RADIOLOGY OF THE THORAX

Indications for Thoracic Radiography

- To determine the size of the heart (VHS).
- To determine the role of the cardio-vascular system in the primary lung disease.
- To determine the pattern as well as distribution of lung disease.
- To determine the presence of secondary / metastatic pulmonary neoplasia.
- To investigate trauma to the chest wall.

COMMOM FACTORS THAT INFLUENCE LUNG APPEARANCE.

- Radiographic Technique: An incorrect diagnosis of increased interstitial opacification will be made in underexposed radiograph.
- Overweight patients often have poor ventilation, leading to an incorrect assessment of an alveolar or interstitial pattern. The superimposed adipose tissue will also lead to increased background opacity to the lung, contributing to the false sense of an interstitial pattern.
- Sedated patients do not ventilate fully, with a resultant decrease in the amount of air within the lung often misinterpreted as an alveolar pattern, an interstitial pattern or both.
- Patient Position. In lateral recumbency, the dependent lung rapidly loses air and has an increased opacity. This contributes to overall lung opacity which can be misinterpreted as an alveolar or interstitial pattern. Lungs will always look more opaque (abnormal) in lateral views than in the VD or DV views.
- Interpretive Bias. Patients being radiographed for lung assessment typically have a clinical sign that suggests intrathoracic disease. This will bias the interpreter because the goal is to find something wrong which explains the

clinical signs. This could lead to misinterpretation of normal lung appearance, or interpreting lung altered by one of the above phenomena as abnormal.

Pulmonary patterns

- Radiographic appearance of lung disease can be divided into patterns of appearance.
- The patterns are based on the structures of the lung that are involved in the disease process.
- The patterns are

A) Pulmonary parenchyma disease pattern

B) Vascular pattern

C) Bronchial lung disease

Pulmonary parenchymal disease pattern can be further classified as;

Interstitial pattern

Alveolar pattern

A) <u>Pulmonary parenchymal disease pattern</u>

The pulmonary parenchyma is considered to consist of (i) alveolar spaces (ii) alveolar walls (iii) and connective tissue network surrounding them.

- The connective tissue network is referred to as the intestitium of the lung.
- Radiographic patterns of parenchymal lung disease can be divided into alveolar and interstitial patterns
- The interstitial patterns may be structured or unstructured, depending on the radiographic appearance of the disease process.
- Diagnosis is based on recognition of the

- Predominant pattern displayed
- The distribution and location of parenchymal lung diseases is helpful in narrowing the diagnostic possibilities diffuse (i) Local or diffuse (ii patchy or nodular (iii) located in specific to be or lobes of the lung or may affect al lobes equally.

B) <u>Alveolar disease pattern</u>

It implies absence of air in the affected alveolar spaces.

- Air may be absent in alveoli either due to collapse (e.g. atelectasis as in pneumothorax) or due to replacement with fluid e.g. transudation, blood exulate etc.
- Based on the type of fluid present 5 roentgen signs of alveolar disease have been recognized as
- Air bronchogram
- Fluffy borders
- Coabtion of borders
- Lobar distribution
- Silhouette sign

Air bronchogram

This sign is produced when the alveolar spaces surrounding a bronchus are fluid filled.

Radio graphically, a branching stripe of air coursing through an area of fluid density in the lungs is seen.

It differs from bronchial pattern because the bronchial wall is not seen. Only the air within the bronchus is seen.

iii. **Fluffy borders**

Alveolar disease pattern have fluffy irregular borders with tendency for affected are us to coalesce.

Alveolar have irregular shapes and thus accounts for the fluffy margins

iv. Lobar **distribution:**

This implies that one or several lung lobes are affected while other lobes remain totally unaffected.

If alveolar disease reaches the subpleural areas of a lobe, and the affected lobe directly abuts unaffected, a lobar margin may be seen.

This margin will be smooth, sharp, curving line of demarcation between the affected and unaffected lobe.

It is due to fluid filled alveoli beneath the visceral pleural of the affected lobe abutting the air filled alveoli beneath the visceral pleural of the unaffected lobe.

Silhouette sign:

The silhouette sign is present when normally visible interfaces between two structures disappear.

It is caused by 2 structures of the same radiographic density being in direct contact with each other.

The silhouette signs thus imply the absence of a normally visible silhouette.

Bacterial pneumonia:

Has a ventral or cranioventral distribution in the lungs. The dependent lung lobes tend to be mostly affected while the right middle lobe is the single lobe most frequently involve.

The ventral distribution of pneumonia is due to the fact that most bacterial infections reach the lung as airborne contaminates due to their weights they fall quickly and tend to accumulate in dependent lung lobes.

Pulmonary oedema: has a distribution that is hilar and dorsal in location. It begins a leakage of fluid out of the pulmonary veins into the connective tissue network surrounding them as the fluid volume in the intestitium increases; it begins to fill the alveoli surrounding the veins.

Due to poorer lymphatic drainage near the hilus pulmonary oedema begins in hilar region. This disease is initially in dorsal direction, and then spread into the dorsal and caudal lung lobes**.**

Pulmonary haemorrhage: most frequently due to lung trauma. It has a random distribution related to the site of trauma to the lungs.

N.B: Since all fluids appear the same on radiographs, the distribution of the fluid filled alveoli will help determine which of the three types of fluid is most likely present this in addition to the history physical examination and laboratory data can be used in determining the diagnosis or the differentials.

Structured interstitial lung disease

These are often nodular lesions, well circumscribed and usually numerous. The lists of differential diagnosis for structured interstitial lung disease include:

(i) primary or metastatic neoplasis
(ii) pulmonary abscess
(iii) mycotic or granulomatous pneumonia and
(iv) Parasitic pneumonia unusual causes of pulmonary nodules include haematocoesle. Emphysematous bullae or a bronchial cyst.

Emphysematous bullae and bronchial cyst often appear as a hollow or air filled nodules rather than soft tissue density nodules.

Nodular lung disease results form less virulent pathogenic process and enlarge by expansion pressing the surrounding alveoli away from them and compressing the alveoli surrounding the nodules.

Modules >=3mm in diameter. Clearly defined, sharply demarcated borders to pulmonary lesions indicate a slowly expanding disease process with essentially no inflammatory component typical of metastatic neoplasm.

Nodular densities with slightly lazy borders represent slowly expanding disease processes with only a slight inflammatory component. This is typical of granulomatous or mycotic pneumonia, pulmonary abscess and parasitic granulomas.

Solitary nodular densities in the lung are often pulmonary abscess or primary lung neoplasm. It is rare for metastatic neoplasia to present as a solitary nodular density. Multiple nodular densities of variable size and having smooth and sharply demarcated borders, indicating an absence of inflammatory reaction, are often metastatic neoplasms.

Multiple nodular pulmonary densities with hazy or blurred margins indicate some active inflammatory component and are likely to represent glaucomatous or mycotic pneumonia.

Primary lung neoplasia has a predilection for the right caudal lung lobe. The exact reason for this predilection is not well understood.

Unstructured interstitial lung diseases

The disease is limited to the interstitium of the lung resulting in an increase in the size or density of the connective tissue network due to fluid cellular infiltration or fibrous tissue proliferation.

In real sense unstructured interstitial lung disease is not really a pattern the lung appears dirty or grey due to an increase in overall lung density.

The disease is diffuse affecting all lobes equally.

Differential diagnoses include:

Early pulmonary oedema, pulmonary fibrosis due to aging, lymphosarcoma,

Viral pneumonia, under exposure and making the radiograph on expiration

Vascular disease pattern

These patterns reflect disease that primarily involves the pulmonary blood vessels or may indicate cardiac or systemic disease that is secondarily reflected in alterations in the normal appearance of the pulmonary vessels.

Vascular pattern, with pulmonary arterial enlargement and normal pulmonary vein is characteristic of heartworm disease.

Vascular pattern, with pulmonary arterial enlargement pulmonary veins are enlarged secondary to left heart disease, while pulmonary arteries remain normal in size.

Enlargement of both the pulmonary arteries and veins is seen in a left to right shunts associated with congenital heart disease.

Evaluation of the cardiac shadow and cognizance of the age of the patient and type of murmur will differentiate these diseases.

Pulmonary arteries and veins are smaller than normal when there is reduced blood flow to the lungs.

Differential diagnosis includes:

(i) Pulmonic stenosis
(ii) Right to left shunt
(iii) Hypovolemic shock
(iv) Severe anaemia and
(v) Dehydaration.

Bronchial disease pattern

Bronchial structures are normally only visualized in the hilar region of the lungs. Aged dogs may deposit mineral salts in the bronchia cartilage rings.

This mineralisation of the cartilaginous walls of the bronchi will make some bronchial structures in the middle lung fields visible. However this is a normal a gin process and indicates know alteration in the bronchial cartilage. Cushing's disease may also cause bronchial mineralization.

Bronchial disease is present when bronchial walls or the immediate surrounding connective tissue are infiltrated with cellular material. Radiographically this is reflected in abnormally thickened bronchial walls with increased density this is visible radiographically in the middle or peripheral zones of the lung. The differential diagnosis for bronchial pattern includes:

(i) sub acute or chronic

(ii) Bronchtiectasis.

Pleural Disease

The pleura are thin layer of connective tissue that covers the entire lung and lines the thoracic cavity. The pleural space has between the visceral and parietal layers of the pleura and is extremely small in dogs/about 0.8mm wide). The pleural and pleura space are not normally visible radiographically.

Radiographic visualization of the pleura or pleural space are seen in conditions such as filling of pleural space with fluid or cellular material (Hydro or Pyo thorax) filling of pleural space with gas (pneumothorax), Thickening of pleural by fibrous tissue

Consolidation of lung lobe.

Pleural thickening can also be associated with the following:

- Natural process of aging
- Previous pleural disease
- X-ray beam parallel to pleural reflection.
- Hydrothorax

All fluids appear the same on radiographs. Thus specific aetiologic diagnosis is only possible following thoracocentensis and fluid analysis.

Radiographic signs of hydrothorax are largely dependent on the position of the animal during radiography and the volume of the fluid.

Radiographic signs of pleural fluid are:

Retraction of lung margins from the plane of the ribs and rounding and reduced depth of the costophrenic angles of the dung best seen on V.D projection.

Increased width and density of the caudal mediastinum on the V.D view.

(iii) Widening of cranial mediastinum and loss of normal visualization of the cardiac shadow.

Widening and visualization of interlobar fissures and clear demarcation of the peripheral lung lobe margins seen on the VD, DV and lateral projections.

Lungs appear to “float “on the fluid appear relatively radiolucent compared to the surrounding pleural fluid.

Pneumothorax

It may be due to (i) traumatic injury of the lung or chest wall (ii) rupture of a pulmonary cyst (congenital pulmonary cyst on emphysematous bulls (iii) or ratrogenic causes following either thoracocentensis or surgery.

Radiographic signs of pneumothorax include retraction of lung borders form the chest wall.

Interlobar fissures are widened but more radiolucent.

Absence of vascular markings in the peripheral regions of the thorax.