QUARTERLY LEARNING SERIES

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Non-Cardiogenic Pulmonary Disease: Is That Pneumonia or...?

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- Standard of care radiography of the lungs consists of three views: Ventrodorsal, Right lateral, and Left lateral.
- The fundamental radiographic findings of size, shape, margination, location and opacity are crucial when formulating a differential diagnosis for lung diseases that look similar.
- Good positioning and using the principles of fundamental radiographic findings help to accurately prioritize your differential list.

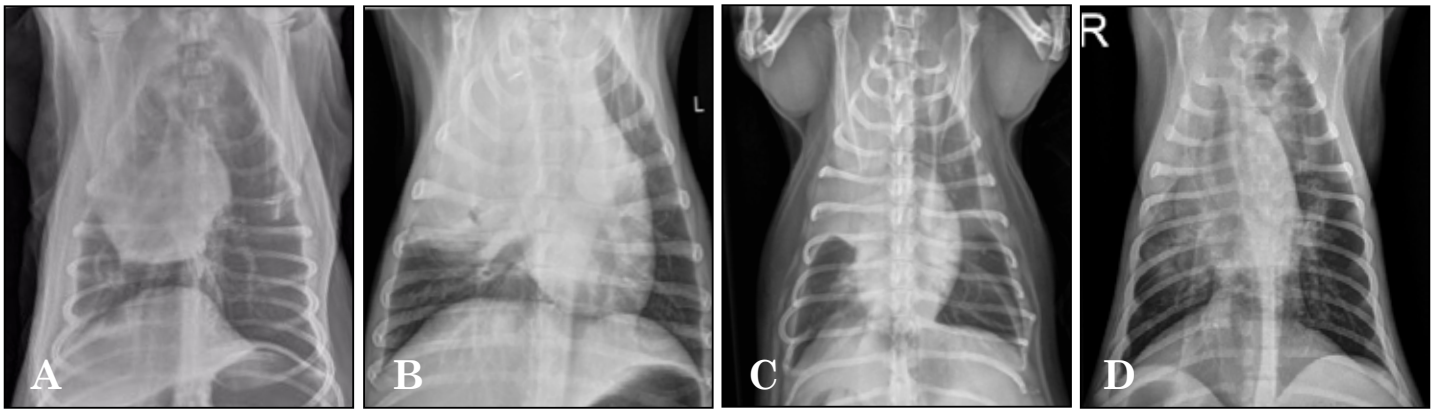

Figure 1. Ventrodorsal radiographs. Note the similarity in diffuse soft tissue opacity throughout the right cranial lung lobe. A) Atelectasis B) Primary pulmonary neoplasia C) Lung lobe torsion D) Lobar pneumonia

When an entire lung lobe is soft tissue opaque on a radiograph, it can be challenging to prioritize a list of differentials. Atelectasis, pulmonary neoplasia, lung lobe torsion, and lobar pneumonia can all look very similar (Figure 1) on radiographs. While radiographic studies are rarely definitive for pulmonary disease, there are some clues that can help us determine the likelihood of a given differential diagnosis based on exercising the fundamental principles of radiographic findings.

Standard of care radiography of the lungs consists of three views. When the animal is placed in lateral recumbency, weight of the intrathoracic structures and overlying bone and musculature cause partial atelectasis of the dependent lung. Air in the lung gives the necessary contrast against any soft tissue opaque structures or other opaque pathology so that we can see it. Partially or completely atelectic lung will cause border effacement of many types of lesions rendering them invisible on the radiograph. Opposite lateral views ensure good visualization of both the right and left lung fields. Good radiographic positioning of the thorax is centered at the caudal border of the scapula and collimated to include the lung fields cranial and caudal and include the extrathoracic structures dorsal and ventral.

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When formulating our differential list for lung diseases which look similar at first glance on radiographs, it is crucial to consider the fundamental radiographic findings of size, shape, margination, location and opacity. Number is also an important fundamental we mustn't forget. Today's examples all have number one, as in one lung lobe is affected.

Diffuse soft tissue opacity in one lung lobe is the most strikingly radiographic finding in all the examples discussed today. There are additional findings that can further narrow the differential list. These include size of the effected lung, shape of the effected lung, presence or absence of a mediastinal shift, direction of the mediastinal shift if present, whether the course of any visible bronchi is normal or abnormal, and pattern of any gas present in the effected lung. Following are some example cases to illustrate this. Although all of the pathology discussed here can occur in any lung lobe, cases where the right cranial lung lobe is affected were chosen to simplify comparisons.

ATELECTASIS

The most common causes of atelectasis include anesthesia, sedation and prolonged recumbency. However, there are less benign causes to consider including bronchial obstruction from foreign material or mucus. Figure 2 shows examples of foreign material obstructing a bronchus and atelectasis associated with anesthesia. The non-specific diffuse soft tissue opacity in the effected lung is most striking. Looking further, notice the mediastinal shift *toward* the effected lung lobe as well as a smaller than expected lung field for the effected lung under sedation vs minimal to no mediastinal shift and a normal sized lung lobe in the lung obstructed by foreign material. In the case of foreign body obstruction of a bronchus, a computed tomography scan removes soft tissue superimposition so we can actually see the effected bronchus and the foreign body (Figure 3). Atelectasis from anesthesia or sedation can be ruled out by repeating radiographs at least 24 hours after the patient has recovered. Atelectasis from recumbency can be ruled out by placing the patient in opposite recumbency for 15-20 minutes to allow reinflation of the effected lung and then repeating the radiographs.

Figure 2. A) Sedation-induced atelectasis of the right cranial lung lobe from Figure 1C. B) Atelectasis caused by a bronchial foreign body. Note the mediastinal shift in A vs. minimal to no mediastinal shift in B.

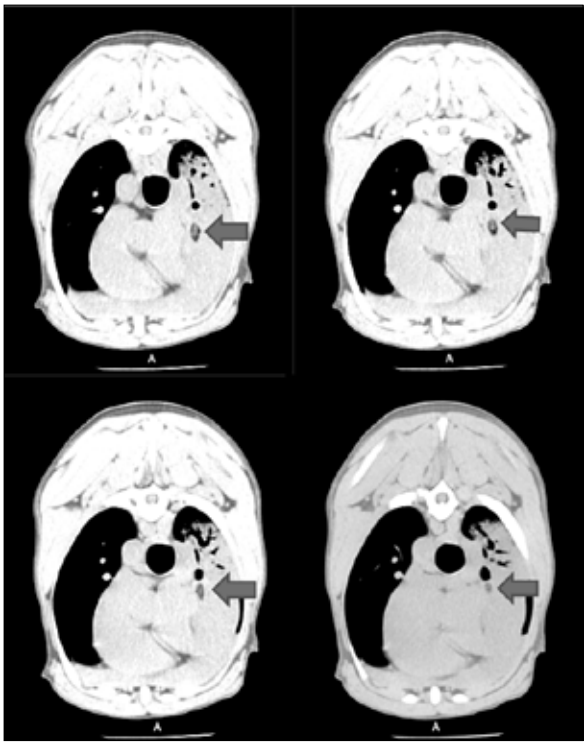

Figure 3. Four successive computed tomography images of the dog in Figure 2B. The patient presented with acute coughing after chewing on a stick. A soft tissue attenuating foreign body (stick) can be seen in the mainstem bronchus to the right cranial lung lobe (arrows). Note that we can confirm no mediastinal shift in the tomographic images.

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PULMONARY NEOPLASIA

While metastatic pulmonary disease usually presents as multiple, spherical, soft tissue opaque nodules, primary pulmonary neoplasia can be either one or a few nodules, or can infiltrate an entire lung lobe while leaving the other lung lobes unaffected. Again, a diffuse soft tissue opacity throughout the effected lung lobe is the most striking radiographic finding. Looking further, we can find convex rounding of one or more of the lung borders as the mass expands. As it grows, a mass effect ensures and we can see a mediastinal shift *away* from the effected lung lobe as the mass pushes the heart to the opposite side of the thorax. Air bronchograms are less likely to be present due to compression by the expanding mass (Figure 4). Pleural effusion is sometimes present. Some primary pulmonary neoplasia such as lymphoma can have irregular mineralization within the mass. When an entire lung lobe is affected by neoplasia, the disease is present just inside the thoracic wall and is readily accessible with ultrasound guided fine needle sampling. Awake patients will often tolerate fine needle sampling of the lung just as they would tolerate intravenous catheter placement.

Figure 4. Ventrodorsal radiograph of the dog in Figure 1B. The patient was diagnosed with bronchogenic carcinoma. Note the rounded caudal border of the affected lung lobe (arrows) and the mass effect causing a mediastinal shift away from the lesion.`

LUNG LOBE TORSION

Lung lobe torsion can occur spontaneously, from trauma, or due to lung pathology such as a mass. Because lung lobe torsion is relatively less common than the other differentials for diffuse soft tissue opacity in a lung lobe, it is often overlooked as a differential. Like the other differentials discussed here, lung lobe torsion is often initially visible as a diffuse soft tissue opacity in the effected lung lobe. Looking closer, there are two radiographic findings that can be seen present in lung lobe torsion that specifically differentiate this diagnosis from other potential diagnoses for diffuse lung lobar opacity. With lung lobe torsion, we can often see the abnormal course of the twisted bronchus and abrupt blunting or disappearance of the bronchus distally and its branches. The affected lung lobe can have a stippled gas pattern from trapped air. Pleural effusion is often present (Figure 5). A mediastinal shift may or may not be present.

Figure 5. Lung lobe torsion in a dog. Note the poor visualization of the bronchus to the affected lung lobe and the presence of pleural fissure lines indicating effusion (arrows). Some effusion can also be seen between the right caudal lung lobe and the body wall.

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LOBAR PNEUMONIA

Pneumonia is one of the most common pulmonary infections in dogs with both younger and older animals at particular risk. It is easy to fall into a habit of assuming a diffusely effected lung lobe is pneumonia which can sometimes lead to delayed diagnosis or misdiagnosis which, in turn, can lead to unnecessary use of antibiotics and delaying the patient from receiving the necessary treatment for the (real) underlying cause of the diffuse lung opacity. Paying close attention to the shape of the lung, presence or absence of air bronchograms, signalment and history helps rule out other differentials and leave lobar pneumonia as a presumed diagnosis rather than an assumed diagnosis.

Conclusion

Using good positioning and the principles of fundamental radiographic findings we are able to accurately prioritize our differential list for diffuse lung lobe soft tissue opacification. This can save us from running unnecessary and often expensive tests or needlessly administering antibiotics. Our clients trust us when we have a clear plan, are succinct and accurate. Happy hunting!

QUICK REFERENCE CHART

Radiographic findings for diffuse lung lobe soft tissue opacities

	Size	Shape/Margination	Opacity	Location/Mediastinal Shift
Normal Lung Lobe	As expected, depending on which lobe	Not visible due to border effacement with other aerated lung lobes	Gas, with soft tissue opaque vessels and slight interstitium visualization	No mediastinal shift
Atelectasis	Small	Can have concave curvature to the borders	Soft tissue +/- air bronchograms	Mediastinal shift toward the affected lung
Primary Pulmonary Neoplasia	Normal to Larger	Often will have a convex curvature to one or more borders	Soft tissue +/- irregular mineralization	Mediastinal shift away from the affected lung
Lung Lobe Torsion	Usually normal, sometimes larger	Normal or rounded	Soft tissue, often a stippled gas opacity is also present	Typically, no mediastinal shift, sometimes slightly away from the affected lung due to venous congestion
Lobar Pneumonia	Normal	Normal	Soft tissue, typically with air bronchograms	No mediastinal shift