

## The Coughing Dog

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### INTRODUCTION

Before being a clinical sign, coughing is also a normal protective mechanism to clear the airways of either excessive secretions or foreign materials. In a normal situation, a coughing episode can end up with acute resolution of the initial problem (foreign material expelled). However, when coughing is triggered but is not associated with a rapid resolution of the initial trigger (infection, tracheal collapse, severe chronic inflammation), severe, chronic and irreversible consequences can affect the respiratory system.

Coughing is by nature a violent phenomenon. Every coughing episode is associated with high intra-thoracic pressure and airway narrowing in order to expulse efficiently air and secretions (or foreign material) out of the airways. Very rapid airflow rates are usually achieved during coughing and will cause high shear stresses on the airway walls. If coughing is frequent and chronic, this high wall shear stress is believed to cause damage to the airways epithelium, potentially perpetuating on-going airway inflammation (Green, 2004). Inflammation can become established and will continuously stimulate the cough afferent pathways. Besides, central and peripheral sensitization develops facilitating the coughing reflex (even with minimal stimulus) and making therapy extremely challenging in these cases.

Once the vicious cycle is established, chronic inflammation can be associated with gradual structural changes of the airways. Airways walls may undergo progressive destruction of their elastic and muscular components, resulting in permanent airways dilation and loss of the mucociliary system. This condition called bronchiectasis is irreversible and is often associated with recurrent episodes of bacterial infections.

Two different types of receptors are present in the respiratory tract and can trigger a cough when stimulated. Rapidly Adapting Receptors (RAR) can be stimulated by mechanical stimulation, pulmonary congestion, broncho-constriction, atelectasis, decreased lung compliance (fibrosis) and cigarette smoke. C-fibers are stimulated by chemicals (Reflux), inflammation (Bradykinin) and hydrogen ions (H<sup>+</sup>). This list of stimuli can easily be linked to common differentials associated with coughing in dogs.

Cough receptors are present throughout the upper respiratory tract extending into the bronchioles (particularly in cats) and are especially prevalent around the larynx, the tracheal bifurcation and the main bronchi. Detailed history (description of the cough – video) and thorough clinical examination (including observation of respiratory pattern, auscultation, tracheal and pharyngeal palpation, lung percussion) can often provide a clear idea about the nature, the anatomical localization and the extensiveness of the disease process. This information can then be used to choose the most appropriate therapeutic and testing approach.

## TESTING

Multiple tests can be used to investigate the respiratory tract. The first step of the work-up should be non-invasive and always include baseline blood work, heartworm testing and possibly fecal analysis (Baermann Flotation technique).

Thoracic radiographs are also extremely useful in coughing dogs to evaluate the cardiac silhouette (right or left sided heart failure), large vessels (pulmonary hypertension), upper airways (tracheal collapse, bronchomalacia, bronchiectasis, foreign material, neoplasia, extramural airway compression, mediastinum evaluation) and the lung parenchyma (interstitial disease, pneumonia, lower airways). Evaluation of intra-thoracic lymph nodes (lymphadenopathy) can also provide important information (fungal infection, lymphoma). The presence of pleural effusion may also change the approach to the case. However, pleural effusion is rarely associated with significant coughing in dogs (except if more diffuse disease process).

Depending on blood work and thoracic radiographs, other tests can be considered (see clinical approach diagram). Arterial blood gases (gold standard pulmonary function test – confirmation of significant interstitial disease and prognostic information), thoracic ultrasound (suspicion of mass – possible transthoracic FNA or biopsy) and fluoroscopy (dynamic evaluation – tracheal collapse and bronchomalacia) can be useful in some cases. Echocardiography is often necessary to exclude definitively a cardiogenic origin to the cough. It will also provide information about possible cardiac changes from chronic respiratory disease (pulmonary hypertension, right sided cardiac failure), which will have important therapeutic and prognostic implications.

Another important and often necessary test to investigate the respiratory system in dogs will be bronchoscopy. Bronchoscopy will provide dynamic evaluation of the upper and lower airways (tracheal collapse, bronchomalacia - grading). Bronchoscopy should always be associated with sampling either through bronchoalveolar lavage (BAL) or brush cytology. Analysis (culture and cytology) of the BAL fluid is important to diagnose airway infections (bacterial - primary vs. secondary, fungal, mycoplasma), inflammatory conditions (eosinophilic bronchopneumopathy – EBP) and sometimes neoplasia (poor sensitivity - carcinoma, round cell). Normal bronchoscopy and normal BAL fluid analysis (normal airways) can also increase the suspicion of primary interstitial lung disease (pulmonary fibrosis – exclusion process). Intraluminal masses or foreign objects can also be seen directly and addressed (biopsy, removal) with bronchoscopy.

Excellent knowledge of the lung anatomy is extremely important during bronchoscopy as some diseases can be focal and only be present in a very limited region of the respiratory tree (foreign body, pneumonia, bronchiectasis). Good quality radiographs (3 views) and/or thoracic CT scan should be performed beforehand and help guide the endoscopist during the procedure.

The main down-side to bronchoscopy is the risk associated with the procedure and general anesthesia. To minimize the risk and the rate of complications, bronchodilators (aminophylline or terbutaline) may be administered before the procedure especially in smaller dogs. In larger dogs, inhalant anesthesia should be favored. A sterile T- or Y-shaped adapter, containing a soft, snug

port for the passage of the bronchoscope is usually used to connect the endotracheal tube to the anesthetic breathing system. A mouth gag should be placed to prevent endoscope trauma, should the plane of anesthesia decrease for any reason during the procedure (Creevy, 2009).

## **DIFFERENTIALS – MEDICAL MANAGEMENT**

The list of differentials to consider in a coughing dog is rather long. Depending on the anatomical region involved and extensiveness of the disease process, some differentials can become more likely than others. Usual categories of differentials can be used for coughing: infectious, inflammatory, cardiovascular, structural-physical factors and neoplasia.

Depending on the definitive diagnosis, treatment and prognosis may be quite variable. Some specific diseases such as primary bacterial infection (antibiotics), fungal infection (antifungal therapy), left sided heart failure and pulmonary edema (diuretics, vasodilation), eosinophilic bronchopneumopathy (prednisone), foreign body (removal by endoscopy or lobectomy), neoplasia (lobectomy +/- chemotherapy) or lung worms infection (deworming therapy) would require specific treatment.

Some conditions such as tracheal collapse (and bronchomalacia), chronic bronchitis, idiopathic pulmonary fibrosis or bronchiectasis can be very challenging diseases to treat. A more general and symptomatic therapeutic approach is usually chosen for these cases.

In these cases, good control of environmental factors such as obesity (Manens et al., 2012), excitability (pulling on the leash), oral hygiene, cigarette smoke, perfumes are often associated with improvement of the cough.

A secondary bacterial infection should always be considered possible (chronic inflammation may impair the mucociliary system). A course of antibiotics (2-4 weeks) ideally based on a positive culture (BAL fluid, trans-tracheal wash) is often beneficial.

Cough suppression does not produce a cure and ideally should not be used as primary treatment for undiagnosed respiratory disease because it may mask clinical signs and allow disease to progress unchecked. It should also be avoided in cases where coughing is believed to be beneficial such as pneumonia or inflammatory conditions (the primary disease process – infection or inflammation - should be addressed in these cases). Hydrocodone is easily available and efficient in many cases. A starting dose of 0.25mg/kg q8h is often used. However, in patients with chronic severe tracheo-bronchomalacia, the dose often needs to be increased significantly (0.25mg/kg gradual increments) up to 1.5mg/kg PO q6h in extreme cases.

The use of bronchodilators is often considered in dogs with chronic cough and chronic airway disease (bronchomalacia, chronic bronchitis). These drugs are not always associated with significant clinical improvement and may exacerbate excitability and anxiety in some dogs due to their sympathomimetic properties. A short trial of theophylline (5-10mg/kg q12h PO) could be considered but this medication

should be discontinued if no improvement is noted. In more urgent situations, inhalation of albuterol (sometimes before fluticasone) can have beneficial but short lasting effects on the airways.

Clearance of thick, tenacious airway secretions can be difficult in some cases with chronic bronchitis. Excessive secretions are a known trigger for coughing. In these situations, inhalation of humidified air (nebulization, steam therapy) and/or use of mucolytic drugs (n-acetylcysteine – 5 to 10mg/kg PO q12h; bromhexine – 2mg/kg PO q12h) can help improve the consistency of secretions and may improve the coughing.

Finally, as chronic inflammation is frequently involved in the pathogenesis of chronic coughing (vicious cycle), many patients may benefit from the use of anti-inflammatory medications. Systemic drugs such as prednisone (0.5-1 mg/kg q12-24h) are usually very efficient to decrease rapidly the airway inflammation. To control low-grade chronic inflammation, chronic inhalations of fluticasone (initial dose of 125-g twice a day for small dog (<10kg) and up to 500-g twice a day for giant breed dogs) can also be very successful with only minimal systemic absorption and side effects. The dose can be gradually tapered and one puff (125 to 500-g depending on the dog size) every other day or twice a week can be sufficient to control the clinical signs in some dogs with chronic bronchitis. Anti-inflammatory therapy should be avoided if an infectious etiology is suspected (or it should be addressed first).

## CONCLUSION

Coughing is a common clinical sign seen in very different clinical situations. Outcome can be excellent in simple cases such as dogs with uncomplicated infectious tracheitis. However, coughing can also be associated with chronic progressive or degenerative conditions (tracheo-bronchomalacia, bronchiectasis, pulmonary fibrosis), which can be extremely challenging to treat. A systematic approach (see diagram) should provide a diagnosis in most cases. Depending on the final (or most likely) diagnosis, expectations (prognosis) should be clearly discussed and explained to the owners.

## REFERENCES

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# Clinical Approach - DIAGRAM

