



Lung Disease

Introduction

The definition of pneumonia is defined as inflammation in the lungs. This inflammation can happen suddenly (acute) or develop over a more gradual period of time (chronic). Pneumonia is generally less common in cats than dogs, and is usually not a disease to be worried about in healthy animals. Most often, pneumonia develops as a secondary problem to an underlying disease that has caused the lungs and airways to be compromised and not function as they should. The underlying causes of pneumonia usually fall under one of three broad categories to include: infectious, inflammatory, or cancer. Each of these categories will be defined in detail later in this handout.

The clinical signs of pneumonia can be very vague clinical signs of a mild cough to very severe signs of shortness of breath especially after excitement or exercise, trouble or difficulty breathing, not interested in food or water, lethargic, and fever. If any of these clinical signs are noted at home, you should have your pet evaluated by your veterinarian right away or if necessary, by the closest veterinary emergency service.

History, Symptoms, and Physical Examination

Animals can have a wide range of clinical signs and symptoms. Symptoms may be predisposed or worsen during times of excitement, or exercise when it is noticed that the pet becomes short of breath, or cannot tolerate as long of a walk or run as usual. Stress may also influence clinical signs as stressful situations can lower the pet's immune system allowing the pet to be more predisposed to underlying bacterial or fungal infections. Stress in a pet can include: a new pet or new baby in the home, moving into a new home, construction, or any underlying disease process. Clinical signs that may be detected at home could include:

- Lethargy, exercise intolerance, playing less, depression
- Decreased or complete loss of appetite
- Weight loss
- Coughing – exacerbated after exercise or excitement or constant
- Fever
- Noisy breathing
- Voice change (change of bark or meow)
- Breathing with more of an abdominal effort or with head or neck extended

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- Restlessness/Agitation
- Pale or blue mucous membranes
- Severe weakness, unresponsiveness

Diagnostic tests

1. Blood work evaluation:

- Complete blood count (CBC): This blood test evaluates the patient's red blood cells, white blood cells and platelets. White blood cells are often increased with pneumonia. The type of white blood cell that is increased can be very important in differentiating the types of pneumonia. Severe inflammation or infection can also make the white blood cells look very "angry".
- Chemistry profile: This blood test evaluates gastrointestinal, liver and kidney enzymes, protein levels and electrolytes.

2. Urinalysis: A urine sample may be obtained to complete the biochemical evaluation to be sure that the kidneys are concentrating the urine appropriately.

3. Thoracic radiographs (chest x-rays): Radiographs may be obtained to look at the chest for any evidence airway changes, certain lung patterns, opacities, mass effect, or fluid within the chest. Lungs are filled with air and should normally appear black on x-ray evaluation. If there is any evidence of a large amount of grey or white coloring within the lungs, this is abnormal. The specific region of the lungs that are abnormal can help us determine the most likely underlying cause for the change. The radiographs also allow the veterinarian to evaluate the heart, airway structures and for any evidence of megaesophagus (dilated esophagus).

4. Endotracheal wash (ETW): This procedure involves placing the pet under anesthesia. A sterile endotracheal tube is placed into the trachea and a small amount of a sterile saline solution is instilled into the trachea. This helps to loosen the mucus in the patient's trachea and lower airway. The veterinarian then aspirates the fluid from the lungs into a sterile container which can then be submitted for cytological analysis and cultures. This test allows for a broad spectrum evaluation, but does not specify a certain area where the cells are coming from and may not be as specific as a BAL (described below). Your veterinarian will choose whether the endotracheal wash or BAL is more appropriate for your pet. With either procedure, there is a risk that the patient's symptoms will become worse afterwards due to the irritation of the procedure.

5. Bronchoscopy and bronchial alveolar lavage (BAL): This procedure involves placing your pet under anesthesia and placing a scope with a camera at the end down the throat and into the lung. Since we can see where we are going, we can guide the scope into specific regions of the lungs. We can also evaluate the lungs for inflammation and irregularities. A small amount of fluid is instilled into the lungs and then the veterinarian aspirates this fluid into a sterile container for collection and evaluation. This test allows for a more specific area of lung to be evaluated. Your veterinarian will determine whether the BAL or endotracheal wash is more appropriate for your pet. With either

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procedure, there is a risk that the patient's symptoms will become worse afterwards due to the irritation of the procedure.

6. Fluid cytology: This procedure is when the cells within the fluid from an ETW or BAL are visualized underneath a microscope. This procedure helps the veterinarian to determine any cellular abnormalities within an organ or tissue.

7. Fluid culture and sensitivity testing: Culture and sensitivity determine if there is any bacterial or fungal growth within the organ and help identify the exact organisms present and which medications they will respond to. This will help the veterinarian best treat your pet.

8. Thoracic ultrasound: If there is an obvious mass or density within the lung tissue or pressing up against the lungs, the veterinarian may recommend an ultrasound of the chest. An ultrasound allows the veterinarian to evaluate for any changes in color, density or pattern of a certain organ. Chest ultrasound can be difficult to do as the ribs or patient disposition (excessive panting) may impede appropriate visualization. Risks of this procedure include air leakage from the lungs into the space around the lungs or, if a blood vessel is punctured, bleeding into the chest. These complications may be mild and may correct themselves, may require surgery, or may be life threatening.

9. Fine needle aspiration: This is a procedure that is done during the ultrasound if an area of lung appears very dense or if the veterinarian is concerned with a mass within the lungs or space between the ribs and the lungs. This procedure involves placing a very fine needle into the area of interest to extract cells to evaluate underneath a microscope. This is called cytology. Cytology will help the veterinarian identify some abnormalities within the organ, however at times, further evaluation through histology (collecting a piece of tissue) may be necessary.

Other historic and diagnostic information that may be considered

If megaesophagus (dilation of esophagus) is determined on radiographic evaluation, this may be a reason that your pet has a pneumonia. An evaluation of megaesophagus may be an indication that other underlying disease is present. Megaesophagus can be a primary condition (idiopathic) or be caused by certain underlying diseases or toxicity. Underlying diseases that may be considered after a diagnosis of megaesophagus include:

- Myasthenia gravis: This is an immune mediated disease of the neuromuscular system. This disease is when certain nerve receptors (acetylcholine receptors) do not function properly which causes muscle weakness. Diagnosis may be from a test (Tensilon test). This test uses a short acting medication allows for the proper function of the specialized neurotransmitter (acetylcholine) for a short period of time. Another diagnostic test is a specific blood antibody titer evaluation. Your veterinarian will decide if these specific tests are appropriate in your pet.
- Addison's disease (hypoadrenocorticism): This disease is caused when the adrenal glands secrete insufficiently low amounts of glucocorticoids (steroids) and

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most times a deficiency of mineralocorticoids (aldosterone). If Addison's disease is suspected in your pet, the veterinarian will discuss specific diagnostic tests to include a baseline cortisol and/or an ACTH stimulation test. The ACTH stimulation test will definitively rule in or out the diagnosis of Addison's disease.

- **Hypothyroidism:** This is an endocrine disorder when there is not enough thyroid hormone produced by the thyroid glands. A diagnosis is made through a blood test to assess thyroid hormone levels. It is controversial as to whether hypothyroidism causes megaesophagus.
- **Lead toxicosis:** The veterinarian will ask you if you live in an older home, have lead paint or if the patient had any exposure to foreign material that may contain lead. A blood test to evaluate lead concentrations can be assessed if lead toxicity is suspected.

Diagnosis

An underlying diagnosis may be discovered based on your history, the veterinarian's physical examination findings and a combination of recommended diagnostic testing (some of which is defined above).

Pneumonia can fall into several different categories of classification. The classification that will be described in this hand out will be under 4 primary headings to include: infectious causes, inflammatory causes, cancerous causes, and other.

- Infectious causes:
 - **Viral:** Virus infections such as Canine Distemper Virus, Adenovirus, parainfluenza virus and feline calicivirus and herpesvirus all can cause lesions in the airways and lung tissue and predispose patients to secondary bacterial infections within the lungs. These viruses are much more commonly seen in young animals. Cats can also develop lung problems secondary to inflammation due to feline infectious peritonitis (FIP, a mutant type of corona virus). FIP can be very difficult to definitively diagnose.
 - **Bacterial:** Primary bacterial infections in the lungs other than Bordetella Bronchiseptica (Kennel Cough) are rare and generally result after initial insult to the lung and airway tissue. Bacterial pneumonia can result from aspiration of material (including stomach contents after the patient vomits) into the lungs. Bacteria that may be isolated from the lungs could include Staphylococcus, Streptococcus, and multiple others. A culture and sensitivity test would determine the type of bacterial organism that may be present. Antibiotics are the treatment of choice for bacterial infections.
 - **Fungal:** Fungal infections can also inhabit the lungs and cause pneumonia. There are many types of fungal spores in nature (Blastomycosis, Coccidiomycosis, Cryptococcus, Aspergillosis) are a few of the more

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common types of fungal infections and may depend on historic travel history, and geographic location of the pet. Cytologic evaluation of the lung fluid and culture and sensitivity testing are used to determine the type of fungal organism that may be present. Antifungal medications are used to treat fungal infections in the lungs.

- Parasitic: Several parasite infections such as lungworms, and heartworm disease are examples of parasites that may cause clinical signs of pneumonia in your pet.
- Inflammatory causes:
 - Bronchitis: Chronic bronchitis and asthma are caused by inflammation of the airways. Chronic inflammatory diseases such as chronic bronchitis cannot be definitely diagnosed until other diseases such as heart disease, heartworm infection, pneumonia, or cancer have been ruled out. It is possible that an underlying disease can coexist with a suspicion of chronic bronchitis. Fluid cytology and culture and sensitivity testing will help in the diagnosis of chronic bronchitis. Typically we see inflammation (white blood cells) without infection in these cases, but secondary bacterial infections may be present. Treatment options include: anti-inflammatory medications (such as prednisone) and bronchodilators to open up the airways better.
 - Pulmonary infiltrates of eosinophils (PIE): PIE is an inflammatory condition that can occur in the lungs in which eosinophils (a special type of white blood cell) infiltrates the lungs. PIE can occur secondary to allergies, heartworms, parasites, or as a primary inflammatory condition. Cytology from a lung wash show large numbers of eosinophils. If an underlying cause is found, it needs to be addressed. If no underlying cause is found, the treatment of choice is prednisone.
- Cancer: Many types of systemic cancers will eventually spread (metastasize) to different parts of the body. One of the more common places for cancers to spread is the lungs. On radiographs the changes in the lungs can look like solitary masses or look similar to the appearance of pneumonia. Cytology or biopsies (wedges of lung tissue) can be used to diagnose lung cancer.
- Other:
 - Aspiration Pneumonia
 - Vomiting: Aspiration pneumonia is much more common in patients that vomit. The more often and severe the vomiting, the more likely aspiration pneumonia is to develop.
 - Megaesophagus: This is dilation of the esophagus. There are multiple possible reasons why megaesophagus may be seen (described under the other historic and diagnostic considerations portion of this handout). If megaesophagus is noted, this problem allows the pet to be at an increased risk of aspiration pneumonia.

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- Anesthesia: Any time a patient is placed under general anesthesia there is a risk of aspiration of gastric contents into the lungs. This is attempted to be minimized by ensuring that the pet has not eaten the day of the anesthesia event (why a veterinarian tells you to stop feeding your pet the night before surgery). Another way aspiration pneumonia is reduced is by endotracheal tube intubation. Although there are ways to help reduce the chance of aspiration pneumonia during anesthesia, it is still a risk that you need to be aware of.
- Surgical correction of laryngeal paralysis: After surgical correction of laryngeal paralysis in dogs (using the unilateral arytenoids lateralization technique or 'tie back' procedure), the risk of aspiration pneumonia increases.

Treatment

Therapy for pneumonia involves treatment for any underlying condition that may be found as well as supportive therapy with intravenous fluids to correct dehydration, antibiotics, and oxygen therapy.

Possible therapy that may be necessary in the hospital includes:

- Antibiotics: Used to help treat bacterial infections
- Antifungal medications: These specific medications would be used only if the pet is diagnosed with a fungal infection causing the pneumonia.
- Intravenous fluids (IV fluids): administered to help correct dehydration. Patients with lung disease lose a lot more fluids through their lungs when they breathe than a healthy patient. Therefore, it is really important to make sure that patient remains well hydrated.
- Oxygen supplementation: If your pet starts at anytime having trouble breathing, showing an increase in respiratory rate or effort, or if the pulse oximetry reading is low then oxygen supplementation will be necessary. There are several different methods utilized in the hospital setting to deliver oxygen to a patient. Some methods include an oxygen cage, placing a nasal oxygen catheter, and an oxygen hood. In very severe cases when a pet is not responding to traditional oxygen therapy as described above, general anesthesia for mechanical ventilation will be necessary.
 - Pulse Oximetry: This is a device used in the hospital that measures your pets peak oxygen saturation. Normal patients have values close to 100% (usually 97+%). If the number falls below into the lower 90s%, oxygen supplementation will likely be necessary.

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- **Nebulization (Humidification):** A nebulizer creates a very fine mist of small water droplets into the air that can penetrate into the lungs to help moisten airway secretions. In the hospital, we use nebulizers. At home, you can still provide some increased hydration to the lungs by bringing your pet into the bathroom while running hot water in the shower to make the room all steamy.
- **Coupage:** This is a physical therapy technique used after nebulization to help mobilize the respiratory secretions. This process is performed several times daily. The process involves cupping the hands and performing taps against the pet's chest. The reverberation from the procedure loosens the mucous in the chest so that it can be coughed up more easily. This is a process that would be demonstrated to you by your veterinarian and a treatment that is usually continued at home in cases of bacterial pneumonia.
- **Bronchodilators:** These medications may be used to help reduce bronchoconstriction (airway constriction), relax the airways and may help reduce inflammation assisting with the ease of breathing.
- **Cough Suppressants:** In some cases, if a cough is constant, dry and non-productive, cough suppressants may be considered, however would not be used in every situation. These medications may also create some drowsiness in some pets which may also be a benefit for anxious patients in the hospital. Cough suppressants are contra-indicated if the patient has bacterial pneumonia as we want him or her to cough up the excessive mucous and bacterial in the lungs so that the lungs can be more clear.
- **Corticosteroids:** In some cases corticosteroids may be used to help reduce inflammation for the pets diagnosed with chronic inflammatory diseases. This treatment is most commonly used with bronchitis, asthma, and PIE.

Complications

Unfortunately there are many severe complications that may occur with a patient with pneumonia.

- Bacteria in the lungs can get into the pet's bloodstream and go to other organs (sepsis) causing multiple organ system failure
- Respiratory failure can result from worsening disease in the lungs or from the patient becoming too tired from straining to breathe
- Collapsed lung can be seen if the airway inflammation is very severe
- Fluid accumulation in the lungs and spaces around the lungs
- Chronic scarring of the lung tissue

Prognosis

Prognosis is variable and depends on any underlying disease present, the severity of the patient's initial physical examination and blood work findings, how quickly the

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underlying cause is found and addressed, and how the patient progresses. While many patients will be able to survive these conditions, they can be life threatening as well. The prognosis is generally considered poor to guarded on initial presentation.

Follow-up

Follow-up evaluation once your pet goes home will be determined by Dr. Prober, Dr. Koch or your veterinarian. Follow up examinations will be very frequent and include follow up radiographs of the chest usually after 1-2 weeks of therapy and every few weeks thereafter until radiographic clinical signs have resolved. Medication therapy will also continue for multiple weeks to months depending on the underlying condition being treated.

It is important to understand that initial hospitalization and improvement is only the beginning of the management for a patient with pneumonia. Follow up evaluation will be frequent and follow up therapy and medications can become very expensive.