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## Diagnosis and management of canine chronic bronchitis: A review

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### Abstract

Canine chronic bronchitis is an inflammatory chronic pulmonary disease that results in cough and can lead to exercise intolerance and respiratory distress. Clinical signs vary from mild to severe, with the most severe cases resulting in respiratory failure. The goals of this article are to (1) review an overall approach to diagnosis and management of chronic bronchitis, (2) review pathophysiology associated with chronic bronchitis and (3) highlight clinical presentation of canine chronic bronchitis.

**Keywords:** Chronic bronchitis, dog, persistent cough, diagnosis, treatment, management

### Introduction

Chronic bronchitis (CB) is an important disease in the dog and it has many of the clinical and pathological features of the condition in man although it has only recently been defined in clinical descriptive terms similar to those developed for the human disease [1]. CB is an inflammatory airway disease characterized by the presence of a persistent cough for greater than 2 months in the past year in the absence of other active disease [2]. In the early 1970s, Chakrin and Saunders [3] stated that spontaneous CB rarely occurred in dogs. But today, it is considered to be one of the most common chronic respiratory diseases of dogs. So, it is important for the veterinarian to be able to recognize and treat this disorder. Unfortunately, CB has not yet been well studied in the dog and the causes have been poorly documented. Only recently have studies provided some understanding of its pathogenesis.

CB is a frustrating disease because the inciting cause is rarely ever determined; because the pathologic changes that accompany and define the disease are typically nonreversible and often slowly progress to more life-threatening disorders; and finally, because there is still little direct scientific evidence for the treatment recommendations that have been offered for the management of this disease in dogs. This clinical review will discuss the current state of our knowledge of canine CB, with emphasis on etiology, clinical manifestations, pathophysiological changes, diagnostic approach and medical management.

### Etiology

The etiology of CB in the dog is unknown; however, it is likely that chronic mucosal irritation or immunologic stimulation is responsible for airway inflammation and clinical signs of disease [4]. Smoking remains the major cause of CB in people, and exposure to air pollution or particulate matter may play a role in the canine disease [2]. In addition, some dogs may suffer from chronic aspiration of small-volumes of gastrointestinal content sufficient to trigger airway inflammation [5].

### Pathophysiology

Experimentally, CB can be induced in dogs following exposure to various inhaled irritants, including sulfur dioxide and cigarette smoke. These animals demonstrated similar clinical findings (spontaneous coughing, crackles on auscultation, excess mucus) and pathologic changes (squamous metaplasia of the tracheobronchial epithelium, an increase in goblet cell numbers, glandular hypertrophy, mucosal inflammation and polypoid mucosal proliferations) as were described in the series of spontaneously occurring CB in dogs by Wheeldon *et al.* [6].

Airway inflammation is accompanied by cellular infiltrates, mucosal edema, glandular hypertrophy, goblet cell hyperplasia and loss of ciliated epithelial cells [7]. All of these contribute to airway narrowing or obstruction, changes in lung mechanics (increased lung

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resistance and decreased compliance), altered ventilation-perfusion ratios, and eventually clinical hypoxemia [4]. In severe cases, this chronic inflammatory process may eventually progress to irreversible structural changes in the airways, which further interfere with gas exchange and secretion clearance. Retained secretions obstruct airways and may also predispose to future infections and pneumonia.

### Clinical presentation

CB occurs most often in middle-aged or older, small-breed dogs and there is no sex predisposition [4]. Breeds commonly affected include; Terriers, Poodles, and Cocker Spaniels. Obese animals are common and may present with more severe signs of respiratory distress [5]. The hallmark of CB in dogs is persistent chronic coughing. The cough is dry to moderately productive depending on the amount of mucus in the airways. Owners frequently complain of post-tussive retching or gagging as secretions are brought up the trachea and cleared through the larynx [1]. Exercise intolerance, tachypnea, cyanosis and syncope may be seen in severe cases [7]. Systemic signs (fever, anorexia and depression) are uncommon unless secondary problems (pneumonia) develop. Physical examination typically reveals a bright, alert and responsive animal. If untreated, an increased tracheal sensitivity is almost always present, and the resulting cough is a dry or harsh-sounding cough. A cough often is induced by palpation of the trachea; this is useful to better characterize the cough and to exclude other conditions that could be mistaken for cough, such as reverse sneezing [8]. Lung auscultation may reveal increased adventitious sounds including broncho-vesicular sounds, crackles, and wheezing [5]. End-expiratory clicks caused by main stem bronchial or intrathoracic tracheal collapse may be heard in animals with advanced disease.

Many small-breed dogs routinely develop lesions of valvular endocardiosis as they age and may present with an auscultable murmur. McKiernan [4] discussed about the history of coughing and the presence of such a murmur, however, do not automatically equal congestive heart failure (CHF). The clinician is frequently faced with the problem of trying to differentiate between CB and CHF. The failing heart responds in part by increasing heart rate to maintain cardiac output; typically, dogs present in CHF with heart rates well above 150 to 180 beats per minute. Dogs with CB, on the other hand, typically present with a resting heart rate in the normal to slightly slower than normal range for the breed. Obtaining a resting heart rate is a simple method of assisting in making this differentiation. Some dogs have syncope associated with cough, or the so-called cough-drop syndrome, which is most likely associated with high vagal tone [8]. A second consideration for dogs with syncope is the presence of pulmonary hypertension, which can occur secondary to chronic tracheobronchial disease.

Obese animals have a tendency toward more airway obstruction and respiratory distress, because closing volume (the lung volume where airways close during expiration) is reached more readily in these animals and compliance (the "stretch ability" of the lungs) decreases with morbid obesity [4]. Improvement in lung function and clinical signs can be achieved in obese dogs with CB with weight loss alone and in those animals it is an important part of the author's client education.

### Diagnostic evaluation

Although a cause is not determined in most cases, a complete

diagnostic evaluation is important in finding those cases that do have a specific cause and predicting the severity and future progression of the airway disease for the owner. CB is usually suspected on the basis of a typical signalment, clinical history and physical examination. Diagnostic testing is then used to rule out other identifiable respiratory disorders and definitively diagnose CB. Therefore, CB is diagnosed on the basis of not only clinical signs but also the elimination of other diseases from the list of differential diagnoses (Box 1).

### Complete Blood Count (CBC)

The CBC is usually normal in CB. The finding of a neutrophilia or eosinophilia in a coughing dog should suggest diagnoses other than bronchitis.

### Chest Radiography

The radiographic examination of the thorax may contribute to the diagnosis of CB, although not all cases demonstrate radiographic changes [9]. Radiographic abnormalities that are found in dogs with CB include the following [9, 10]:

- Increased bronchial-wall thickness, particularly when seen end-on (bronchial cuffing or "donut shadows").
- Augmented number and increased diameter of donut shadows in the peri-hilar and middle lung zones.
- Increased number of tubular shadows or parallel lines (tram line shadows) that extend farther into the periphery than normal.
- Increased interstitial background density (dirty lung).
- Diminished visualization of the vascular markings-that is, sometimes the vascular markings appear "smudged" (increased visualization of third order vascular markings accompanied by bronchial cuff are the sign of circulatory disorders).

### Culture and Cytology

Culture and cytology of airway fluid samples are critical in the evaluation of canine CB. There are two major methods of obtaining airway secretions: performing a transtracheal wash (TTW) or obtaining a bronchoalveolar lavage (BAL) during bronchoscopy. TTW or BAL fluid should be collected at the time of the initial presentation and after a persistent exacerbation of signs. Quantitative aerobic culture of bronchoalveolar lavage fluid yielding large numbers of bacteria and detect intracellular bacteria on cytology. Neutrophilic or mixed inflammation and increased amounts of mucus are usually present [10]. The finding of degenerative neutrophils indicates the possibility of a bacterial infection. Although not a specific finding, airway eosinophilia is suggestive of a hypersensitivity reaction, as can occur with allergy, parasitism, or heartworm disease.

### Bronchoscopy

Bronchoscopy is extremely useful in the diagnosis of CB, particularly in cases that lack typical radiographic findings. Bronchoscopy not only provides a selective means of collecting airway fluid for cytology and culture but also allows for the visual assessment of the entire length of the respiratory tract. Changes encountered during bronchoscopy may involve structural abnormalities of the upper airways (larynx, trachea) or lower airways (trachea, lobar, and segmental bronchi) and some conditions outside the airways themselves (hilar lymphadenopathy, left atrial enlargement and bronchial compression). Gross abnormalities visualized by bronchoscopy include an increased amount of mucus,

roughened mucosa, and hyperemia [10]. Functional abnormalities, such as tracheobronchial malacia or collapse and bronchiectasis, may also be detected [4].

#### Ancillary tests

- An electrocardiogram often shows an exaggerated sinus arrhythmia and may give an indication of right atrial enlargement ( $P > 0.4$  mV) or infrequently of right-sided cardiomegaly (S-waves in leads I, II, III, aVF).
- Pulse oximetry is useful as a screening test for detection of hypoxemia. If the  $SpO_2$  is less than 95%, an arterial blood gas should be performed.
- Arterial blood gas analysis may exhibit mild to moderate hypoxemia.

#### Box 1 - Common differential diagnosis of Canine CB

- Bacterial pneumonia - *Escherichia coli*, *Klebsiella*, *Pasteurella*, *Pseudomonas* spp., *Streptococcus* and *Staphylococcus* are commonly associated with pneumonia in dogs.
- Canine infectious respiratory disease complex- *Bordetella bronchiseptica*, canine influenza, *Mycoplasma*, etc.
- Canine heart failure.
- Fungal pneumonia - Histoplasmosis, blastomycosis and coccidioidomycosis.
- Interstitial lung disease.
- Parasitic pneumonia - *Aelurostrongylus* spp., *Capillaria aerophila*, *Crenosoma vulpis*, *Filaroides hirthei* and *Paragonimus kellicotti*. *Oslerus osleri* can result in coughing, but is found in the trachea rather than the lower airways. *Dirofilaria immitis* (heartworm disease) also results in cough.
- Pleural effusion.
- Protozoal infection - *Neospora caninum* and *Toxoplasma gondii*.
- Pulmonary neoplasia.
- Tracheal collapse.
- Upper airway dysfunction (laryngeal paralysis).

#### Treatment

If, after diagnostic testing, a clinical impression remains that a dog has CB, it is important to initiate therapy. Treatment goals for dogs with CB include reducing inflammation, limiting cough, and improving exercise stamina. Treatment also ideally prevents or slows disease progression and the associated airway remodeling.

#### General

Environmental stressors, such as cigarette smoke, dust, pollutants, heat, and low humidity should be avoided whenever possible [8]. Obesity should be aggressively treated through appropriate dietary control, because it markedly worsens cough and lung function and limits activity [5]. A harness should be used in place of a collar and episodes of excessive barking should be curtailed with appropriate behavior modification. Some patients may benefit from intermittent airway humidification via steam inhalation or nebulization. Owners should be instructed to couple the chest after nebulization or encourage gentle exercise to facilitate clearance of secretions [7].

#### Anti-Inflammatory Drugs

Airway inflammation is the cause of clinical signs of CB.

Glucocorticoids are the mainstay of treatment of canine CB because they reduce inflammation, which reduces cough [10]. Glucocorticoids are administered orally or via inhalation. Prednisone is the most commonly used glucocorticoid and is dosed at 1 to 2 mg/kg/day initially and then tapered to the lowest effective dose that controls clinical signs [10]. For example, in a 10-kg dog with severe CB might be started on 10 mg of prednisone twice daily for 7 days or until cough is improved by 85% to 90%. Failure of the cough to improve should prompt consideration of an alternative diagnosis. After improvement, the dose could be decrease by 25% every 2 to 3 weeks until ideally the lowest possible dose is reached. Alternate-day therapy is preferred to allow normalization of the hypothalamic-pituitary axis and to limit clinical signs associated with use of exogenous glucocorticoids.

Inhaled glucocorticoids have been used widely in people and are used with growing frequency in dogs with canine CB. Bexfield *et al.* [11] reported that the most of the dogs are easily trained to tolerate a face mask. One study demonstrated benefits of therapy with fluticasone (125 mg twice daily). Inhaled steroids are delivered via a spacer chamber and face mask designed especially for dogs. Of clinical relevance, inhaled glucocorticoids are currently more expensive than oral glucocorticoids, although the systemic steroid-sparing effect can be worthwhile in improving quality of life. Examples of recommended anti-inflammatory drugs are given in Table 1.

#### Bronchodilators

Bronchodilators may be helpful in reducing clinical signs in dogs with bronchitis that do not show complete response to glucocorticoids. Bronchoconstriction is likely not a component of CB in the dog; however, bronchodilator therapy may provide a multitude of beneficial effects such as reducing airway inflammation, reducing work of breathing, and stimulating mucociliary clearance.

Theophylline has been reported to have nonspecific effects that could be of benefit in canine CB, such as decreasing diaphragmatic fatigue and increasing mucociliary clearance [12]. Extended-release theophylline administered at 10 mg/kg orally twice a day potentially improves expiratory airflow as well as enhances the efficacy of steroid treatment [10].  $\beta_2$ -Agonists, such as terbutaline, are thought less effective in dogs and can cause anxiety and restlessness [10]. Examples of recommended bronchodilators are given in Table 1.

#### Antitussives

Cough suppressants are helpful in canine CB for improving the quality of life for dogs as well as for families [13]. Additionally, ongoing cough promotes inflammation, which results in more cough. Therapy can be instituted when a clinician is reasonably comfortable that inflammation is acceptably controlled. Over-the-counter cough suppressants are rarely effective in dogs, and narcotic cough suppressants are most effective, with hydrocodone the most widely used. Examples of recommended antitussive are given in Table 1.

#### Antibiotics

Antibiotics are warranted in dogs with an acute exacerbation of CB and a reasonable suspicion of infection or in dogs with evidence of infection (neutrophils and bacteria) on tracheal wash cytology [5]. Pending bacterial culture results, doxycycline (or less preferably minocycline) is a good choice for dogs with CB, as is azithromycin, because these drugs

have anti-inflammatory properties as well as antimicrobial effects. Fluoroquinolones also have good respiratory penetration and could be useful in CB, although overuse of this class of drug leads to increased bacterial resistance [4].

Concurrent administration of fluoroquinolones with theophylline can result in theophylline toxicity [14]. Examples of recommended antibiotics are given in Table 1.

**Table 1:** Alphabetical listing of recommended drugs for the treatment of canine CB

Drug	Dose	Comments
<b>Antibiotics</b> <ul style="list-style-type: none"> <li>○ Amoxicillin/ clavulanic</li> <li>○ Cephalexin</li> <li>○ Doxycycline</li> <li>○ Fluoroquinolones</li> </ul>	10-20 mg/kg PO BID-TID 22 mg/kg PO TID 2.5 to 5 mg/kg PO BID various, full dose given SID	With efficiency against <i>Bordetella</i> and <i>Mycoplasma</i> .
<b>Anti-inflammatory (Corticosteroids)</b> <ul style="list-style-type: none"> <li>○ Prednisone or Prednisolone</li> <li>○ Dexamethasone</li> </ul>	0.5 to 1 mg/kg PO SID-BID for 1-3 days, then taper to alternate-day dosing of approximately 0.25 mg/kg 0.2-1 mg/kg IV IM	Rule out infectious causes before administration.
<b>Antitussives</b> <ul style="list-style-type: none"> <li>○ Hydrocodone</li> <li>○ Butorphanol</li> </ul>	0.5-1.0 mg/kg PO BID-QID 0.5 to 1.0 mg/kg PO BID-QID	Used as needed; antitussive are most important in dogs with non-productive cough or collapsing airways.
<b>Bronchodilators</b> <ul style="list-style-type: none"> <li>○ <b>β<sub>2</sub> agonists</b></li> <li>-Albuterol</li> <li>-Terbutaline</li> <li>○ <b>Sustained-release theophylline</b></li> </ul>	0.02 to 0.04 mg/kg PO BID (increase slowly) 1.25 to 5 mg/dog PO BID 25 mg/kg PO BID	Long-term use is not recommended. Side effects include muscle tremors.

### Prognosis

Canine CB cannot be completely cured. The prognosis for the control of signs and a satisfactory quality of life in animals is good if the owners are conscientious about performing the medical management aspects of care, are willing to adjust treatment over time, and treat secondary problems as they occur.

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