

DR. ANTHONY GONZALEZ

RESPIRATORY DISEASE MANAGEMENT

The Essentials of Respiratory Disease

Foreward by Dr. Philip Padrid • Edited by Dr. Elizabeth Rozanski • With tech tips by Alyssa Mages, CVT



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VET CANDY RESPIRATORY DISEASE MANAGEMENT

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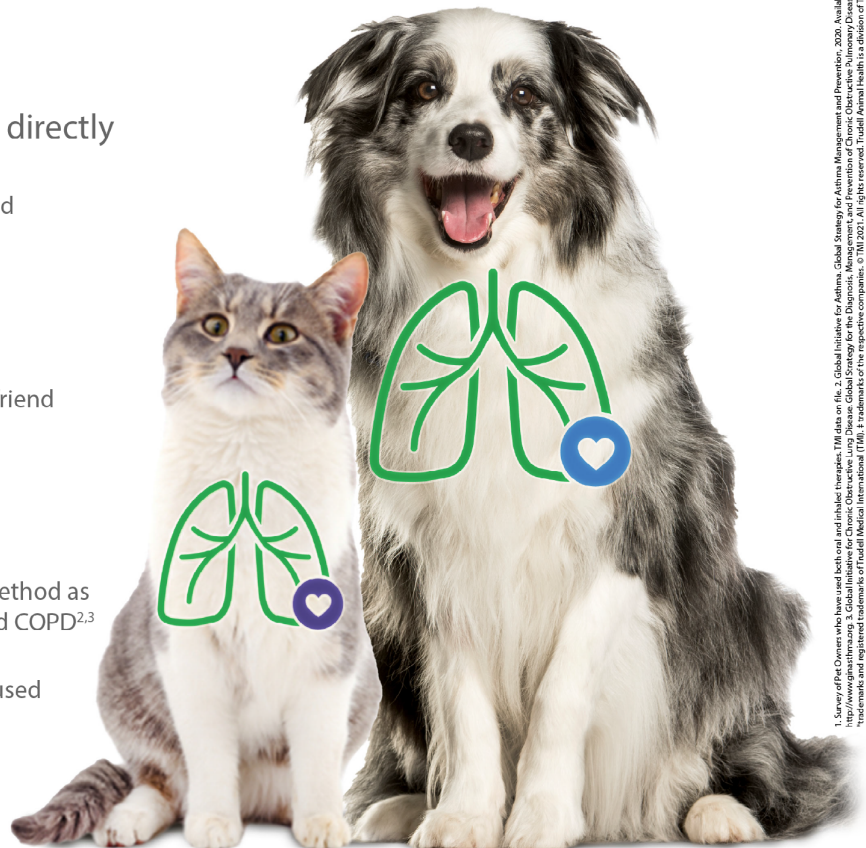
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1. Survey of Pet Owners who have used both inhaled and oral steroids. The data in this study is based on a survey of Pet Owners who have used both inhaled and oral steroids. Management of Respiratory Disease in Dogs and Cats. Global Initiative for Asthma (GINA) 2021. Available from <http://www.ginasthma.org>. 2. Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) Strategy for the Diagnosis, Management and Prevention of Chronic Obstructive Pulmonary Disease (2020 Report). 3. Global Initiative for Asthma (GINA) 2021. All trademarks of the respective companies. © TM 2021. All rights reserved. Truella Animal Health is a division of TMI.



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Foreward

By Dr. Philip Padrid

Regional Vice President Regional Medical Director, VCA

“Respiratory disease” refers to infectious or non-infectious disorders of the pulmonary tree, from the tip of the nose to the smallest alveoli. Additionally, disorders within the pleural space that include air (pneumothorax), fluid (pleural effusion) or tissue (malignant and non-malignant) that prelude expansion of lung may be considered “respiratory disorders”

The respiratory tract is a relatively hidden organ system in our patients. Specifically, it is relatively easy to sample urine from the bladder or perform an ultrasound of the kidney, and an echocardiogram can be obtained in awake dogs and cats or with simple sedation. In contrast sampling of the respiratory tree from the caudal nasal choanae through the trachea, bronchi, and pulmonary parenchyma require that the patient be anesthetized. Because of this, respiratory disease in dogs and cats has not been studied in detail compared to other systems in dogs and cats. This in turn has led to a somewhat simplified approach to the diagnosis of dogs and cats with symptoms including sneezing, coughing, noisy or difficult breathing, shortness of breath and even syncope. For this same reason the treatment of respiratory system disorders in our patients has historically depended on response to therapy and adopting basic treatments used in human patients to treat veterinary patients with similar signs.

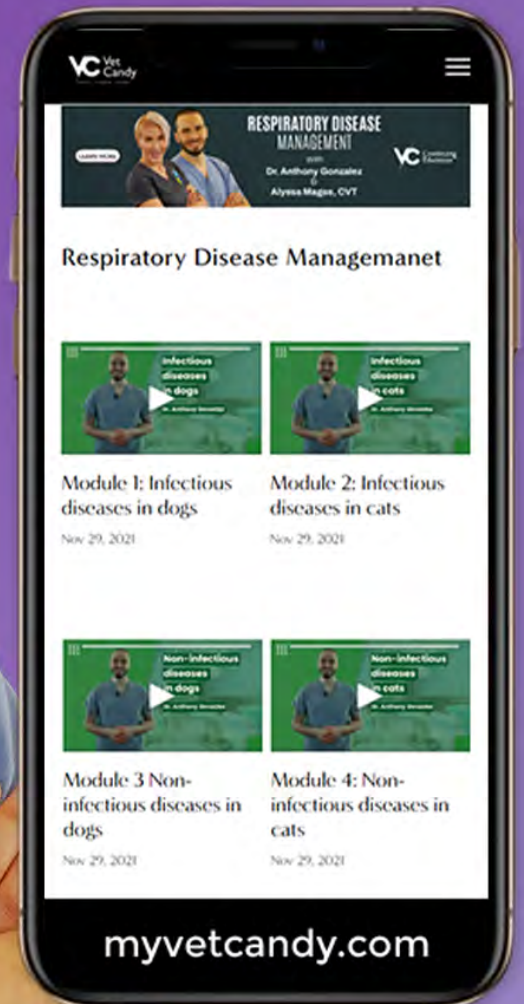
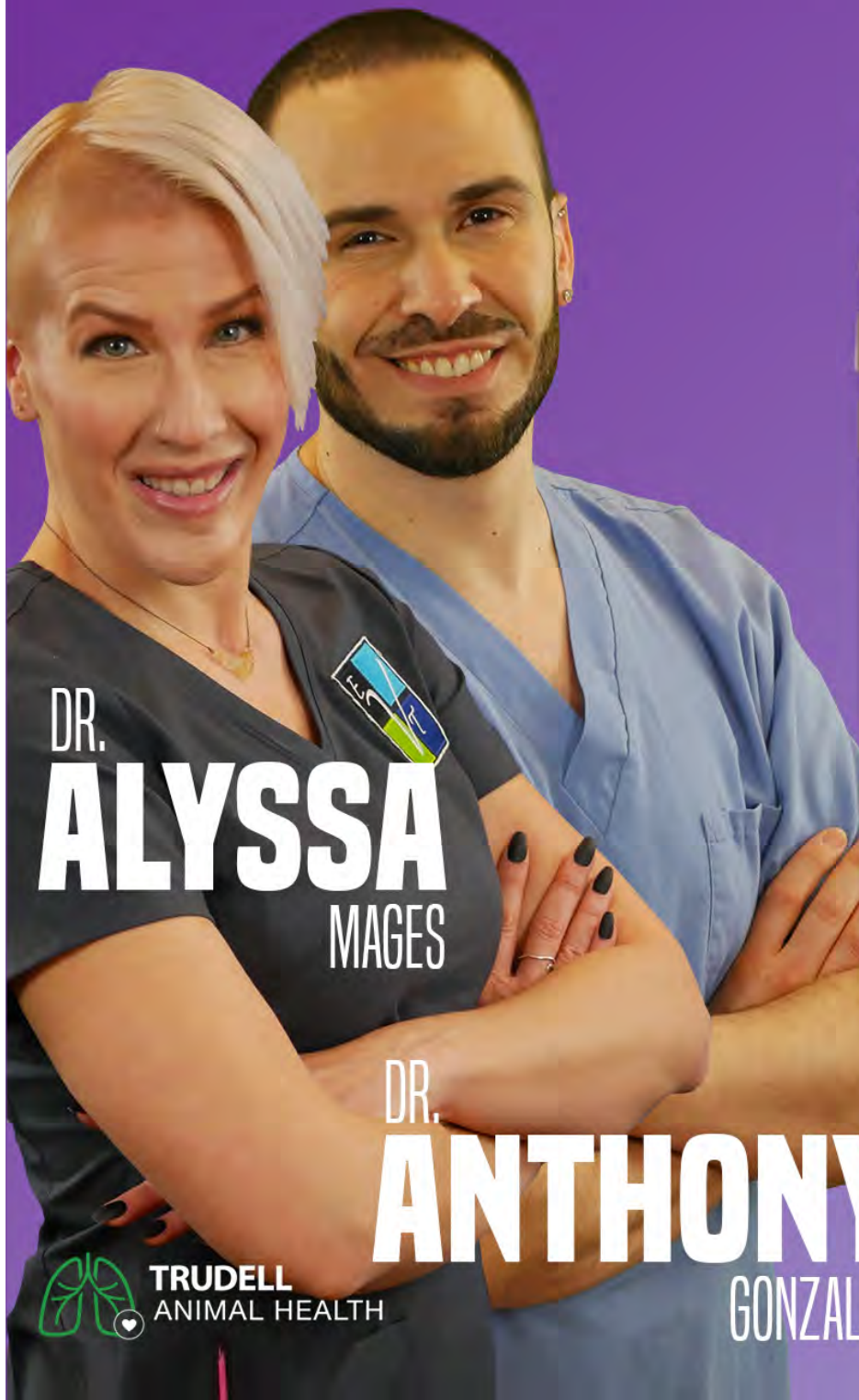
Despite these limitations, diagnostic tests and treatment options for dogs and cats with pulmonary disease have advanced remarkably quickly in the past decade. We can now perform pulmonary function tests, rapidly diagnose infectious disease through the magic of molecular techniques and rapidly acquire advanced diagnostic images that were not possible until recently. We recognize that our clients are committed and passionate about obtaining the very best veterinary medical care for their little ones.

The approach to one specific disorder of cats, “feline asthma” can be used as an example of these more recent advances in diagnosis, treatment and client expectations for “the best” that can be offered. Cats with asthma have been recognized in print since at least 1901, when JW Hill wrote about cats with increased airway mucus, labored breathing, and wheezing. Until very recently we approached the treatment of this disorder by using long-acting systemic corticosteroids. While this approach was effective in the short term, it frequently led to more systemic side effects including increased thirst, urination and even a “diabetic” like state.

Physicians recognized a similar problem with use of systemic corticosteroid treatment in their human patients. Fortunately, Inhaled corticosteroids became available to treat humans with asthma since the 1960’s. Because this form of drug is not systemically absorbed, there are virtually no side effects using this method of delivery. Studies done in the 1990’s demonstrated that a similar approach might be used to treat cats with asthma as well. Currently, we can provide the same method of drug delivery to treat these feline patients, using the same techniques of inhaled drug delivery that people have been using for 60 years. This method of drug delivery to treat veterinary patients was unthinkable a short time ago. Our feline patients are treated sooner, more effectively and with fewer side effects, and this is now a standard of care in our profession.

The advances in veterinary medicine in the past 10 years have been remarkable. The diagnosis and treatment of respiratory disease in our patients has followed a similar trajectory. Our clients expect the best and most advanced care for their pets, and we are now able to provide that level of care. It is an exciting time to be able to treat our respiratory patients, and further advances in the diagnosis and treatment of dogs and cats with respiratory disease are on the horizon.

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Introduction

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Regional Vice President Regional Medical Director, VCA

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Respiratory anatomy and hypoxemia

The respiratory system is one of the most critical body systems in dogs and cats. It's responsible for taking in oxygen and eliminating carbon dioxide from the body. Additionally, as dogs and cats sweat only minimally, thermoregulation is an important responsibility of the respiratory system.





I. RESPIRATORY ANATOMY

a. Upper airway

- i. Nares
 - 1. Lead into nasal passages, left and right
- ii. Turbinates (conchae)
 - 1. Dorsal, ventral, and ethmoidal
 - 2. Thin scroll like bones covered with nasal epithelium
 - 3. Divide each nasal passage into 4 main passageways (meatuses)
- iii. Nasal meatuses
 - 1. Four within each nasal passage
 - 2. Lined with pseudostratified columnar epithelium
 - 3. Cilia and mucus from mucous glands/goblet cells
 - 4. Sensory neurons leading to olfactory nerve CN1
 - 5. Inhaled air is warmed, humidified, and filtered
- iv. Paranasal sinus
 - 1. Ciliated out-pouchings of nasal passages
 - 2. 3 pairs: frontal, maxillary, sphenoidal
 - 3. Function unknown
- v. Pharynx
 - 1. Common passageway for respiratory and digestive system

- 2. Divided by soft palate into nasopharynx and oropharynx

vi. Larynx

- 1. Musculocartilaginous organ that guards the entrance to the trachea
- 2. Four cartilages around rima glottis: paired arytenoids, unpaired epiglottis, cricoid, and thyroid cartilage
- 3. Functions:
 - a. Voice production via vocal cords (connective tissue attached to arytenoid cartilages)
 - b. Swallowing

b. Lower airway

- i. Trachea
 - 1. Goes from cricoid cartilage of the larynx to its bifurcation at the level of the carina into bronchi
 - 2. 35 C-shaped rings of hyaline cartilage, opening faces dorsally
 - 3. Lined with ciliated epithelium
- ii. Primary, lobar, and segmental bronchi
- iii. Bronchioles
- iv. Alveolar ducts
- v. Alveolar sacs of alveoli (think grapes)
 - 1. Site of external respiration
 - 2. Thin-walled sacs of simple squamous epithelium

3. Surround by capillaries
4. Lined with surfactant (important for compliance)

c. Lungs

- i. Divided into lobes
 1. Right lung has 4 lobes
 - a. Cranial, caudal, middle, accessory
 2. Left lung has 2 lobes
 - a. Cranial, caudal
 - b. The cranial lobe is further divided into cranial and caudal segments
- ii. Hilus is where air, blood, lymph and nerve enter and leave lung

d. Thoracic cavity

- i. Lined with pleura
 1. Thin serous membrane, 5 layers
 2. Visceral pleura covers lungs
 3. Parietal pleura covers chest wall
 4. Space in-between is the pleural cavity

e. Mediastinum

- i. Area between the lungs that contains the heart, trachea, esophagus, blood vessels, nerves, and lymphatics
 1. Cranial: trachea, esophagus, thymus, sternal lymph nodes
 2. Middle:
 - a. Dorsal: major pulmonary vessels, aorta, lymph nodes
 - b. Middle: heart
 - c. Ventral: aorta, thoracic duct, esophagus
 3. Caudal: thymus, phrenicopericardial ligament

f. Ribs

- i. 13 pairs

g. Diaphragm

- i. Musculocutaneous partition between thoracic and abdominal cavity
- ii. Tendinous center with 3 thin peripheral muscles
- iii. Convex and extends into the thorax
- iv. Accounts for 75% of change in intrathoracic volume

II. ANATOMY OF A BREATH

a. Normal respiratory rate (RR) is 15-30 breaths per minute

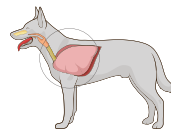
b. Divided into an inspiratory and expiratory phase

- i. Usually in a 1:2 ratio
- ii. Inspiratory time is 1 second

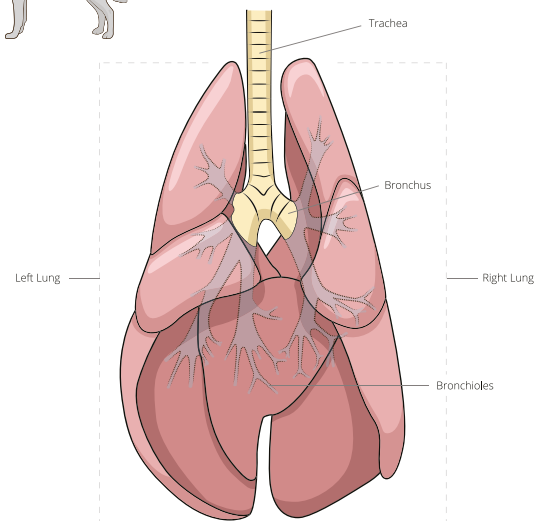
c. Exhalation is passive

d. Pattern

- i. Abdomen and thorax move synchronously; both



Lungs of the dog



push out during inspiration

e. Tidal volume (TV)

- i. Amount of air moved in and out in a single breath (during quiet expiration)
 1. 10-15 ml/kg

f. Minute ventilation

- i. Amount of air moved in and out in 1 minute
- ii. $TV \times RR$

III. GENERATING A BREATH

a. Respiratory center

- i. Medulla oblongata
 1. Ventral respiratory group for expiration/ inspiration
 2. Dorsal respiratory group for inspiration
- ii. Pons
 1. Pneumotaxic center
 2. Apneustic center

b. Inspiratory muscles

- i. Main: diaphragm, external intercostal mscs
- ii. Accessory: scalenes msc, sternomastoids msc

c. Expiratory muscles

- i. Main: abdominal wall, internal intercostal mscs
- ii. Accessory: rectus abdominis msc, external oblique msc, internal oblique msc, transversus abdominis msc

d. Chemical receptors

- i. Found within the carotid bodies and aortic arch
- ii. Monitor CO_2 , pH, and O_2

e. Thoracic cavity has negative pressure

- i. Average $-5\text{cm H}_2\text{O}$, less negative dorsally
- ii. Keeps the lungs inflated, which makes it easier to breathe



f. Components of atmospheric air at sea level (760 mmHg)

- i. Oxygen: 21.0%, 159 mmHg
- ii. Carbon dioxide: 0.03%, 0.23 mmHg
- iii. Nitrogen: 79.0%, 600 mmHg

g. Gas exchange is via simple diffusion

- i. Alveolar pO₂: 104 mmHg
- ii. Post tissue pCO₂: 45 mmHg
- iii. Tissue pO₂: < 30 mmHg, pCO₂: 50 mmHg

IV. HYPOXEMIA

a. Oxygen is carried in arterial blood dissolved in solution and combined with hemoglobin (Four oxygen molecules to one hemoglobin molecule)

b. Hypoxia is O₂ deficiency at tissue level

- i. decreased content, decrease blood flow, inability of cells to utilize O₂ (histotoxic or cytopathic hypoxia, e.g., cyanide toxicity)

c. Causes

- i. Hypoventilation
 - 1. Respiratory depressant, neuromuscular disease, chest wall disease, airway obstruction
- ii. High Altitude

iii. Venous admixture

1. Diffusion impairment

- a. Thickening of alveolar interstitial space or capillary wall due to edema, fibrosis, vasculitis, emphysema
- b. Leads to inadequate equilibration of O₂ tension across alveoli and capillaries

2. V/Q mismatch

- a. V/Q mismatch is common and effects our patient's ventilation and oxygenation
- b. Dead space ventilation (V/Q >1)
 - i. Anatomic (conducting airways), Physiologic
 - ii. Normally have 25-30% dead space
- c. Intrapulmonary shunting
 - i. Capillary flow exceeds ventilation (V/Q <1)
 - ii. Normally have 10% shunting

3. Right to left shunt:

- a. Deoxygenated blood passes from right heart directly into systemic circulation due to atelectasis, flooding of alveoli with fluid, alveolar consolidation, congenital anomaly
- b. Examples: Tetralogy of Fallot, Eisenmenger syndrome

V. DEFENSES

- a. Airflow patterns result in impaction along mucosal surfaces
- b. Protective reflexes such as sneezing or coughing
- c. Mucociliary clearance (pseudostratified columnar airway epithelium have mucoid bilayer cilia)
- d. Alveolar macrophages
- e. Innate immune system

VI. CLINICAL SIGNS OF RESPIRATORY DISTRESS

- a. More common in dogs
- b. Cats mask signs very well
- c. Signs
 - Tachypnea
 - Head and neck extension/Orthopnea
 - Open mouth breathing

- Anxiety
- Cyanosis
- Nares flaring
- Abducted elbows
- Orthopnea
- Paradoxical movement of chest and abdomen

VII. PANTING:

- a. Often as a form of thermoregulation
- b. Dogs oscillate between two patterns:
 - o inhalation through the nose, exhalation through the nose and mouth
 - o inhalation through the nose and mouth, exhalation through the nose and mouth.
- c. Lingual blood flow increases 6-fold, and the tongue, wet from increased salivation, hangs out of the mouth as it lengthens to increase its surface area



Infectious respiratory disease of dogs

Canine infectious respiratory disease complex, commonly referred to as “kennel cough”, is a syndrome of diseases caused by several different bacterial and viral pathogens. With mostly airborne transmission, an incubation period of 10-14 days, and the development of non-specific clinical signs (e.g., coughing, ocular and nasal discharge, fever), this disease complex is considered highly infectious and is often seen with coinfections of a bacterial agent secondary to a viral agent. Clinical suspicion should be raised when a characteristic dry cough develops in a patient 5-7 days after potential exposure. This is especially true with potential risk factors such as an unvaccinated puppy, a patient with a weakened or compromised immune system, and environmental factors such as stress, poor ventilation, and crowding.

It should be noted that clinical signs do not distinguish between pathogens and diagnostic testing via PCR panels and culture with sensitivity testing from airway sampling should ideally be performed. Preventative strategies, such as isolation to stop the spread of disease, are particularly important as vaccinations don't fully induce sterilizing immunity.



BACTERIAL

I. *Bordetella bronchiseptica*

- Gram negative, coccobacilli
- Has outer capsule which protects from body defense mechanisms
- Paralyze cilia which decreases defense of airways
- Secretions allow for bacterial colonization
- Exotoxins causing necrosis of epithelial cells
- Incubation: 2-10 days

II. *Streptococcus equi subspecies zooepidemicus* *Lancefield group C streptococcus*

- Opportunistic
- Severe bronchopneumonia- clinical disease in dogs is similar to that of streptococcal exotoxin-induced toxic shock syndrome
- Incubation: Probably days

III. *Mycoplasma cynos*

- Fastidious organisms that lack a cell wall, smallest known free-living organisms
 - Commensal, normal in 25% of adult dogs
- Aerosol transmission
- Younger dogs
- Incubation period 3-10 days

Secondary opportunistic agents:

- ➔ *Streptococcus* spp.
- ➔ *Staphylococcus* spp.
- ➔ *Pasteurella* spp.
- ➔ *Escherichia coli*
- ➔ *Pseudomonas* spp.
- ➔ *Klebsiella pneumoniae*

VIRAL

I. *Canine Adenovirus 2*

- Genus Mastadenovirus, family Adenoviridae
- Nonenveloped double-stranded DNA
- Transmitted via respiratory secretions or by contact with contaminated feces or urine
- Incubation period: 3-6 days

II. *Canine Distemper virus*

- Genus Morbillivirus, family Paramyxoviridae
- Enveloped RNA
- Transmitted via aerosol secretions; shed from all body secretions at 5 days after infection
- Incubation period: 3-6 days

III. *Canine Influenza virus*

- Genus Alphainfluenzavirus (Influenza A), family Orthomyxoviridae
 - further subtyped based on its hemagglutinin (H) and neuraminidase (N) genes
 - H3N8 strain documented in racing greyhounds in Florida, 2004
 - H3N2 strain documented in Chicago, 2015
- Incubation period: 2-4 days

IV. *Canine Parainfluenza virus*

- Genus Rubulavirus, family Paramyxoviridae
- Enveloped single-stranded negative-sense RNA
- Transmitted via respiratory droplets
- Incubation period: 3-10 days

V. *Canine Respiratory Coronavirus*

- Group 2a coronavirus, family Coronaviridae
- Enveloped RNA virus
- Incubation period: variable

VI. *Canine herpesvirus-1*

- Family Herpesviridae
- Enveloped double-stranded DNA virus
- Incubation period: 6-10 days

Novel Agents:

- ➔ Canine pneumovirus
- ➔ Canine bocavirus
- ➔ Canine hepacivirus
- ➔ Canine picornavirus



Infectious respiratory diseases of cats

Respiratory infections are common in cats, especially in environments of high populations such as shelters and breeding catteries. Common clinical signs associated with the upper respiratory tract include ocular and nasal discharge, epistaxis, sneezing and conjunctivitis.



VIRAL:

Feline herpesvirus type 1 (FHV-1), commonly referred to as feline viral rhinotracheitis, is a double stranded enveloped DNA virus. This virus is transmitted by aerosol droplets and fomites. It has been reported that infected droplets can be transmitted up to 5 feet by forceful sneezing. The incubation period is 2-6 days with viral replication beginning in the tonsils and upper respiratory tract tissue. 97% of cats are exposed to herpes in their lifetime and a lifelong infection will occur in 80% as the virus remains latent in nervous tissue. Of those cats, 45% will become intermittent shedders, especially during times of stress. Clinical signs may include fever, sneezing, nasal discharge and inappetence. The presence of dendritic corneal ulcers provides strong evidence for FHV-1 infection. The clinical course can last for up to 6 weeks.

Feline calicivirus (FCV) is a non-enveloped single stranded RNA virus that can survive in the environment for extended periods, up to 10 days. Like the herpes virus, it also replicates in the tonsils and upper respiratory tract but can also be shed in the feces and urine. The incubation period for calicivirus is around 5-10 days and, unlike herpes virus, is shed continuously. While almost impossible to differentiate from a herpes infection, calicivirus has some predilection for the epithelium of the oral cavity and lung tissue which can result in hypersalivation, lingual ulcerations, or pneumonia. The presence of ulcerative glossitis is highly suggestive of FCV.

There are virulent mutations which can result in atypical syndromes:

- Transient limping syndrome: present with pyrexia and acute transient lameness that may shift quickly from one limb to another. Full recovery usually occurs within 24-48 hours without treatment.
- Acute severe virulent systemic disease: present with facial and paw cutaneous edema and ulceration, bruising, pyrexia, and icterus. Associated with high mortality (30-50%).

Influenza A is a single stranded negative-sense RNA virus in the Orthomyxoviridae family. Influenza is very rare in cats and no well-adapted feline influenza virus has been established. However, they do have the potential to become infected with H5N1 and H7N7. A few natural infections have also been reported with the H1N1 strain.



Feline immunodeficiency virus (FIV) is a lentivirus within the family retroviridae that attacks the immune system of cats. FIV is spread primarily by biting and is not contagious to people. Three phases are seen in infected cats including an acute phase (1-3 months following infection), asymptomatic phase (months to years), and an immunocompromised phase. Affected cats may have a variety of symptoms including infections caused by a poorly functioning immune system, anemia and low blood-cell counts, infections of the gums and mouth, cancer, or neurologic disease. FIV is diagnosed through blood tests for antibody detection such as an ELISA (enzyme-linked immunosorbent assay), IFA (indirect immunofluorescence), or western blot assay. Cats that have been vaccinated for FIV will have a positive test result.

Feline leukemia virus (FeLV) is a gammaretrovirus within the family retroviridae subfamily oncornavirus. FeLV decreases immune system function and is the most common cause of feline cancer. FeLV is transmitted in saliva, nasal secretions, urine, feces, and milk of infected cats. Kittens can be born with FeLV or acquire the virus through their mother's milk. Feline leukemia virus is diagnosed by detection of FeLV P27 protein via an ELISA assay for screening or an IFA assay for confirmation.

Feline infectious peritonitis (FIP) is a positive stranded enveloped RNA virus belonging to the coronaviridae. Many cats are infected with a relatively benign form of the coronavirus but only in certain cats will the virus mutate to become pathologic. Previously, it was suggested that cats could transmit the disease to other cats by saliva, urine, and feces. It was also suggested that multi-cat households may increase the risk of disease. Cats living with an FIP cat will be no more likely to have this mutation in the future than they otherwise would have been not being exposed to the FIP cat. Coronavirus-specific antibodies are present in up to 90% of cats in catteries and in up to 50% of those in single-cat households, and in a cattery only 5% will develop FIP.

There are two forms of the disease: effusive and non-effusive. The characteristic sign of the effusive form is the accumulation of fluid in the chest or abdomen. The non-effusive form is more difficult to diagnose and is characterized by weight loss, depression, and fever. Diagnostic testing for the virus itself has been shown via immunoperoxidase in affected tissue samples, immunofluorescence in affected white blood cells, and polymerase chain reaction in tissue or body fluid. Recent studies show promise to the use of nucleoside analog gs-441524 and viral protease inhibitor gc376.

BACTERIAL:

Bacterial agents that have been described as primary respiratory pathogens in cats include *Bordetella bronchiseptica*, *Chlamydomphila felis*, *Streptococcus canis*, and *Mycoplasma spp.*

Corynebacterium spp., *Escherichia coli*, *Pasteurella multocida*, *Pseudomonas aeruginosa*, *Streptococcus viridans*, and *Staphylococcus intermedius* are also commonly detected but are generally thought to be secondary invaders.

Chlamydomphila felis is an obligate intracellular gram-negative bacterium that is shed via ocular secretions. Mainly results in conjunctivitis.

Mycoplasma spp. are gram negative pleomorphic bacteria that lack a cell wall. They are normal commensal organisms of the respiratory tract but

have been found to be associated with conjunctivitis.

Bordetella bronchiseptica is a gram-negative coccobacillus that is shed in oral and nasal secretions. *Bordetella* colonizes the respiratory epithelium and results in coughing.

Yersenia pestis is a gram-negative coccobacillus bacterium which is the agent responsible for the Plague. It is found in rodents in the southwest U.S. and can infect humans and cats via the oriental rat flea.

FUNGAL:

Cryptococcus neoformans is the fungal species most commonly found in cats. Infection occurs via inhalation of spores found in bird droppings and decaying plant matter. Pigeons are found to be frequent carriers. Clinical signs generally localize to the nose but can spread to the lungs and CNS. Other fungal agents include *Aspergillus fumigatus*, *Histoplasma capsulatum*, and *Blastomyces dermatiditis*.

PROTOZOAL:

Toxoplasma gondii, a protozoan which causes toxoplasmosis, is recognized by the CDC as one of the 5 neglected parasitic infections in people. This protozoan has a split life cycle with two hosts-definitive hosts where the parasite reproduces and forms eggs and intermediate hosts where it reproduces clones of itself which cluster inside cysts. Cats act as the only definitive host. Following ingestion of infected prey/meat, the parasite is released from oocyst into the digestive tract of cats. Here it reproduces and produces oocysts which are excreted in the feces. Newly infected cats shed 3-10 days after infection and shed for 10-14 days. This is the only time they are considered infectious. These oocysts have to undergo sporulation over a 1-5-day period before they can become infective. Some parasites released from oocyst following initial ingestion will penetrate deeper layer of intestine and multiply as tachyzoites which spread to other areas within the cat. They are forced into a dormant or resting stage, forming cysts in the muscle and the brain. Within these cysts, the organism begins multiplying as bradyzoite and can release at a later point, causing pulmonary, hepatic, or CNS manifestations.

Non-infectious respiratory diseases of dogs

The spectrum of noninfectious diseases of dogs includes congenital disorders, neoplasia, inflammatory diseases, and structural diseases.



I. CONGENITAL ABNORMALITIES

a. Pulmonary hypoplasia

- i. Incomplete pulmonary development due to imbalance of bronchial development between lung buds.

b. Congenital lobar emphysema

- i. Alveolar hyperinflation due to bronchial collapse during expiration caused by bronchial cartilage dysplasia.
- ii. Can develop pulmonary blebs or bullae that may rupture.

c. Primary ciliary dyskinesia

- i. Autosomal recessive.
- ii. Ciliary dysfunction decreases mucociliary clearance.

d. Cleft palate/cleft lip

- i. Autosomal recessive trait.
- ii. Common in Brittany spaniel, Great Pyrenees, and Brachycephalics.

e. Brachycephalic airway syndrome

- i. One of the most common congenital airway diseases seen.
- ii. Classic breed examples include French bulldogs, English bulldogs, Pugs.
- iii. Primary anatomic variants seen include stenotic nares and an elongated and thickened soft palate.

f. Create a large amount of resistance to air movement during inspiration.

g. The presence of prominent nasopharyngeal turbinates and a hypoplastic trachea are thought to contribute to this resistance.

- iv. Secondary anatomic variants can develop with prolonged negative pressure to override the above noted resistance including everted tonsils, everted laryngeal sacculles, and laryngeal collapse.
- v. Resistance will be primarily manifested as "stertor" described as a snorty sound.
- vi. 80% of these dogs will have some form of concurrent GI disease such as esophagitis, gastritis, hiatal hernia, or pyloric stenosis.
- vii. Depending on the severity of stertor or airway resistance, surgical intervention is recommended at a younger age to correct the anatomic problems such as widening the nares, trimming the soft palate, and/or removing sacculles/tonsils.
- viii. These patients are at high risk of aspiration pneumonia and any time they undergo sedation or anesthesia for any procedure, one should always be prepared for trouble during extubation and needing to intervene via placement of a



temporary tracheostomy.

- ix. Anxiolytics, weight management, and use of prokinetics and proton pump inhibitors will be major components of long-term medical management.

f. Nasopharyngeal stenosis

- i. Partial to complete narrowing of the nasopharynx by a membrane caudal to the choanae and rostral to the caudal aspect of the soft palate.
- ii. Can be congenital, however more commonly seen secondary to aspiration rhinitis.

II. NEOPLASIA

a. Nasal Neoplasia:

- i. Adenocarcinoma is most common, followed by squamous cell carcinoma.
- ii. 80% of nasal tumors are malignant.
- iii. Most commonly reported in dogs between 8 and 10 years of age.
- iv. No breed is predisposed, but very uncommon in brachycephalic breeds.
- v. Persistent nasal discharge, sneezing, and intermittent epistaxis are common presenting signs.
- vi. Nasal radiographs may demonstrate lytic bone lesions. Lysis of the vomer strongly supports neoplasia vs. mycotic rhinitis.
- vii. Exposure to tobacco smoke has been associated with 2.5x greater risk in long-nosed dogs.
- viii. There is no or minimal response of the nasal discharge to antibiotics.

b. Larynx and trachea

- i. Tumors of the larynx most frequently reported in dogs are oncocytoma, squamous cell carcinoma, mast cell tumor, melanoma, and osteosarcoma



- ii. Osteochondral dysplasia of the trachea (osteochondroma) is a benign tumor of the trachea primarily seen in dogs <1 yr. old.

c. Lung

- i. Primary lung tumors usually originate from the terminal bronchioles and alveoli; they occasionally develop as a second coincidental tumor, which may make differentiation between primary and metastatic disease difficult.
- ii. ≥80% are malignant. Adenocarcinoma and alveolar carcinoma are the most common types. Primary lung sarcomas and adenomas are rare.
- iii. Metastatic spread of primary lung tumors is generally to other areas of the lungs, tracheobronchial lymph nodes, bone, and brain.

III. INFLAMMATORY DISEASE

a. Canine bronchitis

- i. Characterized by a cough that is present for at least two months, inflammation in the airways, and a lack of an identified underlying disease that may cause a cough.
- ii. Neutrophilic inflammation with mucus stimulates cough. Can see hyperplasia of mucous glands and goblet cells, hypertrophy of smooth muscle and fibrosis of lamina propria resulting in obstruction

- of small airways and airway collapse.
- iii. Permanent dilation of bronchi and destruction of bronchial walls can be seen which is known as bronchiectasis (Cockers have an increased risk).
- iv. Disease of middle to older aged small breed dogs.
 - 1. If big dog presents with cough, you should be suspicious of something else going on, ex. Bordetella.
 - 2. Should not see signs of systemic illness (weight loss, anorexia, lethargy).
- v. A sinus arrhythmia supports airway/pulmonary system as primary cause of coughing.
 - 1. cough-drop syndrome (high vagal tone).
- vi. Diagnostics:
 - 1. Thoracic radiographs
 - a. bronchial thickening (donuts and tramlines), bronchiectasis, hyperinflation.
 - 2. Thoracic CT
 - 3. Laryngeal exam with airway sampling
 - a. Cytology: mostly neutrophilic (eosinophils should raise suspicion for eosinophilic bronchopneumopathy).
 - b. Culture should always be performed.
 - i. Role of bacteria is unclear (colonization vs clinical infection).
 - 4. Bronchoscopy

- a. irregular airway without glisten, hyperemia, granular appearance, collapse of airways during expiration.
- 5. Exercise-induced oxygen desaturation during 6MWT (6-minute walk test).
 - a. less than 400 meters is significant lung disease.
- vii. Treatment
 - 1. Limit inflammation and cough via weight loss, use of harness, and avoidance of airborne stimulants.
 - 2. Steroids
 - a. oral vs inhaled
 - b. Inhaled corticosteroid drugs are not as absorbed into the systemic circulation, do not result in significant side effects, and are now the standard of care for dogs and cats with respiratory diseases. (Padrid P. Use of inhaled medications to treat respiratory diseases in dogs and cats. J Am Anim Hosp Assoc. 2006 Mar-Apr;42(2):165-9. doi: 10.5326/0420165. PMID: 16527919.)
 - 3. Bronchodilators
 - a. Theophylline
 - i. decreases diaphragmatic fatigue, increases mucociliary clearance, and enhances the efficacy of glucocorticoid activity.
 - b. Terbutaline
 - i. may be less effective due to the lack of reversible bronchoconstriction in some patients; dogs rarely respond.
 - 4. Antibiotics
 - a. Doxycycline and azithromycin have anti-inflammatory and antimicrobial properties.
 - i. should be considered in patients with no specific bacterial culture and sensitivity data.
 - b. Fluoroquinolones
 - i. Should reduce concurrent theophylline dose by 30-40%.
- 5. Cough suppressants
 - a. Hydrocodone
 - b. Butorphanol
 - b. Allergic pneumonitis
 - i. Acute or chronic allergic reaction of the lungs and small airways.
 - ii. Often higher than normal number of eosinophils in the blood and airway secretions.
 - iii. Underlying cause rarely determined.
 - c. Eosinophilic bronchopneumopathy
 - i. Previously referred to as PIE (pulmonary infiltration with eosinophilia).
 - ii. Develops nodules and pulmonary infiltration with eosinophilia.
 - iii. Causes include parasites, chronic bacterial or fungal infections, viruses, external antigens.
 - 1. Heartworm being the most common.
- 6. The AeroDawg* Chamber
 - a. Designed for cats to work with metered dose inhalers (MDIs). The AeroDawg* Chamber captures and holds the medication in the chamber until the dog breathes it in.
 - b. The patented Flow-Vu* indicator shows you that the patient is taking their medication correctly, whether there's a proper mask seal, and how many breaths they're taking.



IV. STRUCTURAL DISEASE

a. Laryngeal paralysis

- i. Recurrent laryngeal nerve dysfunction that results in atrophy of one or pair of dorsal cricoarytenoid muscle which impairs arytenoid cartilage abduction during inspiration.
- ii. Middle to older age, large to giant breed.
- iii. Can be congenital or secondary to trauma, neoplasia, myasthenia gravis, hypothyroid disease.
- iv. A history of a gradual bark change is often noted with development of "stridor", described as high-pitched wheeze.
- v. Patients may experience an acute exacerbation and present in airway crisis.
- vi. Surgical intervention via 3 techniques
 1. widen the glottis (arytenoid lateralization)
 2. widen ventral glottis (vocal fold resection)
 3. widen both.
- vii. High risk for aspiration pneumonia.

b. Laryngeal collapse

- i. Consequence of chronic upper airway obstruction.
 1. most often associated with brachycephalic airway syndrome.

- ii. Surgical intervention:
 1. cricoarytenoid and thyroarytenoid caudolateralization.
- iii. permanent tracheostomy.

c. Tracheal collapse

- i. Weakened cartilage rings, dorsoventral flattening in middle aged dogs.
- ii. Cervical trachea collapses during inspiration, intrathoracic trachea collapses during expiration.
- iii. Produces nonproductive honking cough.
- iv. Radiographs, bronchoscopy, fluoroscopy used for diagnosis and grading.
 1. Remember dynamic collapse
 2. Multiple grades of collapse
- v. Medical management:
 1. Weight loss, sedatives, cough suppressant, steroids.
- vi. Surgical management:
 1. Extraluminal tracheal rings (only cervical)
 2. Intraluminal stent
 - a. Salvage procedure
 - b. Complications include stent fracture, stent migration, airway collapse cranial/caudal to the stent, secondary infection.
 3. Still need to continue medical management as the cough never 100% resolves.



Non-infectious respiratory diseases of cats

The spectrum of noninfectious diseases in cats includes congenital disorders, neoplasia, and inflammatory diseases.





1. CONGENITAL ABNORMALITIES

a. Congenital choanal atresia.

- i. Abnormal bone or soft tissue obstructing the caudal nasal passage.

b. Congenital lobar emphysema.

- i. Alveolar hyperinflation due to bronchial collapse during expiration caused by bronchial cartilage dysplasia.

c. Brachycephalic airway syndrome.

- i. Persians

d. Pleural bullae

- i. Blister like air pockets.

e. Tracheal stenosis

- i. Tends to be more acquired.

2. NEOPLASIA

a. Nose and paranasal sinus

- i. Incidence is also higher in males of both species than in females.
- ii. Mean age of diagnosis is 12 years.
- iii. $\geq 90\%$ of nasal tumors are malignant, the most common being lymphoma and the second most common being carcinomas.
- iv. Tumors of the nose and paranasal sinuses typically are very invasive locally and metastasize infrequently; metastasis is more likely in carcinomas and usually occurs late in the disease. Common sites of metastasis are regional lymph nodes, lungs, and brain.

b. Larynx and trachea

- i. Squamous cell carcinoma, lymphosarcoma, and adenocarcinoma.

c. Lung

- i. Primary lung tumors usually originate from the terminal bronchioles and alveoli; they occasionally develop as a second coincidental tumor, which may make differentiation between primary and metastatic disease difficult.
- ii. $\geq 80\%$ are malignant.
- iii. Adenocarcinoma and alveolar carcinoma are the most common types
- iv. Primary lung sarcomas and adenomas are rare in both species.
- v. Metastatic spread of primary lung tumors is generally to other areas of the lungs, tracheobronchial lymph nodes, bone, and brain.

3. INFLAMMATORY DISEASE

a. Nasopharyngeal polyps

- i. Found in 28% of cats with nasopharyngeal disease.
- ii. Predominantly affects younger cats.
- iii. Benign inflammatory lesions that arise from the mucosa of auditory tube or middle ear and grow into nasopharynx or external ear canal.
- iv. Cause stertor, dysphagia, sneezing, nasal discharge, upper airway obstruction.
- v. Surgery is usually warranted.
 - 1. Traction-avulsion is simplest, but has 40-50% reoccurrence.



b. Feline asthma

- i. Inflammatory disease of lower airway with no apparent etiology.
- ii. Feline asthma is specific form (smooth muscle hyperreactivity and hypertrophy, mucus production, inflammation, airway remodeling).
- iii. Intermittent bronchoconstriction with predominately eosinophilic lower airway inflammation and an allergic immunopathogenesis separates from chronic bronchitis (neutrophilic inflammation to a previous insult).
- iv. 3 features: airway eosinophilic inflammation, hyperresponsiveness, permanent remodeling.
 1. Type 1 hypersensitivity - Dendritic cells process inhaled allergen regional lymph nodes. IL-4,5,13 (IL-4 most important) causes IgE production that binds to Fc receptors on mast cells.
 - Subsequently inhaled allergens cross link IgE causing mast cell degranulation.
 - Histamines and leukotrienes are released and result in increased vascular permeability, smooth muscle contraction, and mucus production.
 - Eosinophils are recruited which degranulate and release major basic protein, eosinophil peroxidase, and cationic proteins which cause tissue damage.
- v. Young to middle-aged cats
- vi. Clinical signs:
 1. Acute bronchoconstriction and cough receptor stimulation results in orthopnea, tachypnea, cyanosis, wheezing, harsh cough, sneezing, stridor, wheezing, barrel shaped thorax.
- vii. Diagnostics:
 1. No gold standard. Workup generally involves thoracic radiographs, airway sampling for cytology, exclusion of other causes
 2. Rule out: cardiac causes, parasitic bronchitis (*Aelurostrongylus abstrusus*, *Capillaria aerophila*, *Paragonimus kellicotti*, or pulmonary migration of *Toxocara cati*), heartworm disease.
 3. 20-57% of patients may have peripheral eosinophilia and hyperglobulinemia.
 4. Thoracic radiographs:
 - a. Predominate bronchial pattern but can see mixed/alveolar pattern, consolidation of right middle lung lobe, hyperinflation of the lungs.
 - b. 25% of cases may have normal lungs.

- c. Radiographs may not help monitoring overtime due to permanent remodeling.
- 5. Bronchoscopy
 - a. Mucus, nodular irregular airway, airway hyperemia, bronchial stenosis **pretreat with terbutaline**.
- 6. BAL
 - a. Eosinophils ranging from 16-28% have been documented.
- 7. Barometric whole-body plethysmography (BWBP).
- 8. Tidal breathing flow-volume loops.
- 9. Exhaled breath condensate (EBC) can be collected from non-anesthetized cats briefly housed within an acrylic chamber and analyzed for hydrogen peroxide, a marker of oxidative stress.
- 10. IgE allergen identification, intradermal skin testing, flow cytometry.

viii. Treatment: O2, bronchodilator therapy, steroids (inhaled vs oral).

c. Chronic idiopathic rhinosinusitis

- i. Rhinitis/rhinosinusitis that persists longer than 1 month.
- ii. The major clinical sign is cough. One important difference is that asthmatic patients have airflow limitation secondary to bronchoconstriction with inflammation and accumulated mucous debris. Another difference is that asthmatic patients may have an acute onset of dramatic clinical signs (wheezing, dyspnea). Finally, the cellular infiltrate may be used to differentiate the conditions (though this is not definitive); specifically, asthmatic cats tend to have eosinophilic inflammation whereas cats with chronic bronchitis have a predominately neutrophilic infiltration.

4. PLEURAL EFFUSION

a. Fluid Characterization

FLUID TYPE	TOTAL PROTEIN	NUCLEATED CELL COUNT	MECHANISM	PREDOMINANT CELL TYPE
Low Protein Transudate	<2.5 g/dl	<1,500/microliter	Increased hydrostatic pressure, increased vascular permeability or decreased colloid osmotic pressure	Mononuclear- macrophages, mesothelial cells
High Protein Transudate	2.5-5 mg/dl	1,000-7,000/microliter	Increased hydrostatic pressure or vascular permeability, increased lymphatic pressure or impaired lymphatic drainage	Mesothelial cells, macrophages, lymphocytes, eosinophils
Exudate	>3.0 mg/dl	>5,000/microliter	Increased vascular permeability, decreased lymphatic drainage	Neutrophil
Chylous	2.6-10 g/dl	<10,000/microlite	Impaired lymphatic drainage	Small lymphocyte, neutrophils

b. Causes of Pleural Effusion

Low Protein Transudate	High Protein Transudate	Hemorrhagic Effusion	Neoplastic Effusion	Non-septic Exudate	Septic Exudate	Chylous Effusion
PLE	Heart disease	Trauma	Lymphoma	FIP	Pyothorax	Idiopathic
PLN	Neoplasia	Iatrogenic	Mesothelioma	Neoplasia		Neoplasia
Severe hepatic disease	Pericardial effusion	Coagulopathy	Carcinoma			Heart disease
Heart disease- early stage only	Diaphragmatic hernia	Neoplasia	Sarcoma			Heartworm disease
	SIRS	Lung Lobe Torsion				Lung Lobe Torsion
	Lung Lobe Torsion					Trauma
	FIP					

c. Classically, cats with pleural effusion demonstrate a rapid, shallow breathing pattern with an abdominal component to their effort. They often position themselves with their neck extended and their elbows abducted. During auscultation it is often possible to appreciate dull lung sounds ventrally but air movement dorsally. Other clinical findings are dependent on the underlying disease process causing the effusion and may include coughing, weight loss, poor appetite, fever, heart murmur among others.

5. PYOTHORAX

- a. Infection in the pleural space resulting in a septic exudative pleural effusion.
- b. Causes of pyothorax in cats include trauma, rupture or perforation of the esophagus, trachea or airway, migrating foreign body, lung parasites, pneumonia with ruptured abscessation, hematogenous spread and iatrogenic contamination.
 - i. In one study, oropharyngeal aspiration secondary to upper airway infection, parasitic migration and perioperative aspiration were the most commonly identified causes in cats.
- c. Unfortunately, many times the etiology of the pyothorax cannot be determined.
- d. Diagnosis is ultimately made via cytology and culture of the fluid. The predominant cell type should be the neutrophils which may or may not demonstrate toxic and/or degenerative changes.
- e. The most common bacteria cultured from the effusion of cats with pyothorax include aerobes: *Pasteurella* spp (most common overall), *Actinomyces* spp and anaerobes: *Bacteroides* spp, *Fusobacterium* spp, *Prevotella* spp and *Peptostreptococcus* spp.
- f. Bacteria may not be identified in a small percentage of cases.
 - i. Intracellular bacteria were identified in 91% in one study.
 - ii. If the fluid is characterized as an inflammatory exudate, aerobic and anaerobic culture should always be submitted.
- g. Debate whether medical vs surgical management is optimal.
 - i. Broad spectrum coverage is indicated based on

the most common bacterial isolates found in cats with pyothorax.

- ii. Drainage of infected fluid is key to treatment and is most effectively accomplished with bilateral thoracostomy tubes.
 1. MILA vs Trochar thoracostomy tube
 - a. More comfortable and easier to place MILA but higher risk of potential tube clogging.
- iii. Some clinicians advocate for thoracic lavage with warm sterile fluid with or without additives (antimicrobials or anticoagulants).
 1. Risk of iatrogenic contamination.
- iv. In cats that are not responding favorably to medical management, surgical treatment (exploratory thoracotomy) should be recommended.
- v. Survival rate is greater than 50% with a low recurrence rate.

6. CHYLOTHORAX

- a. Abnormality of the thoracic duct system where there is leakage of lymphatic fluid into the pleural cavity.
 - i. Chyle is drained from the mesenteric lymphatic vessels to the cisterna chyle and ultimately to the thoracic duct which runs along the left thorax. The thoracic duct returns the lymph and chyle to the venous system in the cranial thorax, the location that the thoracic duct terminates in the cat varies.
- b. The fluid is comprised of lymph and emulsified fats formed from the gastrointestinal tract and therefore is very high in fat and triglycerides.
- c. Most cases of chylothorax are caused by intact but dilated lymphatics.

Causes of Chylothorax
Congenital
Traumatic
Lymphangiectasia
Neoplasia (especially mediastinal- LSA, thymoma)
Heart Disease (cardiomyopathy, pericardial disease, congenital)
Heartworm Disease
Thrombosis (vena cava)
Granuloma
Lung Lobe Torsion
Peritoneal pericardial diaphragmatic hernia
Idiopathic

d. Himalayan and Siamese cats may be predisposed to developing chylothorax. Older cats have been reported to develop chylothorax more commonly compared to young cats.

e. Fluid analysis is required to confirm the presence of chylous effusion.

- i. Opaque, milky color, predominantly composed of lymphocytes.
- ii. Triglyceride concentration (>100 mg/dl supportive).
- iii. Pleural fluid to serum concentration of triglycerides (higher triglyceride- often by several fold- in the effusion).
- iv. Pleural fluid cholesterol:triglyceride ratio (<0.2-1).

f. Diagnostic workup should include echocardiography, heartworm antigen/ antibody testing, abdominal ultrasound, and possibly more advanced imaging (including thoracic ultrasound or CT).

g. Conservative treatment:

- i. Low fat diet with medium chain triglyceride oil supplementation
 1. Belief was that formation of chylomicrons would decrease and thereby reduce lymphatic flow when compared to higher fat diets with long chain triglycerides.
 2. Medium chain triglycerides were once thought to bypass the thoracic duct completely, which has since been shown to be untrue.

3. Experimentally, no diet has been successful at reducing the volume of chyle transported in the thoracic duct system.

ii. Rutin

1. Benzopyrone supplement that may improve macrophage ability to remove lymph protein and improve chyle reabsorption from the pleural space.

iii. Octreotide

1. Somatostatin analog thought to decrease thoracic duct flow when given subcutaneously every 8 hours.

h. Surgical intervention

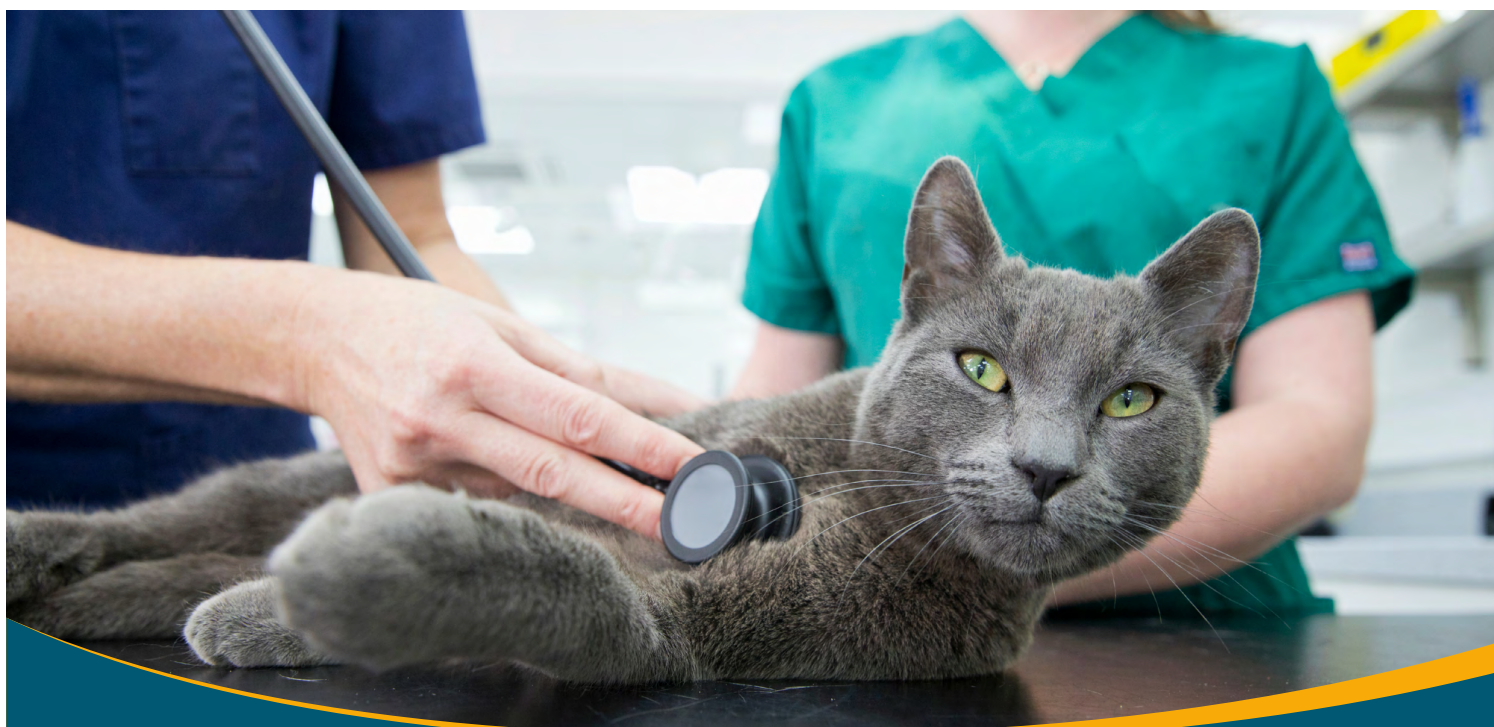
- i. Some advocate earlier surgical intervention to avoid the development of fibrosing pleuritis secondary to the presence of chronic inflammatory fluid.

- ii. Allows for exploration of the chest and biopsy of any abnormalities.

- iii. Thoracic duct ligation is the procedure most consistently performed but has been met with moderate success, 50-80% of cats will continue to have some effusion following surgery.

- iv. Ancillary techniques reported along with thoracic duct ligation include omentalization, pericardectomy, pleuroperitoneal shunting, and pleuralport placement.

1. Thoracic duct ligation in combination with pericardectomy has shown an 80% positive response rate in cats with presumed idiopathic chylothorax.



Diagnosing Respiratory Illness

Diagnosing respiratory diseases can at times be challenging. However, with careful attention to the pet's clinical signs and a carefully planned diagnostic workup, most respiratory diseases can be diagnosed, and an effective therapeutic plan can be instituted. It is important to understand what is causing the symptoms in order to treat the condition effectively. Cough can often be a sign of a chronic condition that requires a long term treatment strategy for the best quality of life of the animal. Symptomatically managing the cough may leave animals underlying condition untreated and at risk of relapse, disease progression, or exacerbation. The first step in diagnosing any respiratory disease is anatomic localization. We need to figure out what part of the respiratory system is the problem.





We can divide the respiratory system in the following anatomic sections:

- Upper airways
- Lower airways
- Pulmonary parenchyma
- Pleural space
- Vascular
- Chest wall disease
- Look-alikes

PHYSICAL EXAMINATION:

A physical examination is always your most valuable diagnostic tool. Much information can be gained before even putting hands on the pet. A pet will often display an abnormal breathing pattern and is often one of the things the owner first notices at home.

Abnormal breathing patterns that can be seen include:

- i. Obstructive
 - i. In this breathing pattern we can see a prolongation in the inspiratory or expiratory phase of a breath.
 - ii. Prolonged inspiration correlates with an upper airway obstruction
 - iii. Prolonged expiration correlates with a lower airway obstruction
- ii. Restrictive

- i. With this breathing pattern the pet takes rapid shallow breaths which correlates with parenchymal disease
- iii. Paradoxical
 - i. With this breathing pattern there is asynchrony and opposite movement between the chest and abdominal wall. This type of breathing pattern often correlates with pleural space disease or impending respiratory fatigue
- iv. Orthopnea
 - i. While considered more of an abnormal body position, orthopnea is crucial to recognize as it demonstrates overall respiratory difficulty. This includes pets that are in sternal recumbency or standing with head and neck extended, elbows abducted, and/or open mouth breathing in attempts to allow more air passage.

Respiratory noises or sounds that can be heard from a distance include:

1. **Stertor**
 - This is a low pitched, snorting like-noise due to resistance in nasal passages or nasopharynx. The noise is classically associated with brachycephalic dogs. It can also be seen with nasal congestion.

2. Stridor

- This is a high pitched, raspy like noise due to resistance in the larynx or upper trachea. This is seen classically in dogs with laryngeal paralysis. It is also seen with impending upper airway obstruction.

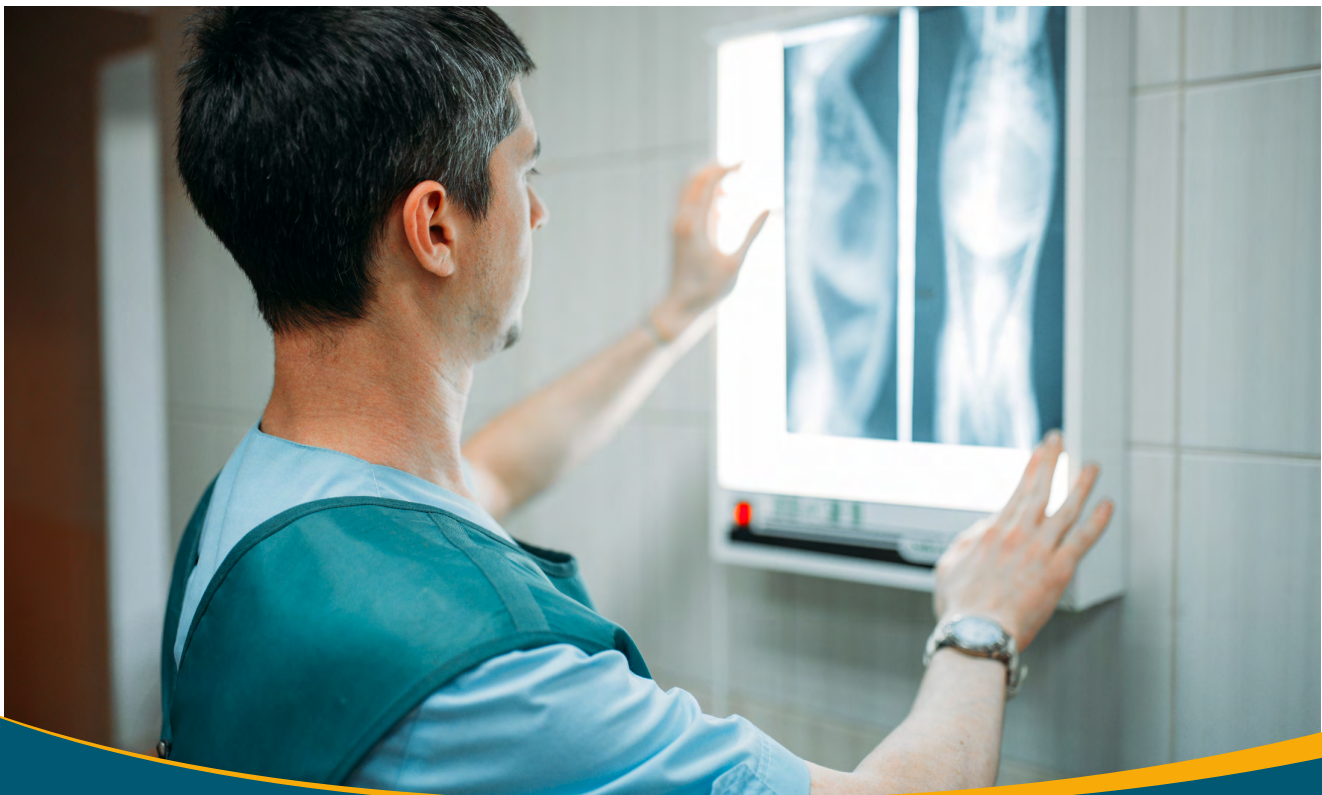
3. Cough

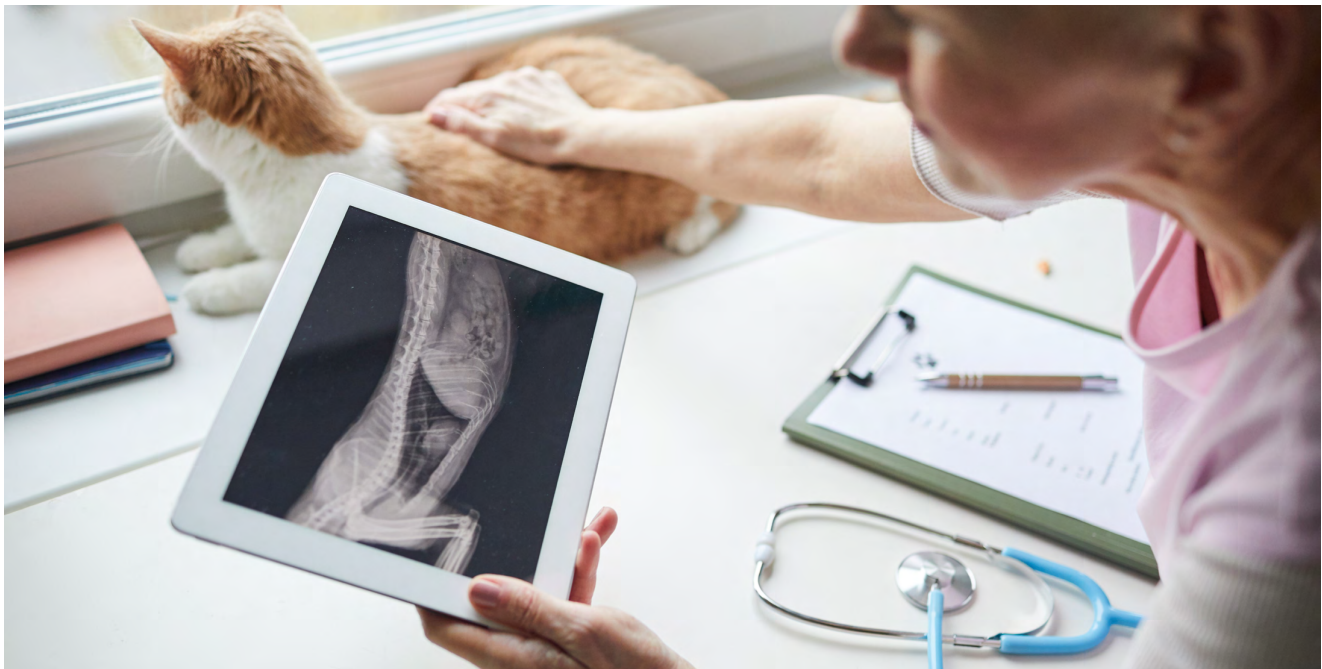
- Defined as a sudden expulsion of air, a cough should be characterized in terms of wet vs dry, productive vs nonproductive, and hacking or honking sounds associated.
- Often a cough is attempted to be elicited by tracheal palpation. This is a fairly nonspecific finding and does not exclude the true presence of a cough or underlying disease if unable to be elicited.
- Coughing in cats can be due to:
 - Feline Asthma
 - Infectious diseases
 - Congestive heart failure
 - Foreign body
 - Neoplasia
 - Heartworm disease
- Coughing in dogs can be due to:
 - Infectious diseases

- Lung tumors
- Pleural effusion
- Upper airway obstruction w/ gastroesophageal reflux
- Interstitial lung disease
- Congestive heart failure

A thorough auscultation of the thoracic cavity should be performed during every physical examination. It's important to evaluate all parts of the lung field bilaterally on inspiration and expiration. Visualizing a grid that divides the lung fields into cranial, middle, and caudal segments and dorsal, middle, and ventral segments is helpful to be sure the lung field is evaluated fully. Allow for the pet to take several good tidal volume breaths when auscultating each field. Often, the detection of abnormalities is often missed because a lung field is auscultated during one breath or the patient fails to generate a good breath due to the presence of the clinician's stethoscope on their chest. Panting can also obscure underlying abnormalities and should be temporarily prevented by closure of the pet's mouth.

Abnormalities during thoracic auscultation can include:





1. Wheezes
 - a. Wheezes are noted as air passes through narrowed airways. This is a common finding in lower airway disease.
2. Increased bronchovesicular sounds
 - a. Often referred to as harsh lung sounds. This is fairly nonspecific and can be associated with anything that causes tachypnea.
3. Crackles
 - a. Crackles are caused by expansion of fluid filled airways. Crackles can be described as fine versus coarse and are associated with parenchymal or interstitial lung disease.
4. Decreased/absent lung sounds
 - a. The inability to detect audible lung sounds often is associated with pleural space disease. Following the general principles of gravity, absent lung sounds along the dorsal lung fields occurs with air in the pleural space such as with a pneumothorax whereas absent lung sounds along the ventral lung fields occurs with fluid or soft tissue in the pleural space.
 - b. It should be noted that atelectasis or severe congestion can also result in decreased or absent lung sounds.

RADIOGRAPHS

Radiographs are often the most accessible imaging modality available. While common practice is to take 2 orthogonal views, it is recommended to perform 3-view thoracic studies to maximize lesion detection and minimize superimposition of structures. Imaging the cervical region may also be of use in some patients. Caution should be taken when performing radiographs as patients can quickly decompensate.

Supplemental oxygen and the use of mild sedation should be considered on a patient-to-patient basis. When pleural space disease is suspected, the pleural space should be evacuated via thoracocentesis prior to obtaining radiographs to allow for maximal visibility and evaluation of thoracic cavity

All thoracic radiographs should be systematically evaluated and should include evaluation of the chest wall, diaphragm, spinal cord, and ribs, followed by pulmonary parenchyma, pleural space, pulmonary vessels, and mediastinum. Differentiating between the various types of opacities within the pulmonary parenchyma along with their pattern of distribution can be helpful in differentiating the underlying disease process.

- Lung patterns
 - i. A bronchial pattern occurs with diffuse thickening of the airway walls giving the appearance of thick lines and rings, often referred to as “doughnuts” and “tramlines”.
 - ii. An alveolar pattern occurs when air in the alveoli is replaced by fluid or cells or not replaced as in atelectasis. Air bronchograms can often be seen due to air filling the bronchus with a fluid opacity in surrounding lobe.
 - iii. A vascular pattern is seen with enlarged or torturous pulmonary vessels that result in an increase in pulmonary opacity. Diseases can be grouped via arterial vs venous enlargement.
 1. Pulmonary vasculature in lateral view (left lateral is best)
 - a. Artery dorsal to vein, bronchus in between
 - b. Vessels should be equal in size, smaller than proximal third of rib
 2. Pulmonary vasculature in VD/DV view (DV view is best)
 - a. Artery lateral to vein, bronchus in between
 - b. Vessels smaller than 9th rib where they intersect
 - iv. An unstructured interstitial pattern is simply increased soft tissue opacity in the lungs that partially obscures blood vessel margins, often referred to as “haziness.” This pattern can be seen with age-related changes or due to the presence of edema, purulent exudate, blood, or other material in the lungs. The appearance of an interstitial pattern itself is not specific for any disease.
 - v. A structured interstitial pattern describes circumscribed opacities ranging from masses (> 3 cm), nodules (<3 cm), or miliary nodules (2-3 mm). Differentials include neoplasia, fungal disease, parasitic cysts or granulomas,

fluid/blood filled bullae, pulmonary osteomas, or end-on blood vessels.

- Pattern of distribution
 - i. Cranioventral: Often seen with bronchopneumonia, aspiration pneumonitis
 - ii. Perihilar: Often seen with cardiogenic pulmonary edema (dogs)
 - iii. Caudodorsal: Often seen with noncardiogenic pulmonary edema, hematogenous pneumonia

The heart may be assessed when there is any clinical condition of underlying cardiac disease.

- A vertebral heart scale of >9.3 was highly specific for the presence of heart disease in cats presenting with acute respiratory distress.

Dynamic diseases such as tracheal collapse and/or mainstem bronchial collapse may not be seen or be underestimated on radiographs. Studies have shown that even with paired inspiratory and expiratory view, radiographs misdiagnose the location of tracheal collapse in 44% of dogs and fail to diagnose tracheal collapse completely in 8% of dogs. In patients with dynamic disease, fluoroscopy and/or bronchoscopy may be necessary for definitive diagnosis.

AIRWAY SAMPLING

Sampling of the airways can be of high value for the diagnosis of underlying respiratory disease. It is important that sampling of the airways via any type of wash procedure is properly performed to retrieve a noncontaminated sample of high diagnostic yield.

- Transtracheal wash
 - Best performed in medium or larger sized dogs
 - Requires light sedation
 - A through-the-needle catheter is passed in-between tracheal rings and fed down trachea

- 5-10 ml aliquots of saline are infused and retrieved.
- Endotracheal wash
 - Best used in cats, small sized dogs, brachycephalic breeds, obese patients
 - Requires brief anesthesia and endotracheal intubation via sterile technique
 - A 5-8 fr catheter is fed through the endotracheal tube and sterile saline is infused and retrieved.
 - i. 3 ml for <5kg, 5 ml for 5-15kg, 10 ml for >15kg
- Blind Bronchoalveolar lavage
 - This is very similar to an endotracheal wash in that it requires brief anesthesia and sterile endotracheal intubation
 - A 5-8 fr catheter is fed through the endotracheal tube and advanced until lodged in the lower airways
 - Large volumes of saline are infused (20 ml aliquots) and retrieved. This is generally repeated once in cats and 2-3x in dogs.
 - Cats should receive bronchodilator prior to procedure.
- Bronchoalveolar lavage
 - Requires the use of bronchoscopy to allow for deeper, more targeted airway sampling.

cytology and culture and sensitivity.

- Aerobic and Mycoplasma culture and sensitivity are typically requested.
- In cases with markedly purulent secretions or a history of known aspiration or foreign bodies, anaerobic cultures should also be requested.
- Serologic testing for fungal, viral, and protozoal pathogens, in addition to PCR and virus isolation assays, should be considered when deemed appropriate.

While it is important to perform any airway sampling technique correctly, it is equally as important to evaluate the stability of a patient and the cost-to-benefit ratio prior to. These procedures may worsen a patient's respiratory status and as such may be contraindicated for some. Clear discussions are important to have with owners with regards to the potential risks of these diagnostic tests and the role of empirical treatment. When this form of treatment is selected, frequent follow ups are imperative to track the patient's response to the medication selected. Any sign of a patient worsening or failing to respond to treatment should prompt reevaluation of the patient and potential escalation of therapy.

Airway samples should be submitted for both



Treatment and management of respiratory disease

Selecting the best course of treatment for any respiratory disease is just as crucial as the diagnosis. To start, a patient's stability and ability to oxygenate appropriately should be assessed. For any patient that is deemed oxygen dependent, referral to a 24-hour facility is recommended for oxygen supplementation while treatment can be instituted.



⇒ Broad spectrum antibiotics

- Warranted with bacterial pneumonia or pyothorax
- Ideally, you should always be basing antibiotic selection from results of culture and sensitivity
- When selecting antibiotics empirically, it's important to consider likely pathogens suspected and the source of the infection to ensure the antibiotics selected have appropriate spectrum and can penetrate the targeted tissue
 - Antibiotics with good pulmonary

penetration include azithromycin, doxycycline, clindamycin, trimethoprim-sulfamethoxazole, and fluoroquinolones

- Want to consider adverse effects of the antibiotic/s and any relative patient safety factors that may contraindicate use of a certain class of antibiotics

First-line antimicrobial options for bacterial respiratory infections in the dog and cat

Acute bacterial upper respiratory infection (URI) in cats	Doxycycline or amoxicillin per os (PO)
Chronic bacterial URI in cats	Doxycycline or amoxicillin PO Base the choice on C&S if available - although cats rarely have chronic bacterial rhinitis, as it is more likely to be secondary to other disease.
Canine infectious respiratory disease complex (bacterial component)	Doxycycline or amoxicillin-clavulanate PO
Bacterial bronchitis (dogs or cats)	Doxycycline PO Base changes if needed on clinical responses and C&S if available
Pneumonia in animals with extensive contact with other animals that have no systemic manifestations of disease (ie, fever, lethargy, dehydration)	Doxycycline PO Base changes if needed on clinical responses and C&S if available
Pneumonia with or without clinical evidence of sepsis	Parenteral administration of a fluoroquinolone and a penicillin or clindamycin initially Base oral drug choices to follow on clinical responses and C&S results if available
Pyothorax (dogs or cats)	Parenteral administration of a fluoroquinolone and a penicillin or clindamycin initially combined with therapeutic lavage initially Base oral drug choices to follow on clinical responses and C&S results if available

Adapted from "Antimicrobial use Guidelines for Treatment of Respiratory Tract Disease in Dogs and Cats: Antimicrobial Guidelines Working Group of the International Society for Companion Animal Infectious Diseases" by Lappin MR, Blondeau J, Boothe D, et al. J Vet Intern Med. 2017;31(2):279-294.



⇒ Diuretics

- Furosemide 1-4 mg/kg IV, IM
- Use when pulmonary edema is of cardiogenic origin; potential use with noncardiogenic edema
- Excessive use can result in hypovolemia, acid-base and electrolyte disturbances, azotemia
- Water should always be made available to the patient when using diuretics

⇒ Bronchodilators + Glucocorticoids

- Combination of the two is mainstay of airway management to relieve the bronchoconstriction and inflammation caused by inflammatory lower airway disease.
- The phase of the disease (acute vs chronic) will dictate the recommended medication options.
- Acute therapy
 - Bronchodilator
 - Beta-2 agonists
 - Preferred for acute therapy
 - Side effects include tachycardia, restlessness, muscle tremors, hypokalemia
 - Caution with use in

patients with cardiac disease hypertension, hyperthyroidism, or seizure disorders

- Terbutaline 0.01 mg/kg IM, SC
- Takes effect within 15-30 minutes
 - Albuterol 90 mcg (Inhalation)
- Uses metered dose inhaler to deliver the medication into a chamber device attached to a facemask
- Takes effect within 5-20 minutes
- As racemic mixture, it should be reserved for use as a rescue therapy as chronic use can cause bronchoconstriction and be pro-inflammatory.
- Glucocorticoids
 - Dexamethasone SP 0.15-1 mg/kg IM, IV
 - First line of therapy
 - Should be given parenterally during acute presentation
- Chronic therapy
 - Bronchodilator
 - Methylxanthines
 - Side effects include tachy-

- cardia, restlessness, increased gastric acid secretion, gastrointestinal upset
 - Theophylline ER 10 mg/kg PO q12h (dog), 15 mg/kg q24 in the evening (cat)
- Decreases diaphragmatic fatigue, increases mucociliary clearance, enhances efficacy of steroid treatment
- Should not be used concurrently with drugs that require cytochrome p450 metabolism (ex. clindamycin, erythromycin, enrofloxacin, cimetidine) without dose reducing by 30-40%
 - Beta-2 agonists (**recommended)
 - Inhaled albuterol can be used PRN to manage flare-ups at home
 - Thought to be less effective in dogs
- Glucocorticoid
 - Prednisone 1-2 mg/kg/day
 - Cats – prednisolone 1.0–2.0 mg/kg every 24 hours¹
 - Dogs - 0.5–1.0 mg/kg every 24 hours²
 - Prednisolone preferred over prednisone in cats as some have impaired hepatic conversion
 - Taper by 25-50% after seven days, continue gradual taper to lowest effective dose
 - Cats – prednisolone 1.0–2.0 mg/kg every 24 hours¹
 - Dogs - 0.5–1.0 mg/kg every 24 hours
- Prednisolone preferred over prednisone in cats as some have impaired hepatic conversion
- Taper by 25-50% after seven days, continue gradual taper to lowest effective dose
- Side effects of long-term systemic use include polyuria, polydipsia, polyphagia, weight gain, alopecia, diabetes, behavioral changes. Inhalation therapy with prednisone has less risk of side effects and therefore, is the recommended route of use.
- Important to establish whether the patient had recently been given nonsteroidal anti-inflammatories prior, as coadministration of glucocorticoids may precipitate adverse effects such as gastrointestinal ulceration and perforation.
- Transition to fluticasone propionate by overlapping therapy for 14 days while weaning from prednisone
- Fluticasone propionate
 - 220 mcg q12h (Inhaled) (**recommended)
 - 110 ug q12 via chamber for cats and dogs < 20lbs
 - Cats with more severe disease may require 220ug q12h
 - 220 ug q12 via chamber for dogs >20lbs
 - Delivered directly to the lungs
 - Shown to be extremely effective while minimizing systemic steroid exposure to reduce physical and behavioral side effects

- Systemic steroid therapy should be used concurrently for the first 14 days until fluticasone takes full effects
- Low dose fluticasone propionate may be safe for animals with comorbidities at risk of high-dose steroids (ex. diabetics or NSAID treatment)
- Nebulization therapy
 - Nebulizing of 0.9% NaCl will provide moisture and soothing to a pet's airways. It also has mucolytic benefits.
 - While the recommendation of breathing in steam from hot shower is good, this technically is a form of humidification and provides no true moisture benefits to lungs.
- ⇒ Additional points to consider in medical management of airway diseases
 - Patients are prone to secondary airway infections
 - Parasite preventative should be used routinely
 - Heartworm, lungworm
- ⇒ Use of inhalation therapy
 - Preferred delivery format for chronic disease management as it is effective, avoids systemic side effects, is easier to administer, and once trained, enables administration of bronchodilators at home to manage flare-ups.
- Rated by owners as easier to administer than pills.
- Use an animal specific chamber to optimize medication delivery, reduce medication waste, and improve patient acceptance
- Anti-static chamber with a fitted mask
- Metered dose inhaler fits right into back of chamber
- Use a chamber designed to hold the medication for long periods of time to allow for activating the puffer before applying the mask and 7-10 breaths through the chamber. **Note – many chambers do not keep the medication available long enough, confirm before purchase.**
- Animal specific low resistance valves can help maximize dose per breath while minimizing leakage to ensure pets with low tidal flow gets appropriate dose administered with little medication wastage
- Fitted mask provides proper seal that avoids loss of aerosolized medication to air or on patient skin, eyes – Choose those with non-stick versions that don't grab on fur/hair because it will help patient acceptance
- Apply mask to muzzle ensuring to cover nose and not the eyes
- Choose a chamber that has an inhalation indicator to indicate appropriate seal and allows breaths to be counted

- Inhalers have been shown to be very efficacious and well-tolerated by patients with just a few days of training.

There are many things clients can do at home when caring for a pet with a chronic respiratory disease:

- ◇ An adult nebulizer can be purchased from the local pharmacy or drug store which will provide moisture and soothing therapy to the airway tract. It also helps with breaking up airway mucus or debris. Nebulization is different than humidification as it produces water droplets that reach the lower airways and alveoli.
- ◇ An air purifier could be considered to eliminate as many pathogens as possible in the air that could potentially irritate the patient's airway. In addition, the cleanliness of the patient's immediate environment is important for avoiding respiratory irritation. This includes clean bedding, avoidance of new carpet cleaners, smoking, and use of incense or heavy perfumes.
- ◇ Consider use of canned food instead of dry food. Patients with respiratory disease may have a decreased ability to smell and canned food can be heated to help release the aromas.
- ◇ Remind pet parents that it is important to have patience when dealing with a debilitated respiratory patient. That includes walking, playing, eating, and also administering medications.
- ◇ Avoid supplement binges. While supplements have their place, many times clients may go a bit overboard and purchase every supplement available. This may cause more stress to the pet and should be avoided.
- ◇ Weight control is also very important for these pets' long term care, so being mindful of diet and a delicate balance of allowed activity is important.
- ◇ Modification of exercise and physical activity becomes important so as to not over exacerbate patients with compromised airways. Patients needing assistance should utilize a harness at all times rather than a collar that may put pressure on the trachea.
- ◇ Having the client record logs of respiratory rates/episodes and even record videos of abnormal episodes at home are important as it removes the insecurity and stress on the client to have to remember and accurately describe the event.
- ◇ To avoid medication fatigue, help create a medication schedule that incorporates lifestyle factors and is achievable by the owner. This includes timing of medications, formulations, and number of medications. Pet parents can use their smart phones to establish a routine and reminder system for pet care.

Owners should always monitor for any signs of respiratory distress, such as:

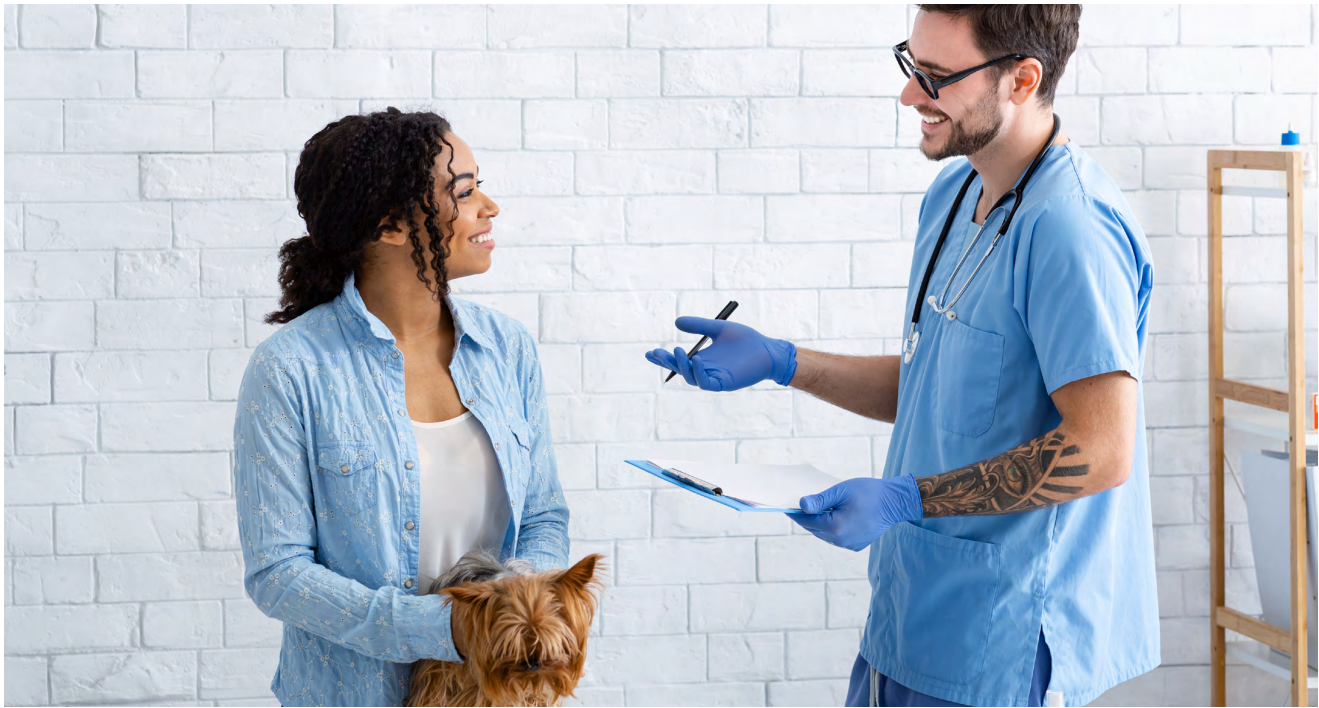
- ◇ Persistent coughing and/or wheezing
- ◇ Respiratory distress
- ◇ Squatting with the neck extended during coughing episodes
- ◇ Gagging or vomiting
- ◇ Open mouth breathing
- ◇ Labored breathing after exercise

Educating your clients

Tips and tricks

Client education is important for dealing with respiratory disease, especially with chronic conditions like inflammatory disease, which often necessitates a lifetime of medical care.





Most cases of respiratory illness are going to require some degree of supportive care and therapy at home, with a majority of cases needing long term management to ensure the patient remains comfortable and maintains a good quality of life. Thus, it is very important that the owner is properly equipped with knowledge of the disease, what to monitor for, a concise follow up plan to give the pet the best chance of having a successful transition back home and care moving forward.

Clients have preconceived expectations when seeking veterinary care based on assumptions, wishes, prior experiences, wishes and hopes. Effective management of the client's concerns and expectations is essential in the current veterinary market as clients present day are becoming more informed, more involved and are provided with many avenues to which they can seek veterinary care.

Considering the limitation in our traditional method of owner communication, we need to adapt newer methods of communication that provide the same sense of reassurance, expertise, and transparency so that owners still feel a sense of support and trust. Establishing clear targeted goals and a clear follow up plan is crucial for compliance. Having the owner set a recheck appointment prior to leaving solidifies that plan for ongoing care and follow up. If that owner leaves without scheduling a recheck, there is a higher chance that it will go unscheduled, and

that patient lost to follow up. Clear communication and honesty regarding prognosis at the beginning of treatment or updates during the course of treatment even if the pet is declining is crucial. Clients don't want to feel misguided or misinformed especially with any thought that their pet could be experiencing any form of suffering. Avoid using complicated medical terminology or jargon that is not common knowledge. Clients may not want to make it known that they do not understand something and thus do not ask questions. This can lead to poor compliance in the pet's care at home or builds distrust with the veterinarian if the pet is not doing well or experiencing an episode of a chronic disease that they did not understand would reoccur to begin with. Engage the client with simple terminology and make references to the human body or experiences that make it relatable for their comprehension.

It is important to educate and grow your nursing staff. Your technical team plays an impactful role not only on patient care but in client relations as they are the ones likely discharging patients or answering owner inquiries. Having a well-trained and knowledgeable team creates better patient care and instills confidence in the client that their pet's care is a top priority. Advancing your team allows them to better serve clients with questions and guidance. There is inevitably going to be a time when the client contacts the office, and you are unavailable; have a second go-to person that they trust.



USING AN INHALER

Inhaled medication is a great way to treat respiratory disease in dogs especially when dealing with chronic bronchitis, collapsed trachea, asthma, chronic obstructive pulmonary disease, and also severe allergies. The dose and frequency of treatment depends on the disease and medication used.

There are two main types of medications that are commonly prescribed for use in inhalers in pets: corticosteroids and bronchodilators.

Corticosteroids work to reduce inflammation and swelling of the airways, while bronchodilators relax muscles in the airways to make it easier for the pet to breathe. Inhaled corticosteroids pose a much lower risk of side effects from corticosteroids as opposed to systemic forms.

The chamber device consists of a mask and a holding chamber to help capture the dose of medication and helps a pet breathe in the medication in multiple breaths. Using treats, a pet can easily be trained to accept the use of the inhaler.

When choosing a chamber device for your patient, it is extremely important to choose one that is specifically designed for that species. That means that the mask will fit properly and the medication will not leak out.

Avoid using human devices because they will not

fit appropriately. A proper chamber device for dogs should include a fitted, non-stick mask to avoid sticking to your pet's fur, and a valve for controlling the flow of medication. Choosing the wrong device may make the experience unpleasant, which could make it difficult to administer medication long term.

The AeroDawg* and AeroCat Chambers are the only **pet specific device that includes a Flow-Vu* indicator** that moves when the pet breathes. This feature allows you to confirm the mask is properly sealed to your dog's face, helps you count breaths by monitoring the number of times the indicator moves, and ultimately confirm the medication your dog needs is being delivered.

Administering medication with an inhaler

After familiarizing your dog with the device, you can **begin administering their inhaler**. Follow these steps to give pets their aerosol medication using the AeroDawg* Chamber:

1. Remove the cap on the inhaler and shake it vigorously.
2. Insert the inhaler into the back of the chamber.
3. Gently apply the mask to the pet's face, ensuring both the nose and mouth are covered.
4. Press the inhaler to release the medication.
5. Count 7-10 breaths to ensure the entire dose of medication is inhaled and then remove the mask.

6. Wipe the pet's face with a damp cloth after treatment to remove any residue from the medication.

If you prescribe more than 1 puff of medication per dose, do not administer all puffs at once. Wait 30 seconds before the next puff.

TIPS & TRICKS

Use these tips and tricks to make treatment time more comfortable for you and your dog:

- Create a positive response by rewarding the pet with treats before and after treatment
- Wipe some wet food on the inside of the mask to encourage the pet to accept the mask on their face
- Be patient—some pets will need some time to adjust to using the mask

There are many things clients can do at home when caring for a pet with a chronic respiratory disease:

- An adult nebulizer can be purchased from the local pharmacy or drug store which will provide moisture and soothing therapy to the airway tract. It also helps with breaking up airway mucus or debris. Nebulization is different than humidification as it produces water droplets that reach the lower airways and alveoli.
- An air purifier could be considered to eliminate as many pathogens as possible in the air that could potentially irritate the patient's airway. In addition, the cleanliness of the patient's immediate environment is important for avoiding respiratory irritation. This includes clean bedding, avoidance of new carpet cleaners, smoking, and incense therapy.

- Consider use of canned food instead of dry food. Patients with respiratory disease may have a decreased ability to smell and so canned food can be heated and be more odorous.
- Patience should always be exercised when dealing with a debilitated respiratory patient. This includes when ambulating, eating, or administering medications.
- Avoid supplement binges. While supplements have their place, many times clients may go a bit overboard and purchase every supplement available. This may in fact cause more negative effects as causes more stress on the client to administer all those medications and is stress imposed on the pet.
- Weight control is going to be very important for these pets long term so being mindful of diet and a delicate balance of allowed activity is important.
- Modification of exercise and physical activity becomes important so as to not over exacerbate patients with compromised airways. Patients needing assistance should utilize a harness at all times.
- Having the client record logs of respiratory rates/episodes and even record videos of abnormal episodes at home are important as it removes the insecurity and stress on the client to have to remember and accurately describe the event.
- To avoid medication fatigue, help create a medication schedule that incorporates lifestyle factors and is achievable by the owner. This includes timing of medications, formulations, and number of medications.

For tips on how to train your clients to use inhalers in their pets, visit the links below:

Cat instruction

[CLICK HERE](#)

Dog instruction

[CLICK HERE](#)

Case studies

Case of the honking Chihuahua

Tiny is an 8-year-old spayed female Chihuahua who presents for coughing. The owner describes the cough as a loud goose honk that will occur intermittently whenever Tiny gets excited. Her episodes seem to be occurring more frequently over the past few days and take longer to resolve. The owner shows you a video captured at home during one of Tiny's episodes.

Based on your suspicion for tracheal collapse, what is the best next diagnostic step?

- A. Sedated oral examination
- B. Cervical and thoracic radiographs
- C. Fluoroscopy
- D. Ultrasound

The best choice for diagnostics at this point would be cervical and thoracic radiographs (B.) Radiographs of both the cervical region and thoracic cavity are recommended to evaluate the entire trachea. As tracheal collapse is a dynamic disease, radiographs should be taken on both inspiration and expiration for the best chances at capturing the collapse.

Remember, a cervical tracheal collapse will occur during inspiration and an intrathoracic tracheal collapse will occur during expiration.

The cervical and thoracic radiographs confirm



the presence of tracheal collapse at the level of the thoracic inlet.

What is the best treatment option to pursue at this time?

- A. Change in diet
- B. Referral for tracheal stent
- C. Cough suppressants and corticosteroids
- D. No treatment indicated

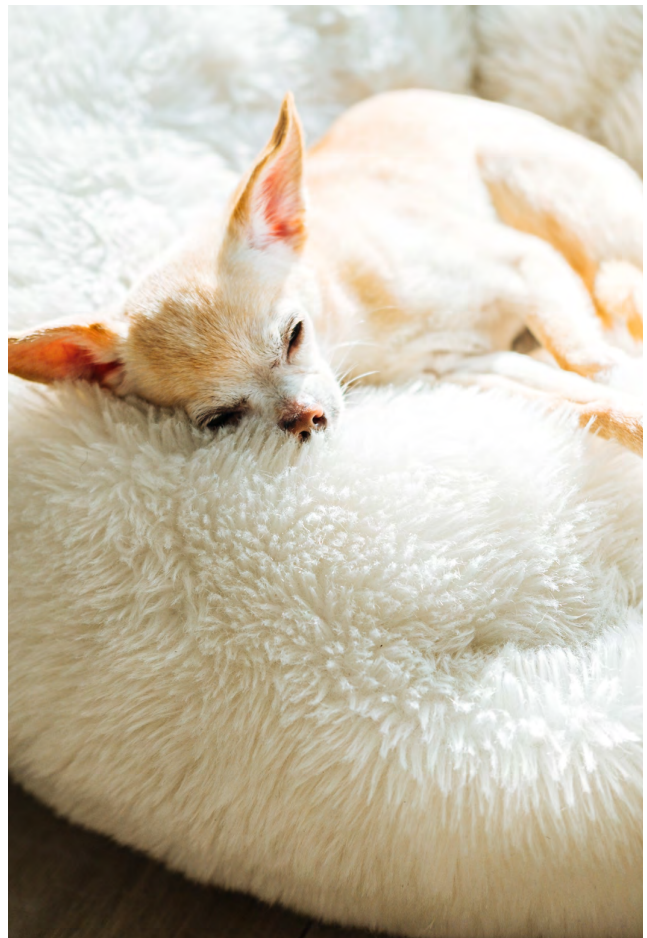
Cough suppressants and corticosteroids are a good choice for treatment at this time (C.) Often times, the degree of tracheal collapse is minimal, and episodes are self-resolving. However, being that the owner has appreciated an increase in the frequency of episodes, starting medical management is recommended which entails a combination of cough suppressants, anxiolytics, and weight management. Medical management is designed to disrupt the cycle whereby inflammation triggers coughing which promotes more inflammation. Short courses of prednisone steroids can be instituted for anti-inflammatory properties during more severe

episodes, but its use must be strategic to prevent side effects adversely affecting symptoms and quality of life. Inhaled fluticasone steroid through a chamber can be initiated earlier and maintained longer to keep inflammation down and prevent airway irritation long term because it does not cause the same systemic side effects¹. Antibiotics should be utilized whenever a secondary bacterial infection is suspected.

Tracheal stents are considered salvage procedures with which of the following complications reported?

- A. Stent fracture/migration
- B. Bacterial tracheitis
- C. Obstructive granulation tissue
- D. All of the above

The best answer for this question would be all of the above (D.) These are all complications associated with tracheal stents and medical management should be pursued to its fullest extent. Tracheal stents are by no means curative and patients will still need to be managed for a chronic cough.



The Case of the Sneezing Kitty

Henry is a 6-month-old intact male cat who was recently found as a stray. Henry was presented to the clinic with signs of sneezing, lethargy, nasal congestion, ptyalism, and a mild fever (103.5 F). He seemed to be very bright and eating well the first few days and all these signs started building about 48 hours ago. Henry is still adjusting to the new home and is still an indoor/outdoor cat. The pet owner has at least 4 other cats in the home.

What would you like to do next?

- A. Auscultate the lungs
- B. Examine the oral cavity
- C. Ask more information about the history of the cat, including vaccination status
- D. All the above

The best option would be all the above (D) for this question.

Examination reveals that Henry is about 5% dehydrated. Nasal and ocular discharge is yellow and thick with minimal air flow appreciated from both nares. Lungs sound clear however referred upper airway noise is appreciated. There are

superficial ulcers along the periphery of his tongue and the lining of the mouth.

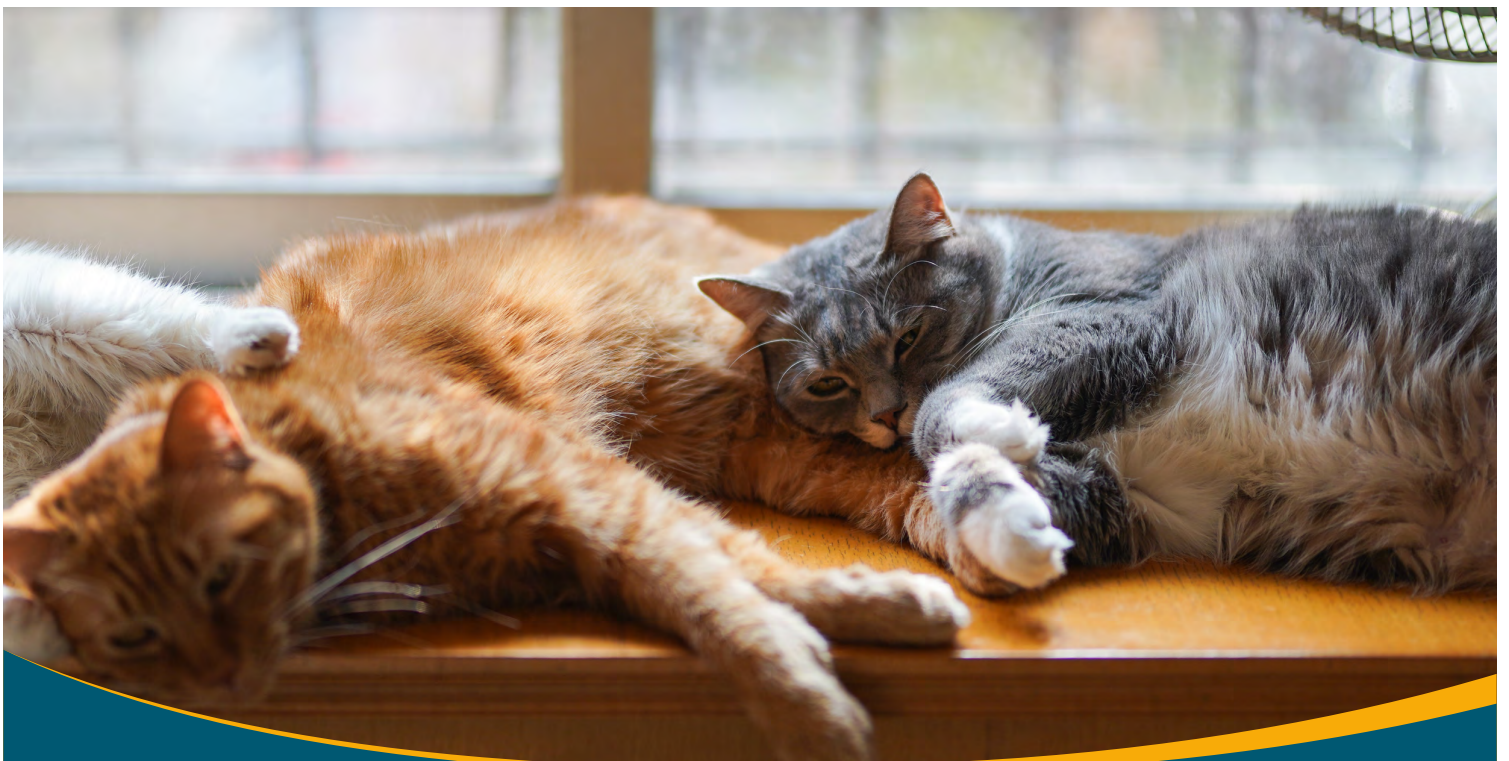
Based on your physical examination, you suspect this is a disease of the upper respiratory tract. What would you like to do next for diagnosis?

- A. Ultrasound
- B. Chest radiographs
- C. PCR testing
- D. Fecal O&P

The best testing in this case would be PCR testing (C.) The results of the PCR testing confirm calicivirus.

Treatment for calicivirus is focused on supportive care including:

- Use of nebulizer and saline nasal drops to break up the ocular and nasal discharge
- Broad-spectrum antibiotic to treat for secondary opportunistic bacterial infections.
- Analgesia for tongue ulcerations
- Nutritional support and fluid therapy as indicated.





In this case, there are multiple cats in the household and those cats are going outdoors – which means they could infect other cats in the neighborhood. These cats should be quarantined.

Cats that become carriers will continue to shed the virus in the home, even after they recover from the infection. Owners may need to re-home carrier cats before disinfecting the home to protect the remaining animals from exposure.

Vaccines are not 100% protective against calicivirus, but they can greatly reduce the severity of the infection if a cat is exposed. Several combination vaccines against FCV, feline herpesvirus type 1 and feline panleukopenia virus are available, which can be given nasally or as an injection.



Case of the Coughing Dog

A dog is presented with signs of coughing, lethargy, and a mild fever (103.5 F). The dog is a social butterfly who goes to a doggie day care daily, visits the dog park at least once a week, and also goes to the groomer once a month. The pet owner mentions that several other dogs at doggie day care have been sick lately. The dog is examined at your clinic.

What would you like to do next?

- A. Auscultate the lungs
- B. Examine the oral cavity
- C. Ask more information about the history of the dog, including vaccination status
- D. All the above

The best answer for this question would be all the above (D.) Examination reveals that the dog's lungs are congested. The respiratory issues are confined to the lower respiratory tract.

What would you like to do next for diagnosis for the causative pathogen?

- A. Ultrasound

- B. Chest radiographs
- C. PCR testing
- D. All of the above

For this case, the best testing would be a PCR test (C.) While the chest radiographs may help determine the extent of illness, a PCR test would be preferred to confirm a diagnosis. The results of the PCR testing confirm Canine Influenza H3N2.

Treatment for Canine Influenza virus is focused on supportive care. That means using nebulizers to help with breathing. Non-steroidal anti-inflammatory drugs can lower the fever and broad-spectrum antibiotics can be used to treat secondary opportunistic bacterial infections.

In this case, this dog is a risk to other dogs. This dog should be quarantined to help stop the spread of disease. Vaccines are not 100% protective against Canine Influenza, but they can greatly reduce the severity of the infection and may help decrease the spread of the disease.



Case of the Coughing Kitty

Sprinkles is a 4-year-old neutered male domestic shorthair who has been noted to be coughing for the past several days without much improvement. No prior health concerns, no current medications, no travel history, indoors only, single cat household.

Before you even put hands Sprinkles to examine him, you should already be thinking of differentials for a coughing indoor only cat.

Here are some differentials that should be considered:

- Feline Asthma
- Infectious
- Congestive heart failure
- Foreign body
- Neoplasia
- Heartworm disease

Of course, we will want more information on the cough, including if the cough is wet/dry, productive, triggered by certain activity or persistent. When we think about cats and a cough, our top considerations

are generally going towards feline asthma versus congestive heart failure. My rule of thumb is that coughing cats are inflammatory until proven otherwise.

During your initial evaluation you note that Sprinkles has mild respiratory effort in addition to being tachypneic.

Let's talk about respiratory sounds. The sound made while breathing can help locate the part of the respiratory system affected by disease.

Wheezing is a high-pitched noise that occurs during expiration. Wheezing typically is often due to narrowing, spasm, or obstruction of the smaller airways in the lungs.

Stridor is a higher-pitched noise that occurs with airway obstruction near the larynx. Determination of whether stridor occurs during inspiration, expiration, or both helps to define the location of obstruction.





Stertor implies a noise created in the nose or the back of the pharyngeal cavity. It is typically low-pitched and most closely sounds like nasal congestion. It occurs frequently in brachycephalic dogs and is also associated with laryngeal paralysis and tracheal collapse.

During which half of a breath cycle would you expect cats with lower airway disease to demonstrate the most effort?

- Inspiratory phase
- Expiratory phase

The correct answer is the expiratory phase. This phase will demonstrate the most abnormal effort with lower airway disease. Expiration is normally a passive process due to the elastic recoil of the lungs. However, with lower airway disease, there is inflammation and secretion production that clogs the airways and creates resistance that the patient needs to breathe against, hence the efforted pattern.

One of the more prevalent feline inflammatory

airway diseases include feline asthma and chronic bronchitis. While the pathophysiology of feline asthma is not completely understood, it is presumed to originate as a type I hypersensitivity reaction to aeroallergens. Inhaled allergens react with immunoglobulin E (IgE) that is bound to previously sensitized mast cells. This stimulates the degranulation of mast cells and the sudden release of inflammatory mediators (histamine, serotonin, cytokines, etc), resulting in the vascular leakage and smooth muscle spasm that occurs during an asthma attack. Allergens that are commonly implicated include dust, cigarette smoke, mildew, mold, parasitic, pollen, cat litter, and household chemicals.

Sneezing and ocular-nasal discharge may be seen. There is a wide spectrum of illness severity with some cats seeming relatively normal besides harsh lungs sounds versus some cats that are cyanotic and in respiratory distress.

Which pulmonary pattern would be most supportive of lower airway disease asthma in a radiograph?

- Diffuse nodular pattern
- Cranioventral alveolar pattern
- Diffuse interstitial pattern
- Diffuse bronchial pattern

Classic radiographic findings for feline asthma include diffuse bronchial to a bronchointerstitial pattern, hyperinflation due to air trapping, and collapse of the right middle lung lobe due to mucus plus. bronchial to It should be noted that the severity of radiographic pulmonary infiltration was not found to be associated with duration of clinical signs.

Additional diagnostics would include an airway wash for cytologic examination, culture and infectious disease testing (mycoplasma PCR). If cytologically there is an eosinophilia present than the diagnosis of feline asthma is confirmed. Chronic bronchitis would have a dominance of neutrophils.

The most important part of treatment is going to be starting corticosteroids. Besides anti-inflammatory effects they will inhibit cytokine gene expression, stabilize cell membranes, and decrease the production of inflammatory mediators. While oral or injectable steroids are often given at the beginning of treatment, metered dose inhalers and aerosol chambers have quickly become the therapy the standard of care in feline medicine for chronic care.

Aerosolized drugs have less side effects than systemic use and are delivered right to the lungs and exert local effects. The aerosol chambers are well tolerated, and pets can be trained within a few days to use them.

True or False: The use of albuterol for management of feline asthma should be that it is given routinely on a daily basis.

The answer to this question is false. Albuterol should be available but for use as a rescue drug for the bronchospasms that occur during an acute crisis episode. Albuterol dilates the airways to help in an emergency but does not address the underlying inflammation. Chronic conditions like asthma should be managed long-term with an inhaled corticosteroid, which help keep the airways clear and prevent exacerbations. Owners can administer albuterol at home to help get coughing flare-ups under control.



Summary of therapy

- Emergent:
 - Supplemental oxygen
 - Albuterol 90 µg/puff by MDI with chamber, 1 puff every 30 minutes as needed for acute control for up to 6 hr intervals
 - Terbutaline 0.01 mg/kg SQ IM IV, works within 15 minutes of injection

- Maintenance
 - Prednisolone 1-2 mg/kg/day for 10 days following acute exacerbation
 - Introduce fluticasone and overlap therapy for 2 weeks while weaning from
 - Fluticasone 110-220 mcg/puff by MDI with chamber
 - Found to not suppress HPAA
 - Due to slow absorbency, needs to be given concurrently with oral prednisolone for 10 days

- Albuterol 1-2 puffs PRN

Owners to monitor for:

- Persistent coughing and/or wheezing
- Respiratory distress
- Squatting with the neck extended during coughing episodes
- Gagging or vomiting
- Open mouth breathing
- Labored breathing after exercise

Home modifications for long term management:

- Avoid exposing pets to cigarette and/or cigar smoke.
- Change furnace filters regularly.
- Control molds, mildew, and dust.
- Do not use perfumes, hair sprays, incense, or air fresheners.
- Consider using an air filtration system, ideally a HEPA-type system.
- Use hypoallergenic household cleaning agents.
- Use shredded paper or even sand instead of cat litter, provided the cat is willing to use the litter box normally with this new litter type.

Case of the Coughing Beagle

Ella is a 10-year-old spayed female Beagle. Her owner reports that she has had a non-resolving cough that has been on and off for the past 4-6 months. The cough is described as dry and nonproductive.

Rule outs for coughing dogs

- Infectious
- Lung tumors
- Pleural effusion
- Upper airway obstruction w/ gastroesophageal reflux
- Interstitial lung disease
- Congestive heart failure

Coughing in dogs can often be mistaken with episodes of reverse sneezing and tracheal collapse. Effort should be made when distinguishing these airway episodes from each other as it can impact a therapy given in response. YouTube videos are always good auditory and visual references for owners.

You complete a thorough physical examination and on thoracic auscultation note the lungs sounded abnormal.

Which abnormal lung sounds are associated with cases of lower airway disease?

- Expiratory wheezes
- Crackles
- Harsh
- All of the above

All of the above is the correct. Patients with lower airway disease can develop any of these abnormal lung sounds depending on where they are in their disease state (chronicity, secondary insults). Evaluation for the presence of a heart murmur is important as cough can be highly associated with cardiac disease.

Canine chronic bronchitis (CCB) is a cough of more than 2 months duration without any underlying cause identified. Airway resistance is created as the airway lumen narrows due to airway thickening and mucus production.

CCB is like feline asthma in that resistance is greatest during expiration. However, it differs in that CCB does not cause bronchospasms.



“

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”

Which imaging modality is preferred for airway evaluation?

- Radiographs
- MRI
- Ultrasound
- Bronchoscopy

Bronchoscopy is the preferred imaging technique to evaluate the airways and requires moderate sedation or anesthesia. Airway sampling can be performed at that time either via a tracheal wash, blind bronchoalveolar lavage (BAL), or via use of bronchoscope to rule out underlying pneumonia or infectious causes for the cough.

After reviewing the diagnostic results, there's enough evidence to support a clinical diagnosis of CCB. Treatment is focused on reducing airway inflammation, reducing the cough, and improving stamina overall.

Treatment summary: treatment path

- Prednisone 1-2 mg/kg/d and then tapered to lowest effective dose
- Long term management is to transition to inhalers.
- Introduce fluticasone and overlap therapy for 2 weeks while weaning from prednisone over 10 days
- Fluticasone

- 110 ug q12 via chamber for dogs < 20lbs
- 220 ug q12 via chamber for dogs >20lbs

- Bronchodilators have limited evidence of efficacy in dogs
- Antibiotics with clinical suspicion of secondary infection
 - Doxycycline, Azithromycin, Fluoroquinolones
- Cough suppressants
 - Need to be given consistently for steady state to be reached

Home management:

- Eliminate any environmental factors that can cause irritation including smoking, fragrances, and incense.
- Prevent or treat obesity
- Use of a harness instead of a collar
- Behavioral modification



The Veterinary Technician's Role in Respiratory Disease Management

Alyssa Mages, CVT

What does the treatment plan look like from a medical personnel standpoint?

Veterinary technicians/nurses are fully equipped to handle any/all medication administration – with the proper training, of course – as well as client communication, appointment oversight, anesthesia induction/monitoring/recovery, diagnostic sampling prep, and general patient care. The veterinarian must oversee the case, handle any/all surgical and diagnostic procedures, prescribe medications, and relay diagnoses and prognoses to the client.

Elaborate further on what a veterinary nurse would do for patients with feline asthma

Client education – discuss the disease, including its symptomology, presentation, and management (medications and their administration), as well as discuss monitoring at home and what constitutes an emergent concern (dyspnea, cyanosis, collapse, etc.). Instruction on the use of medications, plus demonstration when/if necessary.

Medical management – when/if a patient is in hospital, ensure that their overall husbandry is addressed, pain management is in place, physiological stability is maintained (all vital parameters WNL), and medications are administered in a timely and appropriate manner.

What recommendations would you give pet parents regarding long-term care?

Observe

Know what 'normal' is for your pet and understand not only what resting respiratory rate (RR) and heart rate (HR) are, but how to obtain them.

- Respiratory Rate (RR)
 - Place your hands on the sides of the pet's chest
 - Count how many times that the chest EITHER expands or contracts in 15 seconds; do NOT count both
 - Multiply this number by 4 to get the # of breaths/minute (bpm)
 - Should be between 10-40 for dogs and 20-40 for cats
 - Anything outside those ranges, call your veterinarian
- Heart Rate (HR)
 - More accurately this is the pulse rate, but it's correlative
 - Locate a strong pulse point
 - Femoral – follow inside the pet's hind leg up into where it connects with the hip. Gently apply pressure and you should

- feel the artery ‘thump’ on your fingers
 - Pedal – on the underside of the pet’s front paw, just behind the largest pad, apply gentle pressure to feel it ‘thump’ on your finger(s)
 - Tarsal – on the top portion of the pet’s hind paw, where the paw and the shin meet (similar to our ankle). Gently apply pressure to feel the artery thump on your fingers
- Use your middle or ring fingers, NOT your thumb – it has its own pulse
- Count how many times you feel that ‘thump’ or pulse in 15 seconds
- Multiply this number by 4 to get the # of beats/minute (bpm)
- Should be:
 - 120-180 bpm for cats
 - 70-140 bpm for dogs
 - Larger dogs will have lower/slower HR’s
 - Smaller dogs will have higher/faster HR’s
 - Anything outside these ranges, contact your veterinarian

You should also be able to ID triggers of coughing, sneezing, or any other difficulties breathing, for example exercise, treats, litter, etc. It’s also important to recognize a singular event vs. trends, meaning a single episode is not as clinically significant as a series of them. Note similarities, duration, and what your pet is experiencing throughout in order to accurately relay this information to your veterinarian.

Record

Keep a journal for your pet re: their diagnosis, recurring issues, symptoms, medication schedule, etc. Note stand-alone events and/or recurring events to see if there’s a trend/pattern. Take videos and/or audio recordings of an episode of concern. Bring these or send them to your rDVM or specialist at follow-up appointments.

Intervene

It’s extremely important to know what treatments your pet is receiving, when they receive them, and

how much they’re receiving. It’s equally critical to know when to administer additional or alternative medications if your pet is in crisis.

Along those lines, be confident in administering medications to your pet. Ask for a demonstration when initially prescribed to make it easier when you’re at home and doing this on your own.

Keep in mind that tablets and capsules must be swallowed, but not all liquid medications should be. Work to master the techniques for pilling cats and other delivery methods for dogs such as pill pockets, cream cheese, etc.

No one likes to think about this, but it’s vital for us as pet owners to know what constitutes a true emergency vs. general practitioner visit vs. watch and wait. It’s recommended to take a First Aid/CPR course every 6 months to keep your knowledge and skills fresh – check with your veterinarian to see if either they offer these classes or reach out to EVT (hello@empvet.team) as we conduct them.

Readiness at home is key as well. Ensure you have an at-home pet-ER kit (extra meds/copies of Rx’s, water, food, first aid supplies, blankets, etc.) It’s always better to have these items and not need them than to not have them and wish you did.

AeroKat Chamber Use, Maintenance

The particular aerosol chamber that we will be using in this demonstration is the AeroKat. I’ll be going over the different parts, how to administer medications using the AeroKat, and how to get a cat used to having it on their face.

There are a few components to it – for one, we have the mask. You will place this on the cat’s face, so when selecting the mask size, you want to make sure that it fits over the nose and mouth but does not cover the eyes.

We have the mask adaptor to which the mask is attached, the chamber where the actual aerosolized medication will be, and the back piece that you will attach to the metered dose inhaler.

To administer the medication, you just want to shake the metered dose inhaler well, firmly insert it into the back piece, and depress the metered dose inhaler according to your veterinarian's instructions. I recommend doing this before you place the mask on the cat's face, just so you don't frighten the cat. Then, place the mask on their face - gently but firmly, to create a seal - and watch the flow indicator move 7-8 times, so you know that they have fully inhaled the medication. To get your cat adjusted to the use of the chamber, start with the whole device or the mask solely for a few seconds initially. Then reward with treats, petting, or catnip. Once the whole procedure is done, be sure to reward your cat again with a treat.

Now we're going to discuss how you're going to clean and maintain the AeroKat device. You will need to disassemble it by first taking the mask off, then remov-

ing the mask adaptor by twisting and pulling. You can then remove the back piece by pulling it straight off, gently of course.

You'll then want to soak all of the pieces in warm water with some mild dish detergent for about 15 minutes with occasional agitation.

You'll need to rinse each piece with clean water. Allow them to dry vertically, but do not rub them dry. Once dry, you may reassemble and it's ready for use.

That's everything you need to know about utilizing the AeroKat chamber. Please visit our website if you have any further questions regarding this process or any other inquiries regarding clinical skills pertaining to small animal patients.

About Alyssa Mages, CVT

Alyssa Mages is a Certified Veterinary Technician and the Chief Visionary Officer (CVO) of EVT (Empowering Veterinary Teams), where she oversees the content development, clinical skills training, and overall vision of the company. She has over 16 years of veterinary experience and has worked in numerous sectors of the industry.

Throughout her tenure, she has held multiple leadership roles including Lead Veterinary Technician, Adjunct Professor, and Education and Development Coordinator. She co-founded EVT to provide training programs, materials, and coaching/learning opportunities for veterinary practices, as well as content development and training directives for veterinary industry service providers.

About Dr. Anthony Gonzalez

New York native, Dr. Anthony Gonzalez, is a Staff Criticalist at Cornell University Veterinary Specialists in Stamford, Connecticut. He is also an Adjunct Assistant Clinical Professor of Emergency-Critical Care at Cornell University College of Veterinary Medicine

Dr. Gonzalez is a graduate of Cornell University and received his Doctor of Veterinary Medicine degree from Tuskegee University. Following an internship, he completed a residency in Emergency & Critical Care at the University of Pennsylvania. Dr. Gonzalez worked in a busy specialty-emergency hospital in Los Angeles

before joining CUVS in 2018. He is board-certified by the American College of Veterinary Emergency and Critical Care.

Dr. Gonzalez has expertise in both emergency care and in managing critical patients. His special clinical interests are focused on pulmonary medicine and trauma. He believes strongly in practicing the highest level of medicine, going above and beyond for his patients. His warm approachability and authentic connections with his patients' families ensures that these families are engaged in the care of their pets every step of the way.



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Flow-Vu*
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CONTINUING EDUCATION INFORMATION

This program 0-868475 is approved by the AAVSB RACE to offer a total of 1.0 CE Credits, with a maximum of 1.0 CE Credits being available to any individual veterinarian or veterinary technician/technologist.

This RACE approval is for the subject matter categories of medical using the delivery method of any time. This approval is valid in jurisdictions which recognize AAVSB RACE; however, participants are responsible for ascertaining each board's CE

requirements. This program is also approved in the State of New York and CPD for 1.0 CE Credits.

The American Association of Veterinary State Boards RACE committee has reviewed and approved the program referenced above as meeting the Standards adopted by the AAVSB.

[TAKE QUIZ](#)

