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Respiratory Medicine

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Diagnostic Tests For Respiratory Disease

INTRODUCTION

Diagnostic tests are obviously required to confirm the presence of many respiratory diseases in small animals. However, respiratory medicine is an underdeveloped subspecialty in veterinary medicine, and there are relatively few sophisticated tests that are available to the clinician that actually diagnose specific pulmonary disorders. Instead, most of the commonly available tests are best used to point us in the right direction, and to rule out the presence of other potentially confounding disorders. So for example, when an older patient has a new-onset cough, an abnormal chest radiograph can point us toward a diagnosis of pulmonary malignancy, heart failure, while a normal chest radiograph may suggest a diagnosis of a non-serious nature.

This manuscript will review the diagnostic tests that are available to evaluate small animals with signs of respiratory disease, including the advantages, disadvantages and current controversies regarding many of these tests used to evaluate pets with signs of pulmonary impairment.

HISTORY

Accurate history taking is probably the single most important diagnostic test the clinician can perform in veterinary pulmonology.

Age, Breed and Sex

The signalment frequently yields important clues regarding the patient's condition. For example, sneezing and nasal discharge in a kitten suggests a viral etiology, while the identical signs in an aged cat suggest a more malignant process. Pulmonary neoplastic processes tend to occur in older animals, while mediastinal masses and nasopharyngeal polyps are commonly diagnosed in both young and middle aged cats. Particular breeds tend to have increased rates of certain respiratory disease, including asthma in Siamese breed felines.

Present Environment and Geographic Origin

I always ask clients if there are smokers in the house, if they have recently cleaned their fireplace, if they have changed carpeting or if their house has undergone significant renovation in the last 6 months. I also ask every owner about recent travel history to determine if their pet is at increased risk for "geographically specific" diseases such as mycotic infection, heartworm or aelurostrongylus infestation.

Previous Medical History

You will never go wrong by asking clients if their pet has been vaccinated, if vaccinations began when they were youngsters, if they have suffered prior physical trauma, or if they have been previously treated for cancer. Additionally, I always ask the client what specific medications they are currently giving their pet. This is different from asking if they are giving their pet medication, because this subtle change in the form of the question may reminds the owner of a pet's present medical problem that they might otherwise have forgotten.

Present Complaint

Sick animals often hide, or shrink away from frequent contact with the owner. The feline species is of course famous for disappearing for long stretches of time, especially if the cat is an "outdoor" pet. Clients often believe that their pet has "suddenly" stopped eating or playing when the disorder causing these signs has developed over a much longer period of time. This is an important consideration when evaluating a complaint related to the respiratory system. For example, sneezing and nasal discharge may be obvious to most clients, whereas increased inspiratory efforts and nasal flaring due to a slowly developing pleural effusion may be invisible to the owner. So, if we ask our clients "how long has fluffy been ill?" they may tell us "He just started coughing" and we may miss important information. Instead, if we ask clients "when the last time fluffy was was normal?" they may reply "He really hasn't seemed the same for about a month, but I was out of town a lot and I haven't really seen him that much until this weekend."

Additionally, it is important to determine 1) the duration of signs, 2) whether clinical signs are static or evolving, 3) if the patient has ever exhibited the presenting signs before, 4) if treatment was initiated in the past, and 5) the success or failure of such treatment.

PHYSICAL EXAMINATION

The physical state of the patient and the good judgment of the veterinarian will determine how thorough and for how long we perform a physical exam. Experienced clinicians know that the cat with open-mouthed breathing is not a candidate for a leisurely, prolonged physical examination. However, a sneezing but otherwise seemingly healthy animal should have a comprehensive examination during which all organ systems are thoroughly evaluated.

The most important part of the physical examination of the respiratory system is inspection, to determine whether the respiratory difficulty can be identified primarily during inspiration or during expiration. If this isn't obvious during the exam, more subtle clues in evaluating abnormal breathing patterns include inspection of the nares for "flaring", or abduction of the legs to increase the size of the thoracic cage. Even in situations in which the animal is in obvious respiratory distress, I rely upon the finding of inspiratory vs. expiratory difficulty to guide emergency interventions. Specifically, animals with noisy breathing during inspiration (stridor) or inspiratory difficulty most commonly have either upper airway obstruction or disease within the pleural space, including effusion, pneumothorax or mediastinal mass. Animals with labored breathing during expiration most commonly suffer from chronic bronchitis or asthma. Therefore, if a dog or cat has an increase in inspiratory respiratory effort without stridor, you can make a presumptive diagnosis of pleural space disease, followed by thoracocentesis. Similarly, a cat with an expiratory wheeze probably has bronchial obstruction, and should be treated for presumed bronchospasm even before the underlying cause is determined. It is important to emphasize that these quick assessments are often important in the initial phase of emergency care. However, they are not a substitute for more thorough evaluations that can occur after emergency interventions have been initiated.

Animals with panting or open mouthed breathing are not so easily classified, and may suffer from congestive heart failure, pneumonia, pulmonary embolism or neoplasia, although clearly, patients may present in distress in the later stage of any respiratory disorder. The veterinarian should also keep in mind that other, non-pulmonary causes of abnormal ventilatory patterns are common and

may mimic signs of respiratory disease.

Palpation of the thorax is an additional important component of the physical examination. The feline thoracic cage is usually very compliant, and resistance to compression suggests the presence of a space-occupying lesion such as mediastinal mass or diaphragmatic hernia with displacement of abdominal contents into the chest cavity. Additionally, the maximal cardiac beat (point of maximal impulse, PMI) is normally felt at the border of the left elbow, if you feel it more caudally there may be left ventricular enlargement. If the PMI is on the right side, there may be a mediastinal shift due to atelectasis. Chest palpation is also the first chance to detect cardiac arrhythmias. Both inspection and palpation of the nasal planum and frontal bones may reveal asymmetry or enlargement, suggestive of bony distortion from neoplasia or mycotic infection.

Thoracic percussion

In the authors' experience, percussion is not a helpful tool in the physical examination of most small animals, primarily because the chest is so small compared to human beings and large animals (cows, horses).

Auscultation is a classic method of examining the patient with signs of respiratory disease. The terms crackle and wheeze have replaced the older terms rale and rhonchi to describe these adventitious sounds. I don't rely upon information gained by chest auscultation to make diagnoses of respiratory disease in small animals. Physicians always ask their human patients to breathe deeply with an open mouth, and this increases the quality and quantity of respiratory sounds. We can't do that successfully with our patients, and the amount of air moving in and out of a resting animal is often not enough to produce audible sounds of diagnostic significance. Occasionally, by using the tip of one finger to occlude a nostril for four or five breaths, when you release the obstruction the pet will take a big breath in (and out) and this may augment breath sounds that were previously inaudible. When adventitious sounds are appreciated, there is usually significant respiratory pathology that can be recognized by other methods including inspection and palpation. In summary, thoracic auscultation is a valuable diagnostic tool to confirm the presence of respiratory pathology. It is not as important a diagnostic tool as it is in human medicine, and the absence of abnormal respiratory sounds does not imply absence of respiratory disease.

Evaluation of the Nasopharynx and Larynx

Signs of nasopharyngeal and laryngeal disease include coughing, gagging, choking, sneezing, snorting, epistaxis, nasal discharge, stridor, "voice" change and facial deformity. Diagnostic techniques which are frequently used alone, or in conjunction with other tests to determine the cause(s) of these signs include, nasopharyngeal culture, cytology, biopsy, and direct visualization.

Culture

Culture of the nasal cavity is rarely indicated for chronic sneeze, epistaxis, and/or nasal discharge. Small animals have a wide range of normal intranasal commensal bacterial flora, most notably Staph, Strep, E coli, Pasteurella and Bordetella. Therefore, bacterial culture of the nares is an unreliable tool in diagnosing the etiology of rhinitis.

Cytology

Cytological evaluation of cells within the nasal cavity may be indicated when there is a history of chronic sneeze, nasal discharge or epistaxis, the same indications that may be present for nasal culture. Neutrophils and other inflammatory cells may predominate in disorders caused by many different etiologies including foreign body, trauma, neoplasia, and infection. In general, the interpretation and cytological evaluation of material obtained by nasal swab is most likely to result in a reliable diagnosis if fungal organisms or malignant cells are recovered.

Nasal biopsy

Indications for nasal biopsy include gross facial deformity, or radiographic evidence of destruction or deviation of the intranasal structures, or loss of trabecular detail. The author strongly suggests visualized and guided biopsy during rhinoscopy. To perform this technique, a 3 mm rhinoscope is used to visualize the suspected area of disease, and a flexible biopsy instrument is passed through the biopsy port of the endoscope. The biopsy cup can be visualized in the nasal cavity and multiple tissue samples can be obtained.

Naso / pharyngo / laryngoscopy

Nasopharyngoscopy should be considered to evaluate signs of gagging, chronic sneezing, epistaxis, nasal discharge unresponsive to standard therapy, nasofacial deformity, change in meow or purr or bark and noisy breathing. Direct visualization of the lumen of the nares may be accomplished using an otoscope cone (distal aspect only) or rigid fiberoptic scope (1.7-3.3 mm outer diameter), and as described above for nasal biopsy. Small animals with the symptom of gagging or forced swallowing may have a pharyngeal polyp, or less commonly a foreign body such as a blade of grass dorsal to the soft palate. A non-traumatic forceps or hooked dental instrument can be used to retract the soft palate, and a dental mirror is placed within the posterior pharynx to visualize the area dorsal to the soft palate. However, a flexible fiberoptic scope retroflexed 1800 is the most appropriate instrument to visualize this area.

Small animals with stridor or voice change should have laryngoscopy performed to determine if laryngeal dysfunction, including laryngeal neoplasia is present. To perform laryngoscopy, the animal should be lightly anesthetized. A laryngoscope blade or tongue depressor can be used to depress the epiglottis, and a pen light can be used to visualize the area. A diagnosis of laryngeal paresis or paralysis is reasonable if either or both laryngeal folds fail to abduct during normal breathing. It is important not to depress the epiglottis too forcefully, or tilt the head up at an acute angle, because normal laryngeal architecture can be artificially altered, resulting in an inappropriate diagnosis of laryngeal disease. When in doubt, it is appropriate to use Dopram, 1mg/kg i.v. to induce increased rate and depth of respiration. In this way you may avoid the confounding issue of anesthesia-induced respiratory depression that might reduce the normal movement of the vocal folds and associated cartilage.

Evaluation of the Tracheobronchial Tree

Signs of tracheobronchial disease include cough, gag, inspiratory (extrathoracic trachea) or expiratory (intrathoracic airway) dyspnea, and exercise intolerance. The following diagnostic tests may be performed alone or in combination to determine the cause of these signs:

Culture

General Comments: Most small animals with chronic signs of cough, gag or expiratory difficulty that are otherwise systemically well do not have clinically significant respiratory infections. Nevertheless, bacteria may be found in material obtained from the tracheobronchial tree of these patients. This apparent paradox is easily explained, the tracheobronchial tree is not routinely sterile.

As in almost all situations in clinical medicine, the culture results obtained from any of the methods described below should be interpreted in light of the patient's clinical history, physical signs, and other diagnostic test results.

Trans tracheal wash (TTW) is a time honored method of obtaining uncontaminated material from the airway for culture (to bypass the oropharyngeal flora). This technique was first described for use in conscious human patients, and is a suitable technique for medium to large sized dogs. Better methods than TTW exist for retrieval of airway material for culture (see below) and the author does not advocate the TTW technique in cats. If alternative methods are not feasible, TTW can be safely

performed in small animals by placing a long dwelling 23 g catheter through the crycothyroid membrane to the level of the thoracic inlet, followed by injection of 0.5 cc/kg body weight of non-bacteriostatic saline (previously warmed to 37oC). Placement of the animals head and thorax in a dependent position makes it easier to retrieve the instilled fluid. Alternatively, a sterile endotracheal tube may be passed and used as the conduit for the flush solution.

Use of the guarded microbiology brush (Microvasive, Milford Mass) is an alternative to the TTW that is a reliable method of retrieving airway material for culture. The brush is designed to be passed through the biopsy port (2 mm diameter) of a previously positioned adult (5.0 mm outer diameter) bronchoscope. If a bronchoscope is not available the brush may be passed through a sterile endotracheal tube that has been previously placed in the anesthetized patient. The distance from the mouth to the thoracic inlet should be measured. The brush can then be passed this distance, or until any resistance is felt. The inside brush can then be extruded, gently massaged within the airways, and resheathed. Finally, the brush can be withdrawn from the bronchoscope and processed by cutting off the end of the brush into a sterile red top tube, with 0.25-0.5 ml non-bacteriostatic sterile water to prevent the brush from drying out.

Secretions obtained using this brush may be cultured routinely or in a quantitative fashion. Quantitative bacterial cultures have been used to distinguish colonization from infection in human beings with pneumonia. In these cases, bacterial growth at a concentration of less than 104 CFU/ml is believed to represent non pathologic colonization and antibiotic therapy is not recommended. Healthy small animals may harbor an aerobic bacterial population within their main stem bronchi at a concentration of as high as 103 CFU/ml.

Cytology

General Comments: Cytological evaluation of respiratory secretions obtained from small animals with signs of tracheobronchial disease is most helpful to confirm suspected infectious organisms and exfoliated neoplastic cells. Cytology is less helpful to diagnose the cause of non-infectious inflammation of the lower airway. This is because the macrophage and the eosinophil are cells that might reflect inflammation in other body fluids, but is a normal inhabitant of the feline lower airway. Additionally, total cell counts are not routinely determined from airway fluids.

In general, large numbers of neutrophils (more than occasional) supports the finding of chronic bronchitis in small animals, while overwhelming populations of eosinophils (>75 %) are consistent with the diagnosis of asthma.

Trans Tracheal Wash - The TTW technique has significant limitations. For example, the volume recovered from TTW is widely variable. When small volumes are recovered, cells that adhere to mucus are generally studied in greatest detail. Importantly, these cells may or may not reflect the general nature of airway inflammation; the interpretation of the significance of these cells should be made with great caution. This is of sufficient concern that, in the author's opinion, interpretation of cells recovered using the technique of TTW should be limited to the diagnosis of infectious or neoplastic disease. Even in clinical situations when infectious or neoplastic disease is suspected, there are better ways to obtain tracheobronchial secretions for cytological evaluation (see below).

Bronchoalveolar Lavage

General Comments: As previously mentioned, a major limitation in the cytological interpretation of tracheobronchial secretions is the lack of uniformity in the collection, processing and reporting of the samples. Unlike analysis of other body fluids such as whole blood, urine, spinal or joint fluid, total and differential cell counts from tracheobronchial washings are not routinely determined. This is due to, in part, the various methods used to collect and analyze the samples and the lack of uniform results that are obtained. The technique of bronchoalveolar lavage (BAL) was developed to better standardize the collection, analysis and reporting of bronchial and alveolar lining cells and secretions.

To insure the maximal return of fluid, BAL should be performed through a FB "wedged" into a segmental or sub segmental branch of a lung lobe. Using this technique, relatively large volumes of fluid (2 cc/kg of body weight) can be repeatedly instilled and recovered with confidence. If a bronchoscope is not available, a modified BAL may be performed by attaching a syringe adapter to the end of an endotracheal tube and instilling saline (5 cc/kg body weight). Total cell counts in excess of 1000/ l recovered from BAL fluid obtained using either technique may be of value in distinguishing clinically healthy small animals with large numbers of eosinophils within their airway washings from small animals with alveolitis, asthma or heartworm infestation.
To prevent the development of hypoxemia during BAL, pre and post administration of 100% oxygen for a minimum of 10 minutes is necessary. Because of the potential loss of large volumes of fluid within the lung only persons experienced in this technique should perform BAL in small animals.

Tracheobronchoscopy

Tracheobronchoscopy is indicated for animals with chronic cough or gag unresponsive to standard therapy, and for small animals with radiographic evidence of lung infiltrates or consolidation without clinical signs of pneumonia. This technique is also valuable to visualize masses within the trachea and main stem bronchi and to assess the structural integrity of the tracheobronchial tree. Additionally, abnormal mucus secretion, collapsing airways and mucosal appearance can be seen.
Tracheobronchoscopy can be performed with either a rigid or a flexible fiberoptic bronchoscope (FB). The rigid bronchoscope is usually less costly to purchase than a FB and requires little formal training to use. Additionally, the rigid scope is easily passed through an endotracheal tube adapter (Bodai Swivel "Y", Sontek Medical, Dallas TX.) so that gas anesthesia and oxygen may be administered during the procedure. In general, rigid scopes deliver a better visual image than FB's, although the image seen through a FB is certainly adequate for any diagnostic study. In practice, FB's are much more clinically useful. The adult sized FB (5 mm outer diameter) has a 2.0 mm channel that is wide enough to allow passage of biopsy, retrieval and culture instruments. It is very important to recognize that these FB's occlude > 50% of the airway of small animals, these studies should be performed only by persons very familiar with their use. Pediatric sized FB (3.5 mm outer diameter) can be passed through a 4.5 FR endotracheal tube and cause less airway obstruction. Because these FB are smaller the operator can visualize smaller airway branches. The disadvantage of the pediatric FB is the smaller biopsy channel (1.3 mm) which permits only lavage.

Malignancies of the larynx, trachea and bronchi are uncommon but recognized conditions in small animals. Laryngeal masses may be visualized directly using techniques previously recommended to assess laryngeal function. Masses within the lumen of the tracheobronchial tree can be visualized using a rigid or flexible bronchoscope. If abnormal growth is suspected and visualized, biopsy is indicated. This may be easily accomplished using a standard biopsy instrument passed through the biopsy channel of the flexible FB.

PULMONARY FUNCTION TESTS

General Comments: Pulmonary function testing is commonly performed in persons to obtain objective measurements of the amount of respiratory disability present, to recognize the presence of early disease, and to monitor response to therapy. In general, pulmonary function tests require sophisticated equipment and patient cooperation. Clearly this is a limiting factor when attempting to apply these techniques to veterinary patients. Nevertheless, a number of tests to determine pulmonary function in dogs and small animals are now available.

Arterial Blood Gas Analysis

Perhaps the most straightforward and accessible pulmonary function test in veterinary pulmonary medicine is measurement of arterial blood gas (ABG). This examination generally requires 0.3 ml or less of arterial blood. Arterial samples are most practically obtained in a sedated cat, using a 1 cc syringe and 25 g needle to pierce the femoral artery. Arterial blood samples are obtained differently from venous samples, in that the vessel is felt rather than directly seen, and because the needle may

be intentionally passed through both sides of the arterial wall and then slowly withdrawn until the needle is within the lumen of the artery. After a blood sample is obtained the needle is retracted. The puncture site should have pressure maintained for 5-10 minutes following arterial puncture.

Arterial blood gas analysis is valuable in determining the extent of respiratory impairment in most veterinary patients. For example, hypoxemia is the most common finding in small animals with chronic respiratory disease, and the practitioner can assume a direct correlation between changes in the partial pressure of oxygen and the clinical status of the. This parameter should also be evaluated over time to determine the efficacy of therapy. Additionally, ABG analysis will often yield clues regarding the etiology of the disease process. For example, hypoventilation is always characterized by an increase in arterial CO2. Therefore, measurement of ABG's can confirm or exclude hypoventilation as the cause of respiratory difficulty during anesthesia. Additionally, estimates of the metabolic component of the acid base status may be important in cases of diabetes mellitus, renal insufficiency or shock. Without arterial blood to evaluate, the practitioner should consider that the CO2 content of venous blood, which is commonly reported on routine biochemistry "panels", is predictably within one unit of the amount of bicarbonate within arterial blood.

Resistance, Compliance, Airway Reactivity

Spirometric tests of pulmonary function generally relate measurements of lung volume, airflow and airway pressure to better understand the elastic properties of the lung (compliance) and any forces which might tend to inhibit airflow into and out of the lung (resistance).

In general, lung resistance tends to increase in cases of central airway narrowing from bronchoconstriction, edema, and intraluminal mucus (asthma, foreign body etc.). Compliance measurements tend to decrease in diseases that cause decreased caliber of smaller airways, and with lung parenchymal "stiffening"(fibrosis, pneumonia). Thus, small animals with asthma may have increased lung resistance that resolves with bronchodilator therapy, while dogs with interstitial disorders may have normal lung resistance and decreased compliance values.

Tests of airway reactivity are performed in human medicine most commonly to assist in diagnosis of bronchial asthma, although patients with other bronchopulmonary disorders including chronic bronchitis may have increased airway reactivity. Patients are required to maximally inhale and then exhale forcefully. Air volume during the first second of exhalation is measured before and after inhalation of increasing concentrations of nebulized methacholine. Normal individuals generally lose about 20% of expiratory volume within the first second of forced expiration (FEV1) after inhaling an 8% solution of methacholine. In contrast, patients with asthma may have significant decreases in FEV1 after inhalation of very low concentrations of methacholine (<1%).

Historically, to perform these tests in dogs and small animals we needed to anesthetize the animal, and we needed equipment and personnel most commonly found in University settings. However, within the last few years a new technology has been developed that allows us to measure bronchoconstriction (at rest and in response to nebulize methacholine) in awake, unrestrained small animals. The "Buxco Box" is a clear Plexiglas chamber about the size of a home fish tank that is instrumented to measure relative lung resistance in small animals on a breath-by-breath basis. Methacholine can be nebulized into the box to measure airway reactivity. Important uses of this test may be to distinguish small animals with chronic bronchitis from small animals with asthma, and to better assess the patient's response to, and need for, anti-inflammatory and/or bronchodilator therapy.

CONCLUSIONS

Diseases of the small animal respiratory system present a unique diagnosis challenge to the veterinary practitioner. First, veterinary pulmonary medicine is not a subspecialty in veterinary medicine, and there are very few veterinarians who are academically trained in this discipline. Second, the size of cats and small dogs presents a barrier to most invasive procedures. Third, there is a

relative absence of pulmonary function tests that are available in private practice. Nevertheless, new diagnostic techniques are rapidly being developed to evaluate small animals with signs of respiratory disease. Clinicians should not be discouraged, but instead should use the available diagnostic tests as all tests should be used, with knowledge of their advantages, disadvantages and limitations.

Quick Tests for Pleural Fluid Analysis

Is it a transudate or an exudate?

- Transudates contain 200 IU/L of the enzyme lactic dehydrogenase (LDH).
- Send the pleural fluid out for LDH
- If it is a transudate it is almost always from heart failure in cats.
- Otherwise, it is an exudate, see all the other causes below

Is it an infection?

1. pH- if it is around 7.2-7.5 that pretty much rules out bacterial infection (pyothorax).
2. pH lower than 7.0 is usually only caused by bacterial infection.
3. check the pH with a urine dipstick to find out.

Is it malignancy?

1. check the pH, should be normal (around serum pH)
2. check glucose- if it is much lower than serum (< 60) it is either infection or malignancy
3. so, if pH was normal (not infection) and glucose low, there is a high probability of cancer
4. normal glucose doesn't rule of cancer
5. In the absence of trauma, an additional indicator of pleural effusion associated with malignancy is a red blood cell count > 50,000/ul.

Does it look milky?

1. check for chyle by measuring pleural fluid triglyceride and cholesterol. Measure same thing in serum. Chyle has more triglyceride than serum and less cholesterol than serum

Are we worried about FIP?

1. If the serum protein is high check the serum protein by electrophoresis. Usually the highest fraction is the alpha-2 globulin.

Diagnosis and Therapy of Canine Bronchitis

INTRODUCTION

Chronic bronchitis (CB) is an inflammatory airway disease that, in association with tracheobronchial collapse, is probably the most common chronic canine airway disorder. Although the cause(s) of most cases of CB in dogs is unclear, the result is chronic airway inflammation, chronic cough and excessive mucus production. Because dogs do not expectorate, excessive mucus may be difficult to recognize. Therefore, the diagnosis of CB is usually based on chronic cough alone. Importantly, because the diagnosis of CB is based on clinical criteria (cough), the diagnosis should not be made until you rule out other causes of chronic cough such as heart failure, heartworm infestation, pneumonia, lung tumor etc. The purposes of this article are to 1) summarize the main clinical features of canine CB, 2) highlight the most important tests used to confirm the diagnosis of canine CB, and 3) emphasize practical treatment principles and specific treatment strategies.

CLINICAL FINDINGS IN DOGS WITH CHRONIC BRONCHITIS

No one really knows the typical age, breed(s) and sex of dogs with CB. Most of the available information regarding dogs with CB has been based upon relatively few, isolated case reports and one retrospective post mortem evaluation of 24 dogs with histories compatible with CB. In 1990 we reviewed the clinical presentation, pathophysiology, and efficacy of treatment for 18 dogs with confirmed CB. This information, case reports, anecdotal reports from practitioners across the country, and my experience form the basis for the following:

Signalment

Dogs diagnosed with CB are generally 8 years of age. There does not seem to be a clear sex or breed predilection although lots of small and toy breeds such as Poodles and Pomeranians have been clinically diagnosed with CB. I think that many of these dogs cough because of extrathoracic tracheal collapse which is not associated with CB.

History

By definition, dogs with CB have a chronic cough. The quality of this cough is generally deeper and "throatier" than the high pitched "honking" cough caused by extrathoracic tracheal collapse, and yet harsher than the "soft moist" cough caused by pneumonia. If you ask the question carefully you will find that the cough terminates in gagging or retching,this means the dog is bringing up and swallowing mucus.

Some dogs with CB may be otherwise absolutely normal while others will be severely exercise limited by their disease. Although easily fatigued, these animals are otherwise bright, alert and in all other respects systemically well. The clinical signs of depression, lethargy, anorexia etc. are not consistent with the diagnosis of CB. If they are present you should think about another diagnosis, or an additional medical problem.

Physical Examination

Inspection is usually unremarkable. You might be able to detect a prolonged expiratory phase accompanied by an increased expiratory effort. Palpation of the chest wall is unremarkable. Although deep palpation of the trachea will often cause the dog to cough, this finding is common to most dogs with cough from any cause and is not by itself a marker for CB. Chest percussion is not really helpful to me. Thoracic auscultation may be normal or reveal diffuse crackles in all lung fields. If you hold off one nostril (of the dog) for 10-15 seconds the dog will inhale deeply when the nostril is released. Auscultation at this time may reveal previously occult crackles especially at the lung bases. Conversely, crackles may disappear for a few breaths immediately following a cough, and this would not be an appropriate time to determine whether abnormal lung sounds are present.

Diagnostic Tests

Because the diagnosis of CB is based on a history of chronic cough, it is only necessary to perform those diagnostic tests which are required to rule of the presence of other disorders which cause cough. Still, some test results are very helpful to make you comfortable with the diagnosis of CB.

Thoracic Radiographs

Thoracic radiographs of dogs with CB may appear normal. More commonly however, thoracic radiographs reveal the presence of "doughnuts" and/or "tram lines" which are prominent and thickened bronchial walls seen on end or in parallel, respectively.

Bronchopulmonary Cytology

Neutrophils are usually the predominant cell recovered from specimens taken by tracheal wash; these cells do not independently indicate current or past infection. Intracellular bacteria and/or a toxic appearance of neutrophils would of course suggest the presence of bacterial infection. Mucus is generally abundant even when a relatively small volume of fluid is recovered. Lesser numbers of lymphocytes, eosinophils, and epithelial cells are recovered in most samples.

Eosinophils may be recovered from tracheobronchial secretions of dogs with flea allergy dermatitis and an otherwise normal respiratory tract. But in general, dogs with large numbers of eosinophils in airway secretions are frequently symptomatic on a seasonal basis only (suggesting an environmental source of the offending antigen and cause for the subsequent cough), and 2) these cases also seem to respond most dramatically to anti inflammatory therapy (see Glucocorticoid Therapy below).

Tracheobronchial Culture

The airways and lungs of dogs, cats, horses and humans are frequently inhabited by a broad range of inhaled bacterial flora. In most cases, bacteria recovered from the airways of bronchitic dogs reflects innocuous colonization rather than infection.

Bronchoscopy

The airways of dogs with CB are universally erythematous and usually have a roughened or granular appearance. The mucosa is often thickened, irregular and edematous. Excessive and viscid mucus may be seen to span the lumen of an airway or gather together as a mucus plug, which can occlude smaller airways. Collapse of the dorsal tracheal membrane into the lumen of the airway is common in dogs with CB. In my experience, dogs with intrathoracic airway collapse respond only marginally to therapy and in general have a less fortunate prognosis than dogs whose intrathoracic airways are unaffected by passive expiration.

Biopsy and Histopathology

Chronic bronchitis is a clinical diagnosis and does not require tissue biopsy for confirmation.

THERAPEUTIC OPTIONS

The primary treatment of CB is based entirely on controlling airway inflammation. The goal of therapy is to decrease the inflammation upon which all clinical signs result. The guiding principle of any therapy must always be "if in doubt, do no harm".

Corticosteroids

Glucocorticoids (GC) have been used to treat humans with bronchial disease for over 50 years. They are clearly the single most effective means of ameliorating the symptoms of CB in people. Even though GC have no primary antitussive activity, by decreasing inflammation they may decrease stimulation of airway sensory nerves which are responsible for initiating cough in canine CB. Additionally, GC markedly decrease the volume of mucus produced by bronchitic airways. In my experience GC are the most effective drugs available to treat dogs with CB, and should be considered the mainstay of chronic therapy.

I treats new cases of CB with prednisone 1mg/kg PO, q 12h for 7 days, followed by 0.5mg/kg PO, q 12h for 7 additional days. At this point the clinical signs will have greatly improved for the vast majority of dogs with CB. The owner should continue to give the drug on an alternating day basis, while the dose is gradually decreased over the ensuing two months to the least amount of drug needed to adequately, if not completely control clinical signs. A maintenance dose of prednisone of 0.1-0.25 mg/kg PO q 12h, every other or every third day is ideal. Additionally, after and additional 2-4 months an attempt can be made to gradually stop the drug entirely. Commonly, signs may not worsen for months afterward, at which time prednisone may be reinstituted using the schedule described above.

If the side effects of steroid therapy are significant, I use the inhaled steroid Flovent, Although only 10-20% of inhaled steroids reach the small airways, they are rapidly absorbed into the lung and therefore bioavailability is assumed to be high. Additionally, direct absorption into the lung greatly diminishes the side effects of systemically administered corticosteroids. Please see the article on feline asthma for details of administration.

Bronchodilators

The rational use of bronchodilators to treat dogs with CB is based on 2 assumptions; 1) some degree of bronchoconstriction exists, and 2) this bronchoconstriction causes clinical signs. I rarely use bronchodilators for dogs. In my experience the exclusive use of some combination of oral and inhaled steroids predictably controls 75-90% of the initial clinical signs. This is a realistic treatment outcome.

Antibiotics

There is no objective evidence that bacterial infection plays a significant role in the majority of cases of canine CB. Similarly, there is no objective evidence that antibiotic therapy has any effect on the duration or intensity of signs displayed by the dog with CB. I don't routinely perform tracheobronchial wash or prescribe antibiotics for dogs with newly diagnosed CB. This is because, in my experience, dogs with newly diagnosed CB have a more favorable response to corticosteroids than to antibiotics, and because these dogs do not have a better therapeutic response when antibiotics are given concurrently with corticosteroids. Additionally, I have never recognized the development of bacterial pneumonia in dogs with CB who were given corticosteroids and not antibiotics.

Cough Suppressants

Chronic inflammatory disorders of the lower airway often result in the production of excessive viscid mucoid secretions. Coughing serves to clear these secretions, and thus may be viewed as a protective physiologic reflex. However, there are many cases in which the cough is dry and non productive. In these situations the cough is not protective, and serves to further irritate the airway, leading to a vicious cycle of cough-irritation-cough. In addition, some dogs with chronic cough are unable to sleep, and may awake their owners at night. Occasionally, some dogs with chronic cough may become syncopal. In each of these clinical settings cough suppression may be indicated. I use hydrocodone bitartrate, 0.22 mg/kg PO q 6-12h as needed. This is a starting dose and often needs to be increased by 50-100% increments to achieve the desired clinical effect. Although in theory any morphine-like drug can induce respiratory depression, in practice the most common side effects of over

administration of hydrocodone in dogs is drowsiness and constipation. Given at night, the side effect of drowsiness may be a welcome advantage to both the dog and the owner.

PROGNOSIS AND CONCLUSIONS

Canine CB is a common, progressive and chronic airway disorder. Clinical signs can be controlled but the underlying disease cannot be cured. There is great value in establishing excellent client communications so that client expectations are realistic.

Feline Asthma

INTRODUCTION

Asthma in human beings is a chronic inflammatory disease within the lower airways (bronchi and bronchioles) that causes cough, wheeze and exercise intolerance. These clinical signs are the result of a decrease in airflow through airways that are narrowed from excessive mucus secrection, airway wall edema and bronchoconstriction. "Feline asthma" is a remarkably similar condition that has been recognized in the veterinary literature since at least 1911, when Dr Hill described cats with increased airway mucus, airway inflammation and the clinical signs of labored breathing and wheezing.

Diagnosis

There are no clinical signs or laboratory tests available in routine veterinary clinical practice that are pathognomonic for asthma in cats. The tests we can perform are most valuable to exclude other common causes of acute dyspnea, wheeze and cough including heart failure, pneumonia, pulmonary malignancy, respiratory parasitism and inhaled foreign body. Fortunately, none of these diseases routinely causes clinical signs of asthma in an otherwise healthy cat. Therefore, we can usually make the correct diagnosis of feline asthma if we examine only a few clinical signs and radiographic findings, including:

1. A history of a sudden onset of labored breathing that is quickly relieved (usually) with some combination of oxygen, bronchodilators and steroids.
2. In some cases however, the only clinical problem is chronic cough, or unrelieved dyspnea.
3. The most important radiographic finding is bronchial wall thickening and air trapping. These changes are usually described as "doughnuts" and "tramlines."
4. When airway cytology is available, cats with asthma usually have evidence of airway inflammation including large numbers of eosinophils recovered from tracheobronchial secretions. This is not specific for asthma however, as many healthy cats also have large numbers of eosinophils within their respiratory tract.

PATHOPHYSIOLOGY

Although there are many potential causes of asthma, the airways respond to inhaled irritants or immunologic stimuli in a limited number of ways:

1. Airway epithelium may thicken (hypertrophy), evolve to a different structure (metaplastic change), or simply become damaged (erode or ulcerate).
2. The structures responsible for producing mucus (goblet cells and submucosal glands) may enlarge and produce excessive amounts of a particularly thick form of mucus.
3. Bronchial smooth muscle will often spasm and may become hypertrophied.

These changes are associated with cellular infiltration of the bronchial mucosa and submucosa, and this tissue may also become edematous.

The resulting clinical signs of cough, wheeze, difficulty breathing and decreased exercise capacity are due to airway narrowing (and airflow reduction) from excessive mucus secretions, airway edema, airway narrowing from cellular infiltrates, and airway smooth muscle constriction. Cough may also result from stimulation of cough-mechanoreceptors located in airway epithelium that is inflamed and contracted. This is an important concept, because the effects of even a small degree of airway narrowing to produce clinical signs can be dramatic. For example, a 50% reduction in the diameter of an airway results in a 16-fold reduction in the amount of air that flows through that airway. It is easy to imagine why any movement that requires an increase in the depth of breathing, such as chasing a mouse, will be tremendously altered if there is a 16-fold decrease in the amount of air that comes into the lungs during normal respiration. The important take-home message is that small changes in

airway size result in dramatic changes in airflow through that airway. The clinical implications of this finding are twofold. First, relatively small amounts of mucus, bronchoconstriction etc can partially occlude airways and cause a dramatic fall in airflow. On the other hand, therapy that results in relatively small increases in airway size may cause a dramatic improvement in clinical signs.

How Should We Treat Cats With Asthma?

Treatment of feline asthma if symptoms are intermittent (do not occur daily):

In these cases I prescribe an albuterol inhaler with instructions to use "as needed". The assumption in these cases is that cats with symptoms that do not occur daily do not have significant chronic inflammation that requires daily anti-inflammatory therapy. When acute signs do occur (cough, wheeze, difficulty breathing) they can usually be effectively and quickly treated with the inhaled bronchodilator. If signs become more frequent the cat should be re-evaluated to determine if more aggressive treatment should be initiated (see next step).

Treatment of feline asthma if symptoms occur daily:

High Dose, Long Term Corticosteroids.

The most consistent, most reliable, and most effective treatment for feline asthma is high dose, long term oral corticosteroids. I begin treatment of asthmatic cats with prednisone, 1-2 mg/kg PO BID for 10-14 days. At this point the majority of newly diagnosed cats with asthma will feel and act much better. ONCE A BENEFICIAL RESPONSE TO ORAL PREDNISONE HAS BEEN DOCUMENTED (usually within 3-5 days) I BEGIN INHALED STEROIDS AS I WEAN THE PATIENT FROM ORAL PREDNISONE

Inhaled Medications

Corticosteroids and bronchodilators can now be given effectively by inhalation to cats with asthma. Both classes of drugs are available as metered dose inhalers (MDI's) for humans with asthma. Proper use of an MDI requires the patient to coordinate inhaling with the actuation of the device, and this has proven to be surprising difficult for most patients. This is also not realistic for infants and young children. An alternative was developed to allow these individuals to use the MDI's without the need to coordinate their breathing. Thus, the MDI is used in conjunction with a "spacer" designed specifically for cats. The spacer is a plastic chamber the size of a cardboard inner role of toilet paper. The MDI fits into one end of the spacer; the other end of the spacer has an attachment for the facemask. The end of the spacer that connects with the facemask has an inner rubber gasket that acts as a one-way valve so that the medication within the spacer can only leave the spacer during an inhalation.

The client first attaches the MDI and the facemask to the spacer, and then actuates (presses) the MDI twice to fill the spacer with medication. The client then places the facemask gently over the cats mouth and nose. The cat is allowed to breath in and out 7-10 times with the mask in place, and the treatment is completed.

THE "SPACER"

Company: Breatheazy Ltd (www.Breatheazy.co.uk)

Why Use a Spacer?

It acts as a temporary storage area for the medication to sit in until the animal breathes in.

How to Use:

1. One end of the spacer is made to fit the metered dose drug device (MDI, the inhaler). The other end has the mask
2. The mask covers the kittie's nose (they are obligate nose breathers)
3. The instructions with the spacer explain how to clean.

FLUTICASONE PROPRIONATE (FLOVENT)

The inhaled steroid I use is fluticasone. It comes in three doses (44, 110 and 220 mcg per actuation). I use the 110 dose. This drug has virtually no side effects! Reported problems in people included growth retardation and oral candidiasis, but this has not occurred to my knowledge in more than 100 cats treated with flovent over the past 4 years. It has the clinical effect of oral prednisone 1mg/kg bid

There are a few potential problems/limitations. First, the drug takes about 10 days to reach full effect. Second, the owner may not be aware when the canister is empty.

How to Use:

1. Rx the 110 mcg dose as one puffs into spacer BID
2. Cat should breath through mask and spacer for 7-10 second - make sure the patient is not holding its breath!
3. If the animal is currently symptomatic and can tolerate short-term prednisone begin 1mg/kg bid oral pred for 5 days concurrent with flovent, then D/C the pred.
4. Demonstrate how to use the mask/spacer/drug in front of the owner, with their pet.
5. Have them demonstrate the same technique to you, in the office, with their pet, by themselves
6. This is a one-person job.
7. The canister holds enough drug for two months if one puff twice daily is followed.

Albuterol (Proventil or Ventolin)

The bronchodilator I use is albuterol. It only comes in one dose. I use this drug because it is more rapidly acting than the oral or sq or i.m. form of terbutaline. It is also more effective than the theophylline compounds (theodur). It may be used daily or as needed for asthmatic cat already on daily steroids - if there is increased cough, wheeze or increased respiratory rate and effort at rest. I usually prescribe this drug as needed for cats with intermittent signs of asthma (not daily signs). Potential side effects include musculoskeletal twitchiness, excitability, insomnia, and anorexia. THESE SIDE EFFECTS IN CATS ARE VERY UNCOMMON! In fact, this drug is very safe. It has been reported that profound overdose (cat chews canister) can cause problems with potassium regulation-

I have never seen this.

How to Use:

1. Rx the drug as the generic (albuterol MDI) - two puffs into spacer BID
2. Cat should breathe the drug through the mask and spacer for 7-10 seconds.
3. Positive clinical effect should be seen within 5-10 minutes.

4. Can be used every ½ hr for 2-4 hrs as needed in crisis

Summary of use of inhaled medications

Inhaled steroids and bronchodilators are the standard of care to treat humans with asthma. Over the past 4 years we have treated more than 100 steroid-dependent asthmatic cats with twice-daily flovent, and proventil on an as needed basis. Approximately 80% of these patients no longer use oral prednisone. The methods described above are effective, practical and very safe, and avoid the complications associated with chronic oral steroid use.

Antibiotics

There is no objective evidence that bacterial infection plays a significant role in the cause or continuation of feline asthma. Similarly, there is no objective evidence that antibiotic therapy has any effect on the duration or intensity of signs displayed by the cat with asthma. It is important to remember that the clinical signs of asthma frequently wax and wane in severity as well as in frequency of occurrence. Anecdotal reports describing the therapeutic effect of antibiotics in controlling asthmatic symptoms are consistent with the "waxing and waning" nature of the symptoms in non-treated cases.

A positive culture result obtained from a tracheobronchial wash does not necessarily imply the presence of a clinically significant airway infection, and should not automatically prompt the clinician to initiate antibiotic therapy. In general, antibiotics are rarely indicated for cats with asthma, and are appropriate only when there is good evidence of superimposed airway infection. A true infection may be inferred from the growth of a pure bacterial culture on a primary culture plate, from material obtained from tracheobronchial secretions. This is because the concentration of aerobic bacteria recovered from the airways of healthy cats rarely exceeds 5 x 103 organisms/ml. In contrast, growth of a single organism recovered without the use of enrichment broth implies >105 organisms/ml, and this is consistent with an "infected" airway (in humans). Antibiotic therapy is then based upon sensitivity data. Prophylactic or long term therapy should also be avoided unless there is documentation of a chronic airway infection. Documented chronic airway infection is extraordinarily uncommon in feline asthma.
There is a possible exception to the statements made above. Mycoplasma species have been isolated from the airway of as many as 25% of cats with signs of lower airway disease. In contrast, Mycoplasma is not cultured from the airway of healthy cats. For this reason, and because Mycoplasma has the potential to cause significant structural damage to airway epithelium, it may be prudent to treat any cat with a Mycoplasma positive airway culture with an appropriate antibiotic.

Anti-leukotriene (or receptor) inhibitors

There has been a great deal of recent interest in drugs that block production of leukotrienes (LTC4,D4) or ligation of these molecules to their receptor(s). In general, these drugs have limited but significant effectiveness in treating moderate to severe asthma in humans. These drugs have not been studied in cats. We have found that LTE4, the metabolic product of LTC4 and LTD4 metabolism, is found in increased amounts in urine of cats with asthma, but not normal cats or cats with non-asthmatic disorders such as kidney failure or pancreatitis. This suggests that leukotrienes are produced in increased amount in cats with asthma. However, direct instillation of LTC4 into the airways of normal cats has no adverse effect on feline airway structure or function. It is likely that increased leukotriene production, like prostaglandin production, is a clinically non-significant by-product of the general inflammation in asthma. There are no current data that suggest that anti-leukotriene drugs will have an important role in the treatment of cats with asthma.

SUMMARY AND CONCLUSIONS

Human asthma is not a curable disease, although spontaneous resolution is common in adult asthmatics who developed asthma in childhood. This may or may not be true of cats with asthma. Some cats may be only mildly symptomatic and others may suffer life threatening illness. An important new development in our understanding of this disease is the occurrence of airway inflammation even when patients are symptom free. It is therefore imperative that we direct our therapeutic attention towards the underlying chronic inflammation in addition to the acute clinical signs of cough, wheeze and increased respiratory effort. Client education is also critical so that our clients develop realistic expectations of the effectiveness of these treatments for their pets.
