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COMMON FEATURES OF CARDIAC AND RESPIRATORY DISEASE. A DIAGNOSTIC CONUNDRUM

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Introduction
Cardiac and respiratory diseases have many common features which can make diagnosis problematic. This is particularly so in the dog where coughing is a shared clinical sign. Additionally, disease affecting one of these systems can initiate change in the other system that contributes to the overall clinical status of the patient. It is not surprising that an interaction exists between the cardiovascular and respiratory system as they are closely linked in terms of anatomy and function. This inter-relationship is crucial to normal body function as it is the method by which O₂ is delivered to the body tissues and CO₂ is removed.

In the clinical setting the difficulty can be in deciding if a primary respiratory condition or cardiac condition is present, and is this alone the explanation for the clinical signs, or might disease of both systems be contributing to the clinical presentation. Being able to decide if the problem is respiratory or cardiac has major bearing on what diagnostic tests are subsequently undertaken.

Common clinical signs

Cough
Coughing is a cardinal sign of respiratory disease in the dog and cat, but in the dog it is also commonly seen with cardiac disease. This is primarily due to the phenomenon of compression of the left mainstem bronchus by the enlarged left atrium. It is more readily found in smaller breeds of dogs which reflect the inherent collapsibility of the larger airways (trachea, mainstem and lobar bronchi) in such breeds. In larger dog breeds there is greater airway wall rigidity, and this coupled with compression of the left mainstem bronchus by the left atrium less likely. In all dogs there will also be a contribution to coughing from bronchial wall and lung oedema and from the presence of oedema fluid in the large conducting airways, due to congestive heart failure. In contrast, cats rarely cough with heart disease, and if coughing is present in cardiac cases it is usually presumed to indicate that concurrent respiratory disease is present. Why this difference in species occurs is not known, but it probably reflects differences in left atrial compression of the left mainstem bronchus. The nature of the cough is sometimes suggested as being useful in identifying the cause, but this has to be interpreted with caution. Coughing will be exacerbated by exercise, excitement, lead pulling and resting (nocturnal coughing) irrespective of whether the cause is cardiac or respiratory. A harsh cough is more likely to be respiratory, but soft coughing can be due either to pulmonary oedema or lung parenchymal disease. Expectoration of material also can be of little use, not least because dogs rarely expectorate, but if pink-tinged fluid is seen this is likely to be due to pulmonary oedema. Eliciting coughing on tracheal pinching is of little value in diagnosis except to confirm coughing is actually present. This is useful in cats where coughing and vomiting can be confused by the client. Cough on tracheal pinching can be elicited in any animal if the trachea is pressed hard enough.

Tachypnoea and dyspnoea
An increase in respiratory rate is a very sensitive indicator of developing cardiac decompensation in a case known to have cardiac disease, and is a sign owners should be trained to observe. Similarly, a reduction in respiratory rate suggests clinical improvement. Tachypnoea can occur with respiratory diseases but major confounding factors are the level of stress and excitement and the problem of panting in dogs. It can be easier to recognise that some forms of dyspnoea are due to respiratory disease. This is particularly so if there is inspiratory dyspnoea and obvious stridor. In cats with orthopnoea the main considerations are severe asthma and pleural effusion (usually cardiac), but orthopnoea in dogs can be due to a variety of respiratory diseases and severe pulmonary oedema. Hyperpnoea is more likely to be associated with severe pulmonary oedema or pleural effusion, as severe respiratory disease cases tend to adopt a slow purposeful deep respiratory pattern (true laboured breathing) to improve ventilation, but with minor stress breathing can become rapid and laboured.

Exercise intolerance
This is more likely to be associated with cardiac disease than respiratory disease simply because despite congestive heart failure the dog is still interested in exercising. In dogs with left-sided output failure, that have not yet developed congestive heart failure, the problem may only become apparent when the dog exercises. Observing changes in exercise ability in cats is problematic as they tend to be sedentary anyway, although reduced activity can be noted often in association with increased respiratory effort. In severe acute respiratory disease dogs tend to be reluctant to exercise, but in more chronic conditions exercise intolerance will be noted if the lung pathology is sufficiently extensive.-
Collapse and syncope
These clinical signs are more likely to be associated with cardiac disease, and rhythm abnormalities are a major cause of syncope in dogs. If there is a respiratory cause, forewarning with obvious respiratory distress would be expected, but even then true syncope is unlikely. In collapsing cases neurological, metabolic, endocrine and musculo-skeletal possibilities need to be considered.

Cyanosis
Cyanosis at rest or during activity is more likely to be due to respiratory rather than cardiac disease and upper airway obstruction will be the most probable cause. Cyanosis can occur with right-to-left cardiac shunts, but as such conditions are rare they should be very low on the differential list. If cyanosis is present due to cardiogenic pulmonary oedema this would suggest there is minimal functional lung available for ventilation and respiratory failure and death are imminent.-

Auscultatory findings
Auscultation will allow assessment of cardiac and respiratory status through evaluation of respiratory rate and effort, respiratory sounds, heart sounds and heart rhythm. Abnormal respiratory sounds can be expected in both cardiac and respiratory disease. Inspiratory crackles are heard with cardiogenic pulmonary oedema, lung fibrosis and chronic bronchitis. If the crackles have been present for some time then they are due to respiratory disease, for the simple reason that if the cause was cardiogenic pulmonary oedema, and was left untreated, the dog would have died. Rhonchi are also heard with both cardiac and respiratory diseases, but can also be present if the dog is stressed, panting or has upper airway obstruction (brachycephalic breeds). If rhonchi are localised to one side of the thorax, then respiratory disease is more likely. Wheezes suggest airway narrowing or bronchoconstriction and are best heard in cats with asthma; they can be localised and intermittent. An elevated heart rate is more suggestive of heart disease, but the problem of excitement and stress needs to be considered. Also small dogs and puppies tend to have higher resting (consulting room) heart rates. If sinus arrhythmia is present then the clinical presentation is unlikely to be due to heart failure. This is a particularly useful finding in those cases that are coughing and have a mitral murmur. With significant abnormal rhythms, such as sinus tachycardia and atrial fibrillation, then it must be presumed the clinical presentation is due to cardiac disease, but even in such cases coincidental respiratory disease may be causing or contributing to coughing. This tends to become apparent when standard cardiac treatment fails to completely suppress coughing. The identification of audible murmurs indicates cardiac disease is present, but not necessarily that that disease is contributing to the clinical signs. A classic example is myxomatous mitral valve disease. Valve changes are likely to be present in all geriatric dogs, but not all these dogs will develop congestive heart failure. If, however, signs of heart failure are apparent then the identification of a murmur becomes significant. Outflow tract murmurs, such as with aortic stenosis in dogs and hypertrophic obstructive cardiomyopathy (HOCM) in cats, which are of little concern at rest, can affect cardiac output during exercise and excitement and result in syncope.

Useful diagnostic tests
The single most valuable diagnostic test for distinguishing cardiac from respiratory disease is thoracic radiography. In those cases where respiratory distress is severe and life threatening, restraint for radiography may be too great a risk and decisions on likely cause and the best course of action have to be based on sound clinical judgement. The three best examples are fulminating pulmonary oedema caused by congestive heart failure in dogs, pleural effusion, again caused by heart failure, in cats and severe bacterial bronchopneumonia. Notwithstanding the risk, in coughing dogs the absence of changes to the cardiac silhouette that could support a cardiac explanation suggest the coughing is respiratory. Such changes include generalised cardiomegaly, elevation of the trachea, elevation of the caudal vena cava, compression of the mainstem bronchi on the lateral view, and a visible auricular bulge (2-3 o’clock position) and splitting of the mainstem bronchi on the dorso-ventral view. Radiography will also allow the identification of pulmonary vascular engorgement (congestive heart failure), pulmonary oedema and pleural effusion, which will contribute to tachypnoea, dyspnoea and exercise intolerance. In the case of dogs, pleural effusion is typically due to non-cardiac disease, which contrasts with the cat. For respiratory causes of coughing there may be little or no detectable changes on thoracic radiography and other diagnostic tests, such as bronchoscopy, may be needed to achieve a diagnosis. Alternatively, there may be significant radiographic changes that readily point to a respiratory cause for the clinical signs, but this conclusion is still made once the clinician is convinced the heart is not involved.

Echocardiography can also be used to identify changes in left atrial size, as well as overall assessment of cardiac function. This can be useful where the radiographic evidence of left atrial enlargement is equivocal.

Pulmonary hypertension
The complex relationship between the cardiovascular and respiratory systems is best illustrated by the phenomenon of pulmonary hypertension (PAH), and this is being more readily recognised as an important contributor...
Cardiorespiratory

...to respiratory impairment and exercise intolerance in long-standing disease. The greater availability of high quality colour flow Doppler echocardiography equipment has allowed PAH to be more readily recognised. PAH can be caused by left-sided congestive heart failure. The exact cause is unknown, but probably involves a combination of volume overload and raised pulmonary venous pressures. The increased circulating volume, found with heart failure, traversing the lung circulation can be easily accommodated in the short to medium term, but chronic volume overload results in irreversible changes in the pulmonary arteries and PAH ensues. Contributing to this change, although more likely in chronic respiratory disease, will be hypoxia which results in pulmonary artery vasoconstriction and artery wall remodelling. The transmission of the raised left atrial pressures associated with heart failure to the pulmonary veins eventually results in pulmonary oedema. However, the same raised pressure is transferred indirectly through the lung parenchyma to the pulmonary arteries and so contributes to PAH. This is probably the main mechanism by which left-sided congestive heart failure causes PAH. For respiratory disease, PAH is secondary to long-term hypoxia and destruction of lung tissue.

The hypoxia can be intermittent, but in such cases must be over a prolonged period of time. If hypoxia is continuous then the time necessary to institute a change in the pulmonary circulation is likely to be much less. In situations where a dog has both heart failure and chronic respiratory disease, PAH is likely to occur and be very severe. Currently, treatment options are limited and there is no cure for PAH. Attending to the primary disease, cardiac or respiratory, is attempted in the first instance. Phospho-diesterase V inhibitors such as sildenafil (Viagra) and pimobendan (Vetmedin) can be of benefit, and a good response has been best documented so far for sildenafil.

Conclusion

It can be readily appreciated that cardiac and respiratory diseases in the dog and cat can result in very similar clinical presentations. Understanding the way these clinical signs manifest themselves and the application of a thorough clinical examination can greatly improve diagnostic accuracy. The value of good quality thoracic radiography in helping with the differentiation of cardiac and respiratory diseases cannot be overstated.