in pleural cavity

Etiology: Physical – trauma – fracture of ribs, or



Pathogenesis



Pathology of air sacs

Air sacculitis:

Definition: Inflammation of the air sacs is called air sacculitis

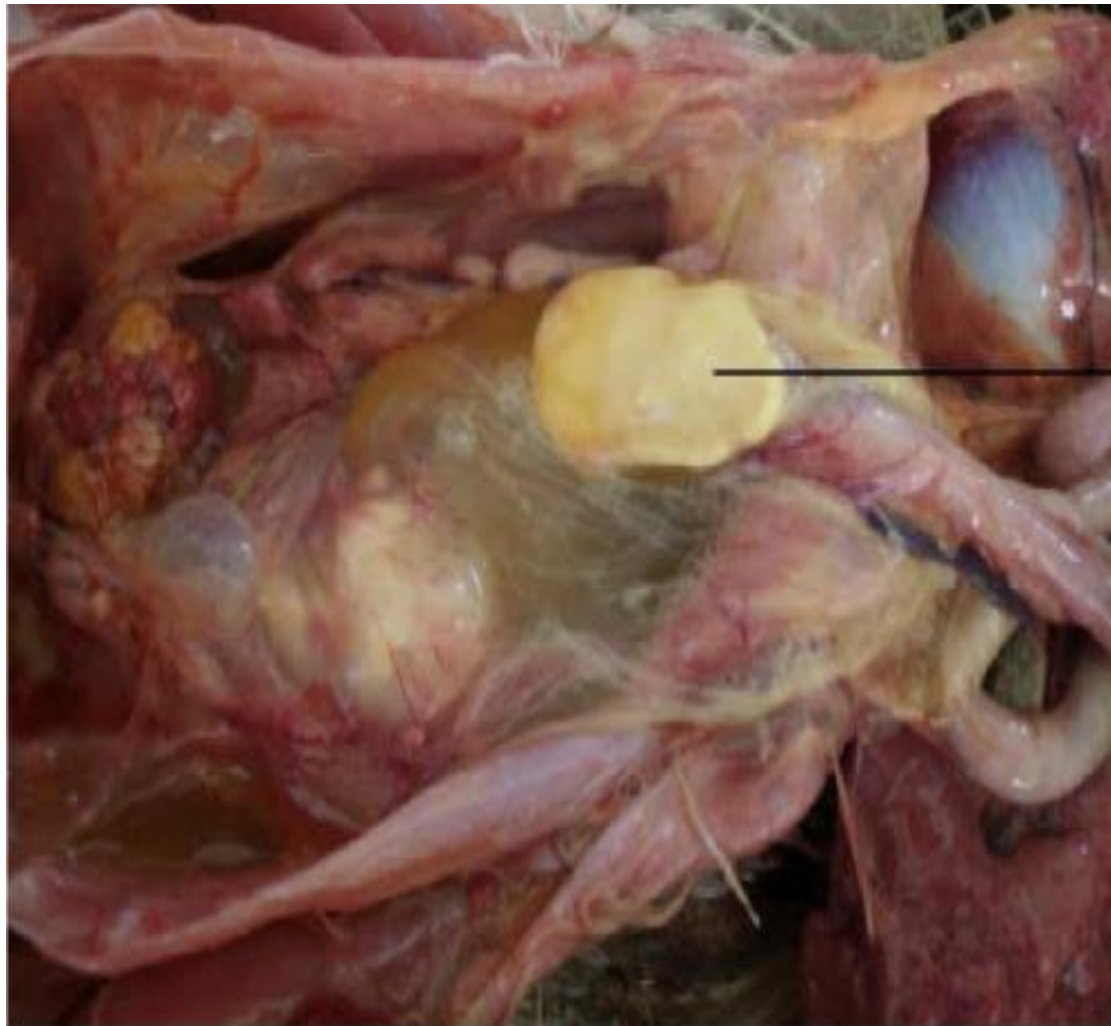
Species affected: Avian – Commercial chicken

Etiology: Mycoplasma gallisepticum,
Escherichia coli, avian reovirus

Gross pathology

Air sacs:

- Pin point pale foci seen in early change
- Cloudy –Mild inflammation
- Thick – Moderate
- Thick with whitish cheesy exudate – severe
- Thick with yellowish cheesy material indicate complicated infection

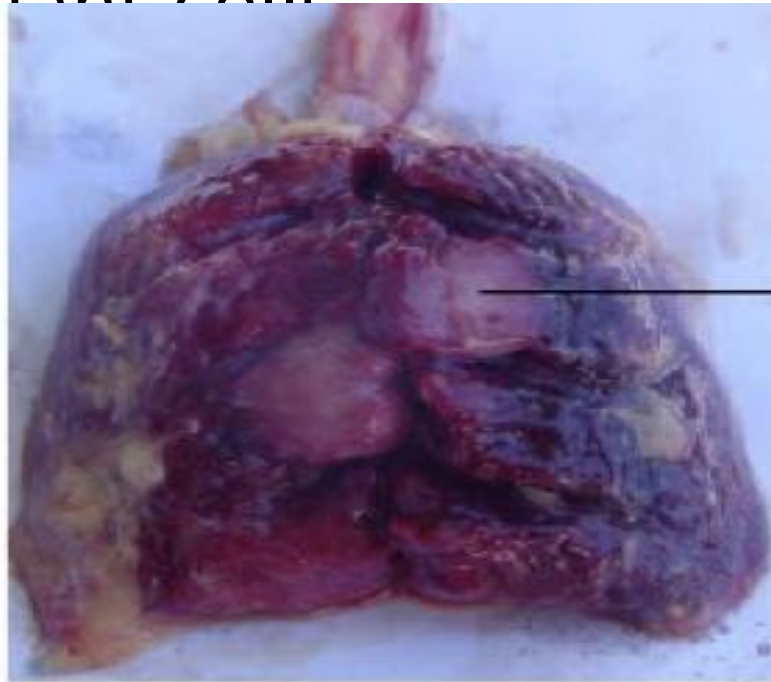


→ Cheesy exudate in the abdominal air sac

Air sacculitis - Chicken

Histopathology

- The air sacs are thickened with congestion
- edema, fibrinous exudates
- infiltrated lymphocytes, macrophages and giant cells



Pale consolidated area

Nodular tumours in lungs - Marek's disease - Chicken