Heart failure is a complex condition. Despite multiple underlying causes and clinical manifestations, successful management is possible. This article describes canine heart failure, provides in-depth information about the most common diseases that lead to heart failure, and offers practical tips for diagnosis and management.

**DEFINITION**
Heart failure is a complex condition that can develop from congenital or acquired heart disease in dogs. Depending on the specific disease process, it can affect the left and right sides of the heart, manifesting in respiratory signs and weakness due to:

- Fluid retention: Congestion; sometimes called *backward failure*
- Pump failure: Low cardiac output; sometimes called *forward failure*.

While the underlying heart disease can vary depending on age and breed, chronic heart failure management for degenerative mitral valve disease (DMVD) and dilated cardiomyopathy (DCM) initially relies on a combination of a diuretic, angiotensin-converting enzyme (ACE) inhibitor, and pimobendan, with additional medications added as necessary.

**DEGENERATIVE MITRAL VALVE DISEASE**
DMVD is the most common acquired heart disease in dogs. Common clinical signs and pathophysiology include:

- **Heart murmur** due to mitral valve (and, sometimes, tricuspid valve) regurgitation, leading to left atrial and left ventricular dilatation
- **Progressive dilatation** of the left ventricle, ultimately leading to systolic dysfunction
- **Significant left atrial enlargement**, leading to atrial (supraventricular) arrhythmias
- **Development of pulmonary hypertension**, which can contribute to clinical signs, such as respiratory distress and syncope.

Not all dogs with DMVD will develop heart failure, characterized by pulmonary edema (see **Progression to Congestive Heart Failure**). In general, dogs with heart enlargement are at greater risk for heart failure, but only 30% of dogs with asymptomatic DMVD develop clinical signs and require heart failure therapy.

**DILATED CARDIOMYOPATHY**
DCM is a primary disease of the heart muscle, characterized by a relatively long asymptomatic stage (1–2 years) followed by sudden death (due to arrhythmias) or heart failure. Changes associated with DCM, starting with the earliest, include:

- Reduced systolic function of predominantly the left ventricle
- Dilatation of the left ventricle and, to a lesser degree, the left atrium due to systolic dysfunction and high preload
- In some dogs, mitral regurgitation, once the heart is sufficiently dilated, because the mitral annulus is stretched to a degree that prevents the mitral valves from closing effectively.

Arrhythmias are common in this disease, both in the asymptomatic and symptomatic stages, and often require treatment. The most common...
Cough is a common complaint that does not necessarily indicate heart failure. Instead, it may be related to an enlarged heart compressing the airway (ie, mainstem bronchial compression) or primary airway/lung disease.

In a dog with a good appetite and normal activity level, a chronic, harsh cough that ends with a gag is less likely to be associated with heart failure. Cough from mainstem bronchial compression can occur before onset of congestive heart failure (CHF) and often persists after active pulmonary edema has been resolved with diuretic therapy (Figure 1).

It is useful to ask the following questions about a cough:
- How long has the cough or respiratory signs been present?
- Is the cough harsh (often described as “ending with a gag” or a sound similar to “a cat with a hairball”)?
- How are the dog’s appetite and activity level?

**FIGURE 1.** Right lateral thoracic radiographs in 2 dogs with DMVD and radiographic cardiomegaly, including left atrial enlargement (LA): A 14-year-old shih tzu (A) was receiving heart failure medications (enalapril, furosemide, pimobendan), but still had a chronic, harsh cough that had been present for several months despite administration of cardiac drugs. The dog had a good appetite and activity level, with an at-home resting breathing rate of 24 breaths/min. Mainstem bronchial compression (arrow) was documented. Following progressive enlargement of the left atrium, a cough from mainstem bronchial compression can develop before heart failure, and persist after initiation of heart failure therapy. Although this type of cough does not typically resolve, it is often managed with a cough suppressant once the dog is not in active CHF. A 9-year-old Cavalier King Charles spaniel (B) presented for acute onset cough and breathing difficulty over 24 hours. There is pulmonary venous enlargement (arrow) and an interstitial pattern consistent with pulmonary edema as evidence of CHF.
ARRHYTHMIAS ARE ATRIAL FIBRILLATION, VENTRICULAR PREMATURE COMPLEXES, AND VENTRICULAR TACHYCARDIA.

A CASE TO CONSIDER
Consider the following scenario: An 8-year-old castrated male bichon frise has a 6-month history of exercise-induced cough and a grade 3/6 systolic left-sided heart murmur. The owner is concerned that the dog is coughing during the night and has labored breathing. During auscultation, the murmur is classified as grade 4/6 systolic, heard loudest at the left apex.

Consider These Questions
Is this dog experiencing heart failure? Can you answer this question based on the available information, or do you need further details? What additional information is needed?

Consider These Answers
The signalment, combined with a heart murmur and cough, suggests that heart failure is possible; however, additional information from the history, physical examination, and diagnostic tests is needed to confirm whether the diagnosis is CHF.

PRACTICAL TIPS FOR DIAGNOSIS & MANAGEMENT
Following are 6 practical tips for optimizing heart failure diagnosis and management in dogs. These tips also provide the additional information needed for diagnosis of CHF as discussed in Consider These Answers.

1. Consider Patient Signalment
Age and breed are useful when considering reasonable differential diagnoses for the type of disease responsible for heart failure.

   Dogs younger than 2 years of age are more likely to have congenital heart disease, while middle-aged to older dogs are more likely to have an acquired, adult-onset disease. Certain breeds are predisposed to specific disease processes. Classic examples include DMVD incidence in small breeds, such as miniature poodles and Cavalier King Charles spaniels, and DCM incidence in large breeds, such as Doberman pinschers and Great Danes.

   Specific examples include:
   • Incidence of DMVD in Cavalier King Charles spaniels increases with age but, in general, DMVD occurs at a younger age in this breed compared with other breeds. A mitral murmur can become evident at or after 4 years of age, but despite early age of onset, rate of progression is reportedly no different than progression rate in other breeds.
   • Lifetime risk for DCM in Doberman pinschers is approximately 60%; thus, about half of all Doberman pinschers develop this disease. The risk for asymptomatic DCM in Doberman pinschers increases with age and likely peaks around 7 years; however, the condition is sometimes seen in dogs as young as 3 years of age.

   Identifying an individual dog’s type of heart disease helps guide assessment and treatment recommendations.

2. Be a Detective: Ask Detailed Questions
Take time to gather information from the patient’s history and physical examination, including details that may help determine whether the dog has heart failure and why it may have occurred.

Does the history support heart disease and heart failure?
• Is there a history of heart disease in a relative or littermate?
• Is congenital or acquired heart disease more likely? For instance, in a middle-aged to older dog, is the murmur a relatively new finding, suggesting an acquired disease, or has it been present since the dog was a puppy, suggesting undiagnosed congenital heart disease? See Consider These Cases (#1).
• Does the history of clinical sign progression support heart failure? Findings from the history that support heart failure are listed in Table 1. These findings, while not specific for heart failure, suggest that pulmonary edema may be present, especially when combined with signalment and abnormal findings on physical examination.

Does the physical examination support heart disease and heart failure?
• A left apical systolic murmur is a characteristic finding in dogs with mitral regurgitation from

<table>
<thead>
<tr>
<th>TABLE 1. Clinical Signs Supportive of Heart Failure</th>
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<tr>
<td>• Difficulty breathing</td>
</tr>
<tr>
<td>• Worsening chronic cough that is associated with increased respiratory rate</td>
</tr>
<tr>
<td>• Decreased appetite</td>
</tr>
<tr>
<td>• Recent onset of coughing</td>
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<tr>
<td>• Reduced activity or exercise ability</td>
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DMVD, and a loud murmur is more likely with advanced disease. See Consider These Cases (#2).

- A rapid heart rate, most often a sinus tachycardia (Figure 2), is associated with epinephrine and increased sympathetic drive in heart failure. A normal heart rate or respiratory sinus arrhythmia (Figure 3) suggests an absence of sympathetic drive and indicates that heart failure is not the most likely cause of respiratory signs.

- Are there other signs of potential heart disease, including a gallop or arrhythmia?
  - As the atria increase in size, dogs may develop supraventricular arrhythmias, such as premature beats, bursts of supraventricular tachycardia, and atrial fibrillation. An arrhythmia may be heard during auscultation of the thorax or appreciated upon palpation of pulses.
  - Pulses may be irregular, weak, or occasionally absent. An S₃ gallop can be heard in dogs with DCM associated with rapid ventricular filling into an enlarged, poorly contracting and relaxing ventricle.

3. Know When to Test
Thoracic radiographs and serum biochemistries are complementary:
Radiographs are critical for assessing cough or respiratory signs and monitoring heart failure therapy. Thoracic radiographs provide information on measures of heart size (ie, number of rib spaces, vertebral heart size), specific chamber enlargement, pulmonary vessel size, and pulmonary patterns.

**Consider These Cases**

**Case #1:** A 9-year-old castrated male golden retriever was presented for increased respiratory rate and restlessness. Initially, on the basis of signalment, the clinician considered pericardial effusion and a heart base tumor as possible differential diagnoses. However, the owner remembered that the dog had a murmur as a puppy. During the physical examination, a grade 4/6 systolic left basilar murmur was auscultated and heart sounds were not muffled. Congenital subaortic stenosis resulting in left-sided CHF (ie, pulmonary edema) was subsequently diagnosed.

**Case #2:** Consider the case presented on page 26—the 8-year-old castrated male bichon frise with 6-month history of exercise-induced cough and a grade 3/6 systolic left-sided heart murmur, whose owner reported coughing during the night and labored breathing. When you auscultate the dog, the murmur has increased to a grade 4/6 systolic left apical murmur. Based on clinical presentation, which scenario outlined in Table 2 is more consistent with heart failure in this patient?

**Scenario 2**—demonstrating increased heart and respiratory rates compared with Scenario 1—is consistent with CHF in this coughing dog with a heart murmur.

**Table 2. Physical Examination Scenarios: Coughing Dog with Heart Murmur**

<table>
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<tr>
<th>PARAMETERS</th>
<th>SCENARIO 1</th>
<th>SCENARIO 2</th>
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<tr>
<td>Heart rate</td>
<td>110 beats/min</td>
<td>170 beats/min</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>35 breaths/min</td>
<td>80 breaths/min</td>
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**Figure 2.** Lead II electrocardiogram demonstrating sinus tachycardia with a regular rhythm and heart rate of 175 beats/min in a dog with CHF (25 mm/s; 10 mm/mV).

**Figure 3.** Lead II electrocardiogram demonstrating sinus arrhythmia with an irregular rhythm and heart rate of 80 beats/min in a dog with a murmur, chronic cough, and tracheal collapse (25 mm/s; 10 mm/mV).
Abnormalities that support CHF include:
- Left atrial enlargement
- Pulmonary venous enlargement
- Perihilar interstitial-to-alveolar pattern from pulmonary edema.

During initial presentation for coughing or decreased exercise tolerance, radiographs are the best way to confirm presence of venous congestion and pulmonary edema. Radiographs can also indicate bronchial compression due to an enlarged left atrium and rule out alternate diagnoses, such as pneumonia or pulmonary neoplasia. When CHF is suspected, diuretic therapy can be initiated before thoracic radiography if the patient is dyspneic.

Periodic biochemistry monitoring is important in dogs receiving diuretics and ACE inhibitors or those with comorbid conditions, such as kidney disease. Adjustments in diuretic dosing can be based on clinical signs, radiographic findings, and kidney values to achieve the lowest effective dose.

Echocardiography is a powerful tool; know when to perform it:
Echocardiography can establish the type of heart disease and identify complicating factors, such as pulmonary hypertension, systolic ventricular dysfunction, high left-sided filling pressures, intracardiac shunts, atrial tears, and pericardial effusion. Echocardiography can also identify anatomic abnormalities and assess function, but it cannot specifically diagnose the presence of CHF.

Echocardiography is not typically necessary until a dog is clinically stable; however, it can provide useful information to guide treatment protocols and is especially helpful when response to heart failure therapy does not meet expectations and additional treatment may be indicated. A more detailed study requires an experienced sonographer to identify complex issues and characterize congenital defects (see Tip 6).

4. When Recommending Therapy, Consider Comorbidities and Drug Interactions and Adverse Effects
For the 2 most common acquired heart diseases in the dog—DMVD and DCM—recommended heart failure therapy includes multiple medications, typically furosemide, pimobendan, and an ACE inhibitor.

Adult dogs are more likely to have concurrent systemic diseases—kidney disease, protein-losing diseases, hyperadrenocorticism, and arthritis—that are important to consider when making treatment recommendations. It is also essential to consider the patient’s medical history, current drug therapy, potential adverse effects of cardiac medications, and drug interactions.
- Decreased glomerular filtration rate in a dog with kidney disease may be a concern when ACE inhibitors, diuretic therapy, and nonsteroidal anti-inflammatory drugs are being administered.
- Electrolyte concentrations are affected by ACE inhibitors and diuretics.
- Pulmonary hypertension can develop in dogs with DMVD, protein-losing diseases, and hyperadrenocorticism.

5. Make Recommendations for Home Care That Considers the Pet’s and Care Taker’s Quality of Life
Involve owners in monitoring their dogs’ heart disease:

Set up a recheck schedule to monitor disease progression, potential adverse effects of medications, patient quality of life, and any challenges faced by the owner. Recheck evaluations for a dog in heart failure are often recommended every 2 to 4 months, or sooner, if medications are adjusted or clinical decompensation occurs.

Educate owners about clinical signs that indicate their dogs need medical attention, including cough (new or worsening), breathing difficulty, anorexia or vomiting, and lethargy or collapse.

Encourage owners to record resting or sleeping breathing rates at home. Many dogs have a resting breathing rate of less than 35 breaths/minute, often in the mid-teens to mid-twenties. An elevated breathing rate that is repeatable within the hour, especially if the dog has breathing difficulty or a decrease in appetite or activity level, should prompt medical attention.

Additional points to consider:
- Ensure the dog is eating and taking its medications. Make recommendations for a palatable diet and advise the owner to avoid high-salt foods and treats when possible.
- Set activity level expectations, which varies for each dog. Light activity is acceptable and encouraged, especially if it enhances quality of life, but strenuous activity needs to be avoided.
- Consider the owner’s lifestyle when making treatment recommendations. For instance, therapy given more than twice daily may be difficult for some owners.
Success is often measured by quality of life as well as duration of survival after diagnosis. With good management, many dogs with progressive heart failure can have a good quality of life as well as improved survival times.

6. Establish a Relationship with a Local Cardiologist

Consider referral to a cardiologist, when available. Clinical evaluation by a cardiologist can be beneficial to establish the diagnosis, develop a comprehensive treatment and re-evaluation plan, fine-tune therapy, and keep up with current guidelines, especially when the diagnosis is difficult or therapy ineffective.

Guidelines for the staging, diagnosis, and management of degenerative valve disease were established by a committee of cardiologists and published by the American College of Veterinary Internal Medicine in 2009 (see Suggested Reading). Additional information from clinical trials continues to become available.

ACE = angiotensin-converting enzyme; CHF = congestive heart failure; DCM = dilated cardiomyopathy; DMVD = degenerative mitral valve disease

Disclosure Statement

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Suggested Reading


