FELINE LUNG DISEASE

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Abstract

Thoracic radiographic studies are likely the most common site imaged in veterinary medicine. The radiographic appearance of lung disease can be challenging in our feline patients. An overview of the lung patterns with examples of radiographic findings in cats with lower airway disease will be discussed. Computed tomography is more sensitive in the detection of chronic lower airway disease and a few case examples will be incorporated into this presentation.

Keywords: thoracic radiographs, lung disease, feline, computed tomography

Where to start?

Diagnosis of lung disease requires obtaining tangential radiographic views with appropriate positioning and technique. A dorsoventral position is safer and less stressful for patients with pleural effusion before acquiring a lateral projection. Minimal restraint is required for the dorsoventral view if the head is positioned relatively straight between the front limbs. Sedation can cause hypoinflation and atelectasis of the lung and alter the cardiac size.

Questions to ask?

- Are the lungs normal or abnormal?
- Is the abnormal opacity increased or decreased?
- Is the affected lung increased or decreased in size?
- What is the distribution of the abnormal lung? Cranioventral, craniodorsal, diffuse, lobar, mixed, or focal?
- Are there radiographic signs that are pathognomonic for disease?
- Is there evidence of pleural or thoracic wall disease?
- General questions: size, shape, position, density, margination, and number

Patterns of Disease

Alveolar pattern

An alveolar lung pattern is due to fluid/cellular accumulation within the alveoli and may form air bronchograms, a lobar sign, fluffy coalescing densities, and border effacement/silhouette sign. Alveolar patterns may be focal, multifocal, involve one lung lobe, or generalized. Although air bronchograms and a lobar sign are commonly associated with alveolar pattern, sometimes neither is present. An intense lung disease is classified as alveolar by excluding the other lung patterns. The most likely cause is pneumonia, pulmonary edema, and hemorrhage. The distribution of the lung changes, along with history and presenting clinical signs, will assist in determining the cause. In cats, generalized or multifocal alveolar disease with enlargement of the affected lobe should be suspected for primary or metastatic tumors.

Location: ventral (aspiration pneumonia); perihilar (cardiogenic edema); caudodorsal (non-cardiogenic edema), variable (pulmonary hemorrhage), neoplasia (lobar distribution), atelectasis (ipsilateral mediastinal shift)

Pneumonia

Pneumonia (bacterial) in cats is less common than in dogs but usually infectious. The right middle and cranial lung lobes are most commonly affected. Mycoplasma is a common organism found in lower respiratory tract infections. A ventral distribution of an increased pulmonary opacity is more common when inhaled/aspiration. The lung pattern can be alveolar, although a mixed pattern bronchointerstitial can also be present.

When the nodular margins are indistinct, with hazy or blurred margins, the differentials should include fungal granuloma or parasitic disease. Parasitic pneumonia due to *Aeleurostongylus* can lead to an interstitial, bronchial, or miliary nodular pattern with patchy alveolar infiltrates. The earliest changes are thickening the bronchial wall with ill-defined pulmonary nodules. *Paragonimus kellicotti* infections result in solitary or multiple ill-defined soft tissue nodules containing air within the pulmonary parenchyma. Verminous pneumonia is induced by worms residing or migrating through the lower airways (e.g., *Capillaria aerophilic*).

Fungal pneumonia due to histoplasmosis or blastomycosis can have a variable radiographic appearance with miliary nodules, ill-defined pulmonary nodules, or an alveolar pattern.

Parasitic pneumonia from *Toxoplasma gondii* is common in acute diseases. The thoracic radiographic findings include random, diffuse interstitial to patchy alveolar infiltrates.

Atelectasis

Collapse of the lung lobe results in an alveolar pattern. When the air is not replaced, this results in a loss of lung volume. The mediastinal shift toward the side of lung collapse is the key to identifying atelectasis. The affected lung may have a decrease in volume, triangular with a board base, and an increase in lung opacity with an alveolar pattern. Atelectasis can be transient due to prolonged recumbency or sedation. Obstruction of the airways can occur due to mucous, foreign body, or masses. It may not be possible to distinguish between atelectasis alone and a combination of atelectasis and alveolar disease on thoracic radiographs.

Vascular lung pattern

On the lateral projections, the cranial lobar artery and vein should be similar in size for each set of vessels. On the VD view, the caudal pulmonary vasculature should not exceed the width of the 9th rib. The pulmonary vessels will not be equally enlarged in patients with cardiac disease. Don't forget to evaluate the pulmonary arteries overlying the cardiac silhouette for evidence of enlargement (e.g., heartworm disease). Pulmonary venous congestion will precede the development of left-sided congestive heart failure. However, an increase in only one set of lobar arteries and veins may be seen with left-sided heart failure. Decreased pulmonary artery and vein size should raise suspicion for volume depletion.

Heartworm Disease

In cats, the cardiac silhouette typically appears normal. Although the main pulmonary artery may be enlarged, its more medial location prohibits identification on

survey radiographs. The pulmonary parenchymal changes associated with heartworm disease are variable, with focal or diffuse interstitial to a bronchial pattern, alveolar infiltrates, and enlarged pulmonary arteries. The pulmonary arterial changes may resolve over time with the persistence of a bronchointerstitial lung pattern. The right caudal lobar artery may be more commonly affected and best seen on the DV/VD view.

Unstructured interstitial pattern

An increase in interstitial opacity with blurring of the vascular margins is the hallmark of this pattern. The increased opacity can be due to the proliferation of fluid or cellular infiltrates or fibrous tissue. An interstitial lung pattern can be artifactually caused by underexposure, hypoinflation of the lungs due to sedation, and the body habitus (obesity). An increase in interstitial lung pattern can be seen due to aging, pulmonary fibrosis, neoplasia (lymphosarcoma, mammary gland carcinoma), and diseases in transition such as pulmonary edema, hemorrhage, pneumonia, and thromboembolism. Pulmonary edema typically begins with a hazy and patchy distribution of interstitial pulmonary infiltrations and can progress to alveolar infiltrations.

Bronchial

A bronchial pattern develops when cellular or fluid infiltrates are associated with the bronchial wall. When the bronchial markings appear to thicken and extend into the periphery of the lung, a bronchial lung pattern is identified. A bronchial lung pattern can be seen as an aging change in the hilar region. The bronchial walls will appear thickened, creating end on donuts and longitudinally as prominent paired lines or tram lines. The most common causes of a bronchial pattern include allergic airway disease, infection (bacterial or parasitic), or chronic irritants.

Chronic bronchial disease may present with lobar collapse, pulmonary hyperinflation, rib fractures, and bronchial mineralization.

Feline lower airway disease

This disease process likely includes feline asthma and chronic bronchitis. The bronchiolar disease is now well recognized in computed tomography studies. Bronchiolar abnormalities involve small airways <2 mm in diameter and cannot be evaluated on thoracic radiographs. Rib fractures may result from coughing/dyspnea episodes.

Feline asthma is a hypersensitivity reaction to eosinophilic airway inflammation and airway remodeling. Thoracic radiographs show an increase in bronchial markings with visualization into the periphery. Some cats may have flattened or tenting of the diaphragm (hyperinflation) and collapse of the right middle lung lobe (due to atelectasis and mucous trapping) or less commonly affects the caudal subsegment of the left cranial lung lobe. The right middle lung lobe will appear relatively homogeneous opacity and maybe triangular. A mediastinal shift towards the collapsed lung may be noted. Pulmonary hyperinflation likely results from air trapping secondary to chronic airway disease.

Chronic bronchitis is due to previous airway insults and a neutrophilic inflammation found on BAL. Chronic bronchitis is believed to be due to earlier lung insults, resulting in permanent damage to the lower airways. Chronic bronchitis can present with the bronchial pattern on radiographs. Bronchial wall mineralization is more common in cats with chronic bronchitis. There is hypertrophy of the mucosa with an increase in mucous production. Bronchiectasis and bronchomalacia occur secondary to

long-standing inflammation and are irreversible. Bronchiectasis in cats, the bronchi are diffusely dilated without tapering. Broncholithiasis is a pathologic condition when mineralized material is present within the lumen of the bronchi and maybe seen in cats with chronic lower airway disease. Respiratory distress occurs due to excess mucous secretions.

Structured (Nodular) interstitial pattern

Well-defined solitary or diffuse nodular structures with well-defined smooth margins include neoplasia, pulmonary abscess, traumatic pneumatocele, hematoma, or cyst. In cats, a primary neoplastic process includes carcinomas, which can appear as a large solid mass, cavitary mass, or diffuse disease. Central mineralization and cavitation of primary pulmonary neoplasia are common findings in cats. Metastatic neoplasia is often poorly marginated and irregularly shaped compared to metastatic nodules in dogs (e.g., mammary gland neoplasia). Primary pulmonary neoplasia in cats has been associated with pulmonary adenocarcinoma, pulmonary squamous cell carcinoma, and bronchogenic carcinoma.

Pleural effusion

Many pleural effusions are bilateral due to communications between both sides of the thorax. Radiographic features include retraction of the lung lobes from the thoracic wall. The presence of interlobar fissures, rounding and separation of the lung margins, lack of visualization of the heart, mediastinal widening, increased lung opacity, and dorsal deviation of the trachea. On the lateral view, the lung margins have a scalloped appearance. Don’t confuse the separation of the dorsocaudal lung from the spine from the psoas minor muscle as fluid. The position of the carina on the lateral view will help estimate the size of the cardiac silhouette. If the carina is at the same level as the trachea, cardiac disease should be considered. When a mediastinal mass

and pleural effusion are suspected, the cranial lung lobes may be retracted more caudolaterally on the DV/VD view. The cardiac silhouette may be displaced caudally with a mediastinal mass.

Causes of pleural effusion: Cardiac disease, mediastinal masses, diaphragmatic hernia, idiopathic (chylothorax); exudative (FIP), hypoproteinemia, hemorrhagic or neoplastic effusions

Pneumothorax

Air is present within the pleural space resulting in lung lobe retraction, partial collapse of the lung lobes, increased lung opacity, and separation of the cardiac silhouette from the sternum. Typically, pneumothorax is bilateral in distribution.

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