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APPROACH TO THE COUGHING AND DYSPNEIC DOG

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Clinical Overview

Coughing is a sudden expiratory effort resulting in noise with expulsion of air. It is associated with both respiratory and cardiovascular disease, as well as inflammation, neoplasia, parasitic diseases, trauma, degenerative disorders, physical causes, and allergic states. The coughing reflex may be initiated throughout the upper and lower respiratory system (pharynx, larynx, tracheobronchial tree, and small airways). In some animals coughing is occasional and of no clinical significance, while in others, coughing is irritating and often fatiguing (both to the animal and the owner), and a harbinger of serious underlying disease. Clients may confuse coughing with gagging, wheezing, labored breathing, and reverse sneezing. Some dogs may retch or vomit after a bout of coughing and this is misinterpreted as gastrointestinal disease. Most coughs sound alike.

Coughing may accompany other clinical signs. Dyspnea or respiratory distress refers to difficult or labored breathing. Severity may be judged by assessing breathing effort, respiratory rate, rhythm, and character. Affected animals display a standing or sitting posture (cats rest on their sternum), with neck extended and elbows adducted. Tachypnea (polypnea) relates to an increased breathing rate, which may or may not be associated with a dyspnea. Cough reflex may be initiated throughout the upper and lower respiratory system (i.e., pharynx, larynx, tracheobronchial tree, and small airways). Coughing may be occasional and of no clinical significance, or persistent, fatiguing (both to the animal and the owner), and a harbinger of serious disease. Clients may confuse coughing with gagging, wheezing, labored breathing, and reverse sneezing. Some dogs retch or vomit after coughing, and this is often misinterpreted as gastrointestinal disease. Naso-pharyngeal diseases often induce gagging which can simulate a cough, although these cases may also exhibit nasal discharge, sneezing and snorting, ptyalism, or stridor. Laryngeal diseases may result in gagging, stridor and sometimes coughing.

Certain generalizations have been made about the character of the cough: tracheal disease may cause dry, honking, resonant cough (dogs) and dyspnea or stridor (cats); bronchiolar disease may cause coughing that is often followed by retching; alveolar disease may cause mild cough with dyspnea, or a moist cough with gagging and expiration of frothy fluid (pulmonary edema). Certain generalizations have been made about the character of the cough: tracheal disease may cause dry, honking, resonant cough (dogs) and dyspnea or stridor (cats); bronchiolar disease may cause coughing that is often followed by retching; alveolar disease may cause mild cough with dyspnea, or a moist cough with gagging and expiration of frothy fluid (pulmonary edema). Cats rarely cough from pulmonary edema but do from bronchitis, asthma, heart-worm, lungworms, neoplasia, and foreign bodies. In dogs, coughing commonly results from heart failure- particularly

pulmonary edema; impingement on the main stem bronchi by severe left heart enlargement; heart worm disease, large airway disease; tracheobronchitis, and pulmonary fibrosis. In cats, feline bronchial disease (including 'asthma') is the most common cause for coughing.

Approach to the Coughing Dog

The diagnostic foundation for acute and chronic coughing is the history followed by a complete physical examination. The thoracic radiograph is an essential initial diagnostic test, which often serves to direct further diagnostic evaluations. Fluoroscopy can be useful to detect dynamic airway compression. Routine data base includes a CBC, biochemical profile, and urine analysis. Cytology and microbial culture for pleural effusion or tracheal wash may be informative and disclose infective, inflammatory, neoplastic, and other disorders. Direct visualization of upper and lower airways via laryngoscopy and bronchoscopy may be useful. Diagnostic ultrasound provides valuable information about cardiac structure and function when heart failure is considered, can help evaluate cases of cor pulmonale, and examine noncardiac structures for suspected masses and other lesions. Testing for heartworm (serology) and lungworm (Baermann fecal) is necessary in endemic areas. CT examination thorax provides a more accurate assessment of pulmonary nodules than does plain film radiography, and can also disclose unsuspected masses and other lesions. Fine needle aspiration, thoracoscopy, and biopsy include specialized procedures.

History and Physical Examination

An insightful history followed by complete physical examination is critical for distinguishing between cardiac and noncardiac causes of coughing, and help direct further testing.

Role of Thoracic Radiography

The thoracic radiograph provides information about thoracic musculoskeletal conformation and disease, cardiac size and shape, pulmonary parenchymal and vascular disorders, airways, and conditions involving the pleura, mediastinum, esophagus, and diaphragm. Radiographs help confirm or exclude clinical impressions, support or reject specific diagnoses, and provide important information not otherwise suspected. They help to screen for cardiopulmonary, systemic, and metabolic disorders and assist to formulate initial treatment strategies. Repeat radiographs (using the same radiographic technique and positioning as in initial exposures) supply useful comparative data. Radiographs should be evaluated in context with the history, physical examination, and data base. Good quality chest films are essential for accurate diagnosis and effective management.

Radiographic Technique

Films should be exposed at peak inspiration using a high kVp/low mAs technique. Poorly inflated lungs will appear increased in density- i.e., 'whiter'. Breed conformation, state of respiration, obesity, relative state of hydration,

stage of cardiac cycle, positioning errors and effusions alter radiographic appearances. Over exposure results in loss of important information; under exposure causes over interpretation of lung fields.

The ventrodorsal (VD) radiograph is advantageous to evaluate the cardiac silhouette when pleural effusion is present, since free fluid will gravitate along the paravertebral gutters, and does not superimpose over the heart- as occurs with the DV view. The VD view may be less stressful for severely dyspneic animals. While inspiratory films are generally desired, expiratory films can help detect dynamic collapse of intrathoracic trachea or bronchi, and demonstrate pulmonary air-trapping as occurs with chronic obstructive lung disease or emphysema.

RADIOGRAPHIC INTERPRETATION

The Heart and Great Vessels

In the lateral canine view, the heart is oriented at approximately a 45 degree angle, is situated between the 3rd-8th thoracic vertebrae, occupies about 3 intercostal spaces, and measures about 8.5-10.6 (average, 9.7) vertebral bodies (T4) wide using the vertebral heart score method. In the VD or DV view it has a roughly elliptical shape with a curved right ventricular and relatively straight left ventricular border. Breeds often influence anatomic contours. Anatomical structures include (clockwise); aortic arch (extending from 11 to 1 o'clock); main pulmonary artery segment (1 to 2 o'clock); left auricular appendage (2 to 3 o'clock); left ventricle (2 to 6 o'clock), and right heart (6 to 12 o'clock). In the right lateral view, the left atrium is superimposed over the caudal-dorsal one-third of the heart just distal to the tracheal bifurcation. When significantly enlarged, the left atrium may compress main stem bronchi and contribute to coughing in dogs.

Abnormalities in Cardiac Size and Shape

Conformation, respiration, hydration, stage of cardiac cycle, positioning errors and effusions alter radiographic appearances. Pleural effusions may obscure the cardiac silhouette. Cardiomegaly usually results from congenital or acquired lesions causing volume overload (e.g. valvular insufficiency or shunts), pressure overload (e.g., valvular stenosis), myocardial disease (e.g., cardiomyopathy), pericardial disease, or respiratory conditions (e.g., cor-pulmonale). The cardiothoracic distance decreases in the DV or VD view but this can also be influenced by phase of respiration and pleural disease. Cardiac function cannot be directly assessed by radiography.

Radiographic Lung Patterns

Increased lung opacity (i.e., 'whiter' appearing lungs) may be associated with pleural effusion, parenchymal disease (e.g., pneumonia), and over circulated lungs (e.g., left to right shunts such as PDA or AV fistulas). Increased opacity may also result from under exposure, expiratory films, and obesity. Decreased lung opacity ('blacker' appearing lungs) may result from pneumothorax,

diseases associated with air trapping (e.g., emphysema), and hypoperfusion (e.g., shock, severe hypovolemia). Additional causes include thin, emaciated animals or over exposure. Radiographic interpretation of pulmonary parenchymal disease includes a pattern-based approach. Many diseases cause mixed patterns which are classified according to the major pattern, or specified as a combined pattern, such as bronchoalveolar).

ALVEOLAR PATTERNS indicate alveolar collapse or filling (with blood, pus, or water). Findings include: 1) patchy, poorly defined, increased densities with fluffy, indistinct margins which tend to coalesce, 2) air bronchograms (i.e., air-filled [and therefore on radiographs-grey or black] branching tubes surrounded by abnormal radiographically opaque [i.e., whitish] opacities, and 3) silhouetting of pulmonary vessels and bronchial walls by lung alveoli and interstitium containing fluid. Alveolar patterns are typically fluffy and indistinct, and coalesce. Cranioventral distribution is most associated with bronchopneumonia; perihilar distribution (in dogs) is most associated with congestive heart failure. Noncardiogenic edema usually occurs in dorso-caudal lung fields. Diffuse or patchy alveolar distribution may be seen with bronchopneumonia, pulmonary edema, hemorrhage (often lobar), and atelectasis.

INTERSTITIAL PATTERNS indicate involvement of pulmonary interstitium. One form includes increased nodular densities having distinct, well defined margins (e.g., neoplasia, chronic granulomas). The second form causes a nonspecific localized or generalized "grayness" without distinct features, (e.g., pulmonary edema, pulmonary fibrosis, some neoplasia, interstitial pneumonia or hemorrhage); vasculature and bronchi are blurred.

BRONCHIAL PATTERNS result when bronchial walls become more opaque due to thickening or when surrounded by fluid or cellular infiltrate. These appear in cross section as circular, whitish or grayish thickened or calcified rings ('donuts'); when viewed in longitudinal section they are linear, parallel thickenings or lines. Bronchial disease may progress to bronchiectasis that appears as thin-walled, cylindrical or saccular bronchial dilation with enlarged bronchial lumens that lose their distal tapering; emphysema appears as saccular or coalescing airways.

Radiographic Vascular Patterns

Cranial lung lobe vessels are best assessed from the lateral projection; arteries are dorsal and veins are ventral to related bronchi. Caudal lobar vessels are best assessed from the VD or DV view (arteries are lateral and veins are medial to associated bronchi). Normally, arteries and veins are approximately the same size. Hypervascularity refers to arteries and/or veins which may be enlarged together in states of increased pulmonary blood flow (left-to-right shunts), high output states (thyrotoxicosis, severe anemia, fluid overload), left-sided CHF from severe mitral insufficiency or canine dilated cardiomyopathy (i.e., chronic pulmonary venous dilation with secondary pulmonary hypertension). Increased pulmonary artery size and shape suggest pulmonary hypertension (usually dirofilariasis; occasionally, right-to-left

shunts, idiopathic pulmonary hypertension). Pulmonary venous congestion is associated with left-sided CHF. Hypovascularity (hypoperfusion or under circulation) creates thin arteries, veins and radiolucent interstitium and may accompany low cardiac output [shock, dehydration, caval syndrome, cardiac tamponade, acute blood loss, hypoadrenocorticism, restrictive pericarditis, severe myocardial failure), or right to left shunts.

Causes of a Cough

A long list of etiologies can be associated with coughing including: cardiovascular (pulmonary edema, severe left atrial enlargement, pulmonary embolism); infectious (tracheobronchitis, pneumonia); neoplasia; allergic and inflammatory (asthma, chronic bronchitis, chronic obstructive pulmonary disease, pneumonitis); parasitic (*Dirofilaria*, *Capillaria*, *Paragonimus*, *Aelurostrongylus*, *filarioides*); trauma; physical abnormalities (tracheal foreign body, tracheal stenosis or masses); dynamic every collapse; longing Airways, injury (smoke inhalation).