PEER REVIEWED

CANINE CHRONIC BRONCHITIS

A Review & Update

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Cough is a common clinical sign in dogs. There are many possible causes; identification and therapy of the specific cause is more likely to result in an amelioration of clinical signs than nonspecific supportive care. Common causes of cough include:

- **CANINE INFECTIOUS RESPIRATORY DISEASE** (CIRD) is a complex that is caused by several respiratory organisms, such as *Bordetella bronchiseptica* infection and canine influenza.
- **CHRONIC BRONCHITIS** is the most common cause of chronic cough, but is largely a diagnosis of exclusion.
- **CONGESTIVE HEART FAILURE** should not cause cough, although dogs with heart failure often have a dry cough. This has classically been associated with marked left atrial enlargement, which causes compression of the mainstem bronchi; however, a recent study has suggested this may not be the case.[1]
- **INTERSTITIAL LUNG DISEASES** often cause tachypnea and exercise intolerance; however, some cough may be present as well.
- **LUNG TUMORS** are often bronchial adenocarcinomas that grow around bronchi. As tumors grow, they can cause compression, inflammation, and necrosis, which results in mucus and debris draining into and accumulating in the airway lumen; the end result is cough.
- **OTHER INFECTIOUS CAUSES:**
  - **Bacteria**, such as *Escherichia coli*, *Klebsiella*, *Pasturella*, *Pseudomonas* species, *Streptococcus*, and *Staphylococcus*, are commonly associated with pneumonia in dogs, frequently leading to cough.
  - **Fungal pneumonia** and its resultant cough can occur secondary to blastomycosis, histoplasmosis, and coccidiomycosis infections. Histoplasmosis, in particular, may result in enlarged hilar lymph nodes, possibly causing airway compression.
  - **Parasitic pneumonia** can result from *Aelurostrongylus* species, *Capillaria aerophila*, *Crenosoma vulpis*, *Filaroides hirthi*, and *Paragonimus kellicotti*, leading to cough.
    - *Oslerus osleri* can result in coughing, but is found in the trachea rather than lower airways.
    - *Dirofilaria immitis* (heartworm disease) also results in cough.

  - » **Protozoal infections** with *Neospora caninum* and *Toxoplasma gondii* can occasionally result in pneumonia and subsequent cough.
- **PLEURAL EFFUSION** is a less common cause of cough, but is thought to cause cough by irritation of the pleural surfaces and compression of the lung parenchyma and airways.[2]
- **TRACHEAL COLLAPSE** is commonly associated with cough, but should be considered an extension of chronic bronchitis rather than a specific entity localized only to the trachea. Medical management of tracheal collapse often includes treatment of lower airway collapse with mechanisms similar to those employed for chronic bronchitis.
- **UPPER AIRWAY DYSFUNCTION** (eg, laryngeal paralysis) may cause cough due to intermittent aspiration of food and liquids. In geriatric dogs, laryngeal paralysis may be associated with pharyngeal dysfunction, leading to additional cough and sputtering of food. In a recent report, gastroesophageal reflux in a St. Bernard was associated with laryngeal dysfunction, although this association has not been widely appreciated.[3]

INTRODUCTION: CANINE CHRONIC BRONCHITIS

Canine chronic bronchitis (CCB) is defined as cough that is present most days for a minimum duration of 2 months, without evidence of other underlying diseases that may cause cough.

- CCB results in chronic inflammatory changes in the lower airways, including neutrophilic inflammation and increased mucus production.[4-6]
- This inflammatory response perpetuates the coughing cycle, and may contribute to progressive decline in lung function and, potentially, lower airway collapse.

This article will review diagnosis of chronic bronchitis and discuss treatment options for controlling clinical disease and preventing progression.

CLINICAL APPROACH

Signalment

Signalment is very helpful in establishing a suspicion of chronic bronchitis as it is most common in older, small-breed dogs. Cocker spaniels have an increased risk of bronchiectasis, which commonly occurs with chronic bronchitis. Bronchiectasis is permanent dilation of bronchi that results from chronic inflammation and destruction of the structural integrity of bronchial walls.[7]

Dilated cardiomyopathy may present acutely with cough and tachypnea in Doberman pinschers; heart failure should be suspected until proven otherwise. In general, CCB is less common in large-breed dogs; careful consideration of alterative diagnoses, such as laryngeal paralysis with intermittent aspiration or pulmonary masses, should be considered in these dogs.

History

Pertinent historical considerations include:

- Exposure (even limited) to other dogs/puppies with CIRD syndrome
- Evidence of systemic disease, such as weight loss or exercise intolerance.

Other considerations include:

- Exposure to passive (second-hand) smoke[8]
- Presence of excessive environmental odors/perfumes.

Prior prescriptions or home remedies and their effect on the cough should be explored.

Physical Examination

Most dogs with CCB are systemically well, with persistent productive cough as the major complaint. A physical examination should focus on the cardiopulmonary system, as well as any signs of systemic disease, including:

- Recent weight loss or gain
- Loss of appetite
- Weakness or lethargy.

Causes of Canine Cough

- Bacterial pneumonia
- Canine infectious respiratory disease complex (eg, *Bordetella bronchiseptica* infection, canine influenza)
- Chronic bronchitis
- Congestive heart failure
- Fungal pneumonia, secondary to histoplasmosis, blastomycosis, and coccidiomycosis
- Interstitial lung disease
- Lung tumors
- Parasitic pneumonia (eg, lungworm)
- Protozoal infections
- Pleural effusion
- Tracheal collapse (isolated)
- Upper airway dysfunction

Diagnostics for Canine Chronic Bronchitis

- **Laboratory Testing**
  - » Complete blood count & serum biochemical profile
  - » Urinalysis
  - » Heartworm antigen testing
  - » Fecal analysis
  - » NT pro-BNP
- **Diagnostic Imaging**
  - » Chest radiographs
  - » Fluoroscopy (if concurrent tracheal collapse is suspected)
  - » Ultrasound (if isolated lesion or pleural effusion is found)
  - » Computed tomography
  - » Bronchoscopy
- **Airway Sampling: Cytology & Culture**
  - » Tracheal wash (transtracheal or endotracheal)
  - » Blind bronchoalveolar lavage
  - » Bronchoscopic bronchoalveolar lavage
- **Lung Function Testing**
  - » Arterial blood gas samples and/or pulse oximetry
  - » 6-minute walk test

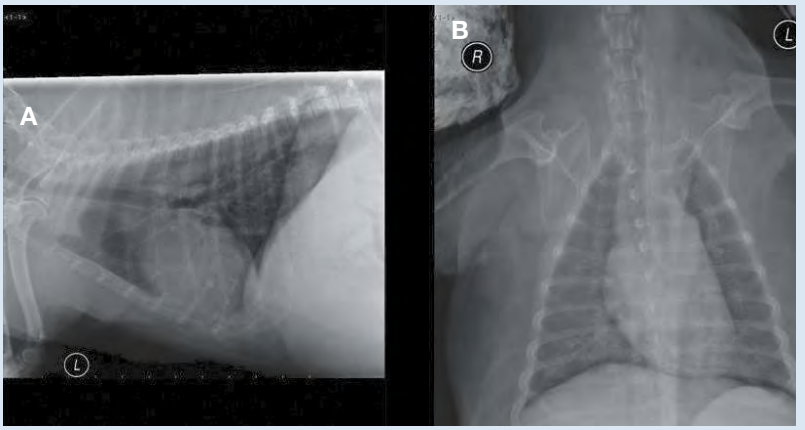

Figure 1. Lateral (A) and ventrodorsal (B) radiographs from a dog with chronic bronchitis; note the prominent bronchial thickening and obesity; obesity will contribute to chronic cough.

Auscultation of the lungs can provide clues of lower airway disease, and presence or absence of a murmur should be noted. Although mitral murmurs and even congestive heart failure may co-exist with CCB, the presence of a sinus arrhythmia supports the cough being of airway/pulmonary, rather than cardiac, origin.

A cough may be induced by **palpation of the trachea**; this may better characterize the cough as well as exclude other conditions, such as reverse sneezing, that may be mistaken for cough.

The **nature of cough** should be explored:

- Is it dry or productive, paroxysmal, or intermittent?
- Is there a relation to eating and activity?

Voice change or reluctance to bark may support upper airway disease. Some dogs will have **syncope associated with cough** (the so-called *cough-drop syndrome*), which is most likely associated with high vagal tone.

DIAGNOSTICS

Diagnostic testing should be tailored to the individual patient; however, the following tests may be useful.

Laboratory Testing

Baseline laboratory testing, including a complete blood count, serum biochemical profile, and urinalysis, are useful in establishing general health and are anticipated to be largely normal in a dog with CCB. Other laboratory tests to consider include heartworm antigen testing, fecal analysis for both eggs and lungworm larva, and evaluation of NT pro-BNP, which is a useful biomarker that will become elevated in the presence of left atrial enlargement/congestive heart failure.[9]

Diagnostic Imaging

Chest radiographs are imperative when evaluating the coughing dog. In fact, if diagnostic testing is limited for an individual patient, chest radiographs are the most useful test.[10]

- Chest radiographs should be evaluated for suggestion of bronchial thickening, evidenced by increased donuts and tramlines (**Figure 1**).
- Additional signs consistent with CCB include hyperinflation and bronchiectasis.
- Chest radiographs help exclude other conditions, such as cardiomegaly, lung masses, pneumonia, pleural effusion, and interstitial lung disease.

Fluoroscopy may help evaluate the trachea and larger airways for collapse, but is less helpful for evaluation of chronic cough unless concurrent airway collapse is suspected.

Ultrasound is useful to aid in diagnostic sampling if an isolated lesion is found on radiographs or in the presence of pleural effusion, but is not useful in CCB.

Computed tomography (CT), which is widely used in people with airway disease, is growing in popularity for identification of canine bronchial disease as well.[11] The airway detail is much improved from that of thoracic radiography (**Figure 2**). CT scanning requires brief general anesthesia, so is commonly combined with evaluation of

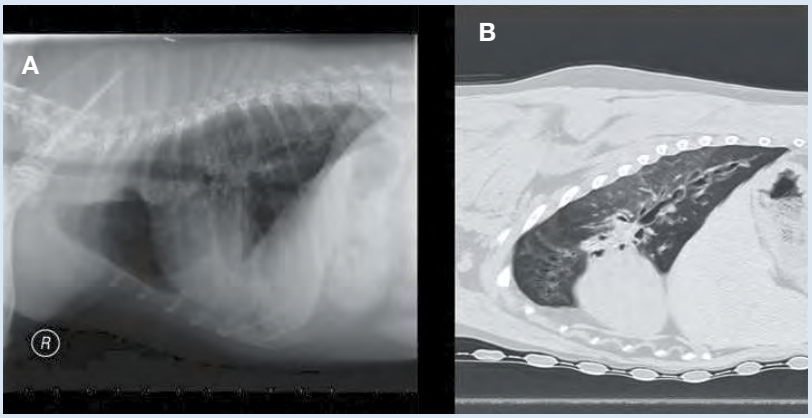

Figure 2. Comparison of a lateral thoracic radiograph (A) and reconstructed CT slice (B) from a dog with chronic bronchitis.

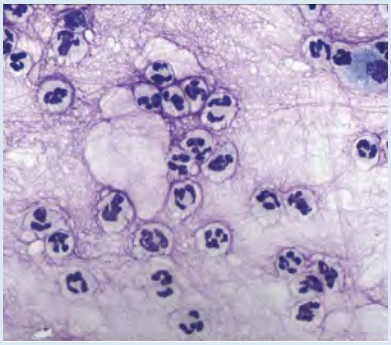

Figure 3. Neutrophilic inflammation without evidence of intracellular bacteria is commonly observed in canine chronic bronchitis. Courtesy Perry Bain, DVM, PhD, Diplomate ACVP

TVP For more information on **chest radiographs**, read **Small Animal Thoracic Radiography** (September/October 2011), which is part of our **Imaging Essentials** series and available at **todaysveterinarypractice.com**.

laryngeal function, collection of airway cytology samples, and bronchoscopy in dogs suspected of having CCB.

Bronchoscopy, if available, is the preferred technique to evaluate and visualize the airway.

- In a study of chronic bronchitis, all dogs demonstrated irregular mucosal surfaces without the glistening seen in healthy airways.
  - » Often the mucosa was noted as being thickened and granular with a roughened appearance.
  - » Most dogs had hyperemia of mucosal vessels and showed partial collapse of bronchi during expiration.
- The presence of excessive mucus in the airways is also suggestive of CCB.[5]

Airway Sampling

Airway samples for cytology and bacterial culture are very useful in characterizing CCB.[12] Cytology samples may be collected via a tracheal wash, a blind bronchoalveolar lavage, or with a bronchoscope. The technique chosen reflects clinician preference and availability of supplies and equipment. See **Airway Sampling Techniques** for a description of each method.

Cytologic samples should be collected into EDTA tubes and processed promptly to avoid changes in cell counts and appearance. If analysis will be delayed, a small aliquot of the sample may be centrifuged and a direct smear made.

Interpretation of respiratory cytology from a dog with CCB typically reveals:

- Predominantly neutrophilic infiltrate with excessive mucus (**Figure 3**)
- Small numbers of lymphocytes, eosinophils, goblet cells, ciliated cells, and epithelial cells
- Variable numbers of alveolar macrophages.

If a sample shows marked eosinophilia, an eosinophilic bronchopneumopathy should be suspected rather than CCB.

Bacterial culture is commonly performed in association with airway cytology. However, the role of bacteria is unclear, as colonization is common, but may not reflect actual infection.[14]

Lung Function Testing

Pulmonary function testing is widely used in human medicine to better characterize specific defects associated with chronic bronchitis. However, due to patient cooperation, it is less widely used in dogs.

Tidal breathing flow–volume loops have been described in dogs with CCB.[15] More practically, 3 forms of pulmonary function testing may be used in dogs:

- Collection of arterial blood gas samples
- Measurement of oxygen saturation with pulse oximetry
- Use of the 6-minute walk test (6MWT).

AIRWAY SAMPLING TECHNIQUES

Obtaining cytologic samples from the airway can be performed by tracheal wash, blind bronchoalveolar lavage, or with a bronchoscope.

A blind endotracheal wash for cytology and culture being performed in practice

Transtracheal washes (TTW) are best suited for cooperative medium- or large-size dogs.

- TTW is performed in dogs that are unsedated or lightly sedated.
- After aseptic preparation of a small area over the cervical trachea or larynx and a local anesthesia block, a through-the-needle catheter is passed through the cricothyroid ligament or in between tracheal rings; then fed down the trachea (beveled edge down).
- Two to 3 aliquots of 5 to 10 mL sterile saline are flushed into the trachea; then promptly retrieved. Retrieval volume is typically about 50%; remaining fluid is rapidly reabsorbed.
- Collection of diagnostic samples is facilitated by the patient's ability to cough.

Endotracheal washes (ETW) are commonly performed in smaller patients that may be less amenable to restraint.

- ETW is performed by briefly anesthetizing the dog with propofol; then intubating with a sterile endotracheal tube without lubricating gel.
- A 5 or 8 Fr catheter is fed through the endotracheal tube and sterile saline is infused and re-aspirated.
- Saline aliquots of 3, 5, and 10 mL are used for dogs < 5 kg, 5 to 15 kg, and > 15 kg, respectively.
- A sterile collection cup may be used to collect any additional samples that may be expectorated.
- Supplemental oxygen should be available during this procedure and for recovery.

Blind bronchoalveolar lavage (BAL) is performed similarly to an ETW; however:

- The flexible catheter is advanced until it is lodged in the lower airways.
- A larger volume of body temperature saline is used.
- A simple technique using a modified stomach tube has been used successfully.[13]

Bronchoscopic bronchoalveolar lavage can be used to collect samples via bronchoscope by flushing sterile fluid through the chamber of the scope and re-aspirating it back through the biopsy channel.[12]

Treatment for Canine Chronic Bronchitis

1. **Limit exposure** to air-borne pollutants and sick animals.
2. **Treat obesity** aggressively and/or prevent it.
3. **Limit exercise and barking**; harnesses should be used instead of neck collars.
4. **Consider use of medications:**
   - Glucocorticoids
   - Antibiotics
   - Bronchodilators
   - Cough suppressants

Arterial blood gas analysis may document mild hypoxemia (PaO2 < 80 mm Hg) or an increased alveolar–arterial (A–a) gradient (> 15) although these are uncommonly performed in CCB.

Pulse oximetry is widely available in practice, and may be used to gauge arterial oxygen saturation with a value of > 97% considered normal. Pulse oximetry may also be measured after a short walk, as desaturation may be more commonly observed after exercise.

The **6MWT** formally measures the distance that a dog can walk over 6 minutes; distances less than 400 meters are supportive of significant lung disease.[16] The 6MWT may also be combined with pre and post walk pulse oximetry to evaluate whether exercise-induced oxygen desaturation is present.

TREATMENT

If, following diagnostic testing, the clinical impression remains that the dog has CCB, it is important to initiate therapy. The treatment options for dogs with CCB include:

- Limiting inflammation
- Limiting cough
- Improving exercise stamina.

Environmental Exposure

- Any environmental pollutant should be eliminated. Owners should be advised not to smoke indoors and to limit exposure to other air-borne irritants.
- If extensive remodeling with potentially noxious fumes is planned, the dog should stay with friends or family.
- Exposure to potentially sick puppies and trips to dog parks, grooming parlors, and boarding kennels should be avoided.

Health Initiatives

- Obesity should be aggressively treated, as it will markedly worsen cough and lung function.
- Activity should be limited and episodes of excessive barking curtailed.
- Neck collars should be replaced by harnesses.

Medications

Glucocorticoids are the mainstay for treatment as they reduce inflammation, thereby, reducing cough. They may be administered orally or via inhalation.

- ***Prednisone*** is the most commonly used glucocorticoid; it is dosed at **1 to 2 mg/kg/day** to start; then tapered to the lowest effective dose that controls clinical signs.
- ***Inhaled glucocorticoids*** have been used widely in people and with growing frequency in dogs with CCB.
  - » Inhaled steroids are delivered via a spacer chamber and face mask designed especially for dogs (eg, AeroDawg, trudellmed.com).
  - » Inhaled glucocorticoids are more expensive than oral glucocorticoids, although the systemic steroid-sparing effect may be worthwhile.
  - » One study demonstrated benefits of therapy with fluticasone (125 mcg Q 12 H).[17]

Bronchodilators are commonly prescribed for dogs with CCB; evidence supports efficacy in approximately half of treated dogs.[4]

- ***Theophylline*** (extended-release; **10 mg/kg PO Q 12 H**) has been shown to have nonspecific effects that may be of benefit in chronic bronchitis, such as decreasing diaphragmatic fatigue, increasing mucociliary clearance, and enhancing the efficacy of glucocorticoid activity.
- ***Beta2-agonists***, such as terbutaline, may be less effective as not all dogs have reversible bronchoconstriction that potentially responds to beta2-agonists.[18] However, some clinicians appreciate the benefit of beta2-agonists in CCB. Note that beta2-agonists may cause anxiety and restlessness when first administered; however, these signs often resolve within a few days.[5]

Antibiotics are warranted in dogs with an exacerbation of CCB or dogs with evidence of infection on tracheal wash cytology.

- ***Doxycycline and azithromycin*** have anti-inflammatory and antimicrobial properties; either is a good choice for dogs with CCB but no specific bacterial culture and sensitivity data. Clinician preference commonly reflects cost and formulation.
  - » Doxycycline tablets are usually less expensive.
  - » Azithromycin liquid is easier to dose and often less expensive than doxycycline suspension.
- ***Fluoroquinolones*** also have good respiratory penetration for dogs with CCB.

It is important to note that concurrent administration of fluoroquinolones with theophylline may result in theophylline toxicity. If concurrent administration of both drugs is necessary, reduce theophylline dose by approximately 30% to 40%.

Cough suppressants help improve the quality of life for both dogs with CCB and their families. Additionally, on-going cough promotes inflammation, which results in more cough.

- ***Over-the-counter cough suppressants*** are *rarely effective* in dogs.
- ***Narcotic cough suppressants*** are most effective, with hydrocodone (**0.22 mg/kg PO Q 6–12 H**) the most widely used.
- A human medicine study has recently reported on the efficacy of ***gabapentin*** for control of cough in humans; this deserves investigation in dogs.[19]

PROGNOSIS

The clinical course of CCB is variable. In the majority of dogs, permanent changes are present in the airways at the time of diagnosis and the disease cannot be cured. Proper medical management can typically ameliorate clinical signs

and stop or slow progression of bronchial damage. Periodic relapses of cough are not uncommon and require adjustments in the treatment protocol, such as temporary increase in glucocorticoids or addition of antibiotics.

IN SUMMARY

- CCB is a common cause of chronic cough and is a condition that will frequently be treated by the clinician.
- An understanding of the pathophysiology, diagnosis, and treatment of CCB allows for prolonged quality of life for the patient.
- Frequent checkups and tailoring of the therapeutic plan to individual dog's signs will provide the best outcome.
- Continued advancement of early detection and effective treatments for CCB will improve our understanding of this disease and allow us to limit the effect that it has on our patients.

6MWT = 6-minute walk test; CCB = canine chronic bronchitis; CIRD = canine infectious respiratory disease; CT = computed tomography

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