Thoracic Radiographs: How to read the ENTIRE chest

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Thoracic Radiographs: Old techniques reinvented

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1. Introduction:

The goals of this lecture are to provide you with techniques of radiology of the dog and cat thorax. Thoracic radiology remains the main imaging modality in the interpretation of pulmonary and other intra-thoracic diseases. These techniques should provide the basis for production of diagnostic images and ability to derive a reasonable set of differential diagnoses.

A few key points to remember:
-Radiographs provide information NOT answers
-answers are derived from proper interpretation of the radiographic signs in concert with other clinical aspects of the case
-radiographs may lead you to ask more or different types of clinical questions
- if poor quality, radiographs are a waste of personnel time and client money
- without a systematic approach to film interpretation, the information may be on the radiograph, but goes unseen
-without a good knowledge of clinical medicine, the changes are noted on the radiographs but incorrect conclusions are reached

What is a radiograph:

Radiographs are images on photographic film by x-rays that have passed through tissue. The interaction of x-ray photons with the intensifying screen in the cassette produces photons of visible light. The light interacts with silver in the film to produce a latent image. The latent image is converted into the blacks and whites by the developing process.

The whiteness of the film is termed "opacity". There are five radiographic opacities:
metal
mineral (bone)
soft tissue
fat
air

The resultant opacity of the image is a function of both the object density and the thickness of the structure (which is why some end-on blood vessels can appear as opaque as a rib). The film has characteristics that allow us to image structures as varied as air-filled to metallic objects on the same radiograph. We are very dependent on proper technique, positioning, and developing for production of diagnostic images.

A radiograph is medical legal document and needs to be diagnostic, identify the patient, date, clinic name and properly marked with patient positioning (lateral views are marked by the side closest to the cassette)and anatomical sidedness (left versus right).

2. Thoracic Radiology

a. Film Reading technique

Learn a system then use it! Make sure to look at the ENTIRE film. My system is listed below, but any system used consistently, is a good system:

Peripheral structures in a clockwise direction starting cranially:

- forelimb
- neck (soft tissues, spine and trachea)
- thoracic spine (spinous processes, canal and bodies)
- diaphragm
- stomach
- liver (and any other intra-abdominal structure)
- falciform fat pad and other intra-abdominal fat
- sternum

Mediastinum and pleural spaces
Ribs for symmetry
Heart
Lungs

Inevitable some portion of the films will be "dark" (overexposed). To best view these areas use a bright light. Alternatively use a "bob-o-scope" (two lightly clenched hands arranged in series or an empty paper towel roll!). Either of these devices limit the extraneous light, size of the portion evaluated and thereby, increase acuity of detecting lesions in the darker areas of the film. Bright lights are more expensive but fewer people laugh at you!

4. Radiographic Anatomy of the Thorax

a. Introduction

Knowledge of "what is normal" is essential for detection of lesions. "Normal" includes all the variations by age, breed, sex and body condition. Radiographic variations are as clinically important as, and more difficult to learn than, normal radiographic anatomy. Remember that cats are not little dogs.

b. Radiological Variations

Expiration causes increased lung opacity. Decreased amount of air in the lung results in proportional increased interstitial pattern. Overlap of the diaphragm and caudal cardiac silhouette should alert you to this variation. (see comments below on obese patients)

Underexposure causes increased lung opacity. Poor penetration of the spine, especially superimposed on the scapula, should alert you to this variation. Especially a problem with obese patients if the technique is not adjusted accordingly.

Flexion of the neck causes bending of the trachea in the lateral projection. Undulation of the trachea should not be mistaken for "dorsal deviation" secondary to a cranial mediastinal mass. Repeating the radiograph with the neck hyperextended tests the validity of the tracheal positioning due to head position.

Rotation of the chest in the lateral projection makes the heart base appear larger. Without foam support beneath the ventrum, an increased opacity in the heart base mimics left atrium enlargement and hilar lymphadenopathy.

Oblique positioning on VD/DV projections distorts the cardiac silhouette mimicking chamber enlargements.

c. Geriatric patients

With increased age we see a large number of changes to the appearance of the thorax. The most common change in cats and dogs is increased lung opacity. This is mostly due to combined increased bronchial and interstitial patterns. The bronchial pattern is due to dystrophic mineralization in the walls. The interstitial component is thought to be due to pulmonary fibrosis. mineralized costal cartilages and costochondral junctions are seen in the ventral thorax. Spondylosis deformans is a radiographic change (more common in dogs than cats) associated with smooth bone formation extending (= originating) from the vertebral end plates towards the adjacent vertebral end plate. This change thought to be a degenerative of the annulus fibrosis part of the intervertebral disk and, as an isolated finding, is an incidental finding. Heart orientation often changes in older patients. The heart in older animals (more common in cats) tends to be less upright (= "falls forward", "leans over") than in young animals. This exaggerates the appearance of the aortic arch on both the lateral and VD/DV views.

d. Obesity

With increased obesity, increased lung opacity. This is mostly due to a increased interstitial pattern. This is due to relative expiration. The weight of the thoracic wall fat limits chest wall excursions and intra-abdominal fat decreases caudal movement of the diaphragm. Increase the KvP 10 to 15% compared to a normal conformation patient of the same measurements.

The heart size is apparent increased in obese patients. The smaller lung volume makes the heart appear larger (= out of proportion). This is a challenge with both the subjective interpretation and when using cardiac measuring schemes that utilize intercostal spaces or percent of chest width.

In obese patients increased width of the mediastinum is seen. Fat infiltration in the cranial mediastinum can mimic a mass (cats and dogs). This increased width usually has parallel sides, as seen on the VD/DV view, unlike an enlarged lymph node or thymoma. In the middle mediastinum the fat adjacent to the heart may silhouette with the cardiac outline mimicking heart enlargement. Caudal mediastinal widening, between the accessory and caudal left lung lobes can be mistaken for pleural effusion.

Finally, increased distance between lung lobes or between lung and inner body wall is often noted. Fat can accumulate in pleural fissures or on the inner aspect of the chest wall mimicking pleural effusion.

e. Breed variations

Brachycephalic dogs often have smaller diameter to trachea (normal > other brachycephalic breeds > bulldogs). Additionally, they have apparently larger heart size (result of wide, shallow conformation). A bulldog is not a bulldog without a caudal thoracic hemivertebra. Dachshund and greyhound hearts measures big using the vertebral heart scale. Collies commonly have heterotopic bone formation in the lungs (mimic nodules).

3. Summary

Thoracic radiographs are powerful tools for the detection and characterization of lung, heart, mediastinal, pleural and body wall lesions. Through knowledge of normal variants (according to age, breed, species, and body conformation) differentiation of disease from a normal variant is possible.