

Canine cardiac disease: a review of recent developments

Author : Emma Gerrard

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ABSTRACT

The field of veterinary cardiology is continually expanding, with scientific studies and papers arising each year that provide additional knowledge so a better quality of care can be provided for our patients. The most significant recent development in canine cardiology is the outcome from the PROTECT study. Further studies into mitral valve prosthesis are also under way.

It is vital vet nurses understand the anatomy of the heart and the effects heart failure can have as their role can be extensive. It is also beneficial to have an understanding of the treatment advances to provide the best care possible to these patients.

CARDIAC disease is commonly encountered in general veterinary practice and can account for approximately 15% of all medical cases seen.

What is cardiac disease?

Cardiac disease is a broad term used to describe a range of diseases that affect the heart. It can be a condition of the heart, blood vessels or valves that disrupts normal function. Cardiac disease in small animals can be classified by whether the defect or disease is congenital (present at birth) or acquired (occurs in adulthood).

Many heart diseases are heritable and some congenital heart diseases are known to be hereditary. Cardiac disease can also be classified according to the part of the heart affected – for example, valves, muscle or major blood vessels (congenital, valvular, myocardial – primary heart disease – and pericardial).

Heart anatomy

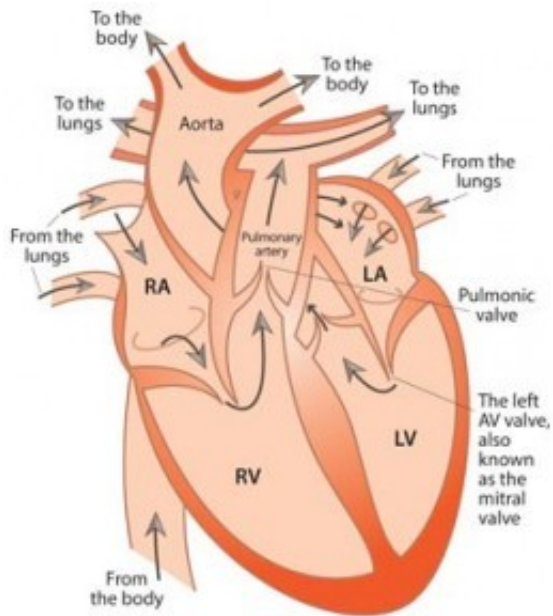


Figure 1. Diagram showing heart functionality.

The heart is a muscular pump divided into four chambers – two atria and two ventricles – that lies within the mediastinum in the thorax. The interventricular septum separates the two sides of the heart and, unless there is a septal defect, the two sides never directly communicate.

Deoxygenated blood returns to the right side of the heart via the venous circulation. It is pumped into the right ventricle and then to the lungs where carbon dioxide is released and oxygen is absorbed. The oxygenated blood then travels back to the left side of the heart into the left atrium, then into the left ventricle, from where it is pumped into the aorta and arterial circulation. The pressure created in the arteries by the contraction of the left ventricle is the systolic blood pressure.

Once the left ventricle has fully contracted, it begins to relax and refill with blood from the left atrium. The pressure in the arteries falls while the ventricle refills. This is the diastolic blood pressure (**Figure 1**).

Congenital heart disease

Congenital heart disease accounts for about 5% of the cases of heart disease seen in practice (Buchanan, 1992). Congenital heart diseases are often detected at first vaccination when auscultation of the heart reveals a murmur. Owners may notice their pet fails to grow, suffers from exercise intolerance, develops a cough, displays dyspnoea or has episodes of syncope. Canine congenital defects often have breed predispositions and the most common include:

- aortic stenosis (AS)
- patent ductus arteriosus between the aorta and pulmonary trunk
- pulmonic stenosis (PS).

Other defects include:

- ventricular septal defect (VSD; **Figure 2**) between the left and right ventricles
- atrial septal defect (ASD) between the left and right atria

VSDs and ASDs are cardiac shunts and are abnormal communications between chambers of the left and right sides of the heart.

Aortic and pulmonic stenoses



Figure 2. Ventricular septal defect. IMAGE: Mark Overend.

A stenosis is a narrowing over a valve or an inadequate opening of the valves. AS and PS are equally prevalent congenital heart defects in which a malformation impedes the flow of blood through the heart. AS is the most common congenital defect seen in dogs; boxers are thought to make up 50% of the number of dogs diagnosed in the UK (Martin and Corcoran, 1997). Other breeds commonly affected are Newfoundlands, German shepherd dogs, golden retrievers, Samoyeds and Rottweilers.

Three types of AS exist – the most common is subvalvular fibrous ring, followed by valvular and supra-valvular (rare). Subvalvular stenosis is also known as subaortic stenosis. AS is most commonly a narrowing or reduction just above or below the aortic valve, and very rarely affects the actual valve. This causes a partial obstruction of the blood flowing from the left ventricle through the aortic valves and into the aorta.

Common acquired heart disease

Common acquired heart disease includes:

- degenerative mitral valve disease (DMVD) or myxomatous mitral valve disease (MMVD)
- dilated cardiomyopathy (DCM)

The study of chronic valvular heart disease (CHVD) and DCM are two of the most researched fields in canine cardiology.

Degenerative mitral valve disease



Figure 3. Degenerative mitral valve disease echocardiogram. IMAGE: Mark Overend.

DMVD, also known as MMVD, is chronic degeneration of the heart valves causing valve malfunction (leaking). DMVD accounts for more than 75% of cardiovascular disease patients in dogs (Prosek, 2007). It is the most commonly diagnosed acquired heart disease in dogs, with cavalier King Charles spaniels, Yorkshire terriers, miniature poodles and dachshunds being over-represented (Borgarelli and Haggstrom, 2010).

The atrioventricular, mitral and tricuspid valves are affected. These allow blood to move one way between the atria and ventricles, and create a seal between the atrium and ventricles to prevent regurgitation. When degeneration occurs, the valves have impaired closure, resulting in regurgitation, causing volume overload in the heart chamber and vessels.

The mitral valve is most commonly affected and this is often known as mitral valve disease (MVD), leading to left-sided congestive heart failure (CHF). In approximately 60% of dogs with DMVD, the mitral valve will be affected, 30% will have mitral and tricuspid valve degeneration and 10% will be affected by tricuspid valve disease.



Figure 4. Degenerative mitral valve disease echocardiogram colour flow. IMAGE: Mark Overend.

Valvular disease is the most common cause of left-sided CHF in dogs, with a higher incidence in older dogs and small to medium-sized breeds, such as cavalier King Charles spaniels, miniature poodles and cocker spaniels.

The majority of DMVD cases will go undiagnosed until clinical symptoms are noticed by the owner or when a vet first detects a murmur. Therefore, it is very important clients are made aware of the importance of annual checks and screenings (**Figures 3 and 4**) – especially for breeds predisposed to heart conditions.

Unfortunately, valve replacements are not available in veterinary medicine (Uechi, 2012), so palliative treatments are the only option for these patients. However, a specifically designed mitral valve prosthesis for dogs is being developed through a collaborative effort between Colorado State University and Avalon Medical. The device is being tested with clinical cases at Colorado State University.

DMVD treatment involves eliminating CHF signs by using medication to resolve disease symptoms. Patients with right-sided CHF may require abdominal paracentesis to relieve ascitic pressure. DMVD is not curable, but treatment can increase the patient's life expectancy. It is vital clients are informed of the importance of giving medication and the detrimental effects of not.

Dilated cardiomyopathy

DCM is the most common form of cardiomyopathy in dogs and the second most common form of acquired heart disease in dogs after DMVD (Summerfield et al, 2012). DCM primarily affects the myocardium and is characterised by a thin ventricular wall, enlarged heart chambers and reduced pumping of the ventricular muscle.

As the ventricular heart muscle deteriorates, systolic pump function decreases and intracardiac pressures increase, putting affected dogs at high risk for fatal CHF. DCM most commonly affects the left side of the heart, specifically the left ventricle. As a result, blood backs up, causing pulmonary oedema (left-sided CHF). Less commonly, DCM can affect the right side of the heart, resulting in ascites and pleural effusion (right-sided CHF).

In some dogs, both sides of the heart may be affected, with an obvious detrimental effect. It tends to occur in giant breeds such as Newfoundlands, Dobermanns, boxers and great Danes. DCM was previously seen in cats with taurine deficiency, although with the increase in complete commercial diets, it is now rarely seen. Carnitine deficiency has been associated with myocardial disease in people and its role in canine DCM has been of interest (Devi and Jarni, 2009).



Figure 5. A dilated cardiomyopathy case. IMAGE: Mark Overend.

Clinical signs include weight loss, lethargy, coughing, ascites and heart murmur, and signs are often apparently acute in onset. Many dogs have electrical changes, with atrial fibrillation a common rhythm disturbance seen in dogs with DCM. Sudden death can occur (Summers, 2002). The prevalence of DCM in Dobermanns increases with age and the estimated proportion of purebred Dobermanns that develop DCM in their lifetime is about 25% to 50% (Wess et al, 2010).

Around 30% of Dobermanns die suddenly in the occult phase of DCM (O'Grady, 2002). Reduced cardiac output and poor ventricular contractility results in a weak pulse, tachycardia and poor peripheral perfusion in these patients. Diagnostic tools to diagnose occult DCM include Holter monitoring (www.holtermonitoring.co.uk), thoracic radiography in lateral and dorsoventral views, echocardiography and ECG (**Figure 5**).

DCM is a progressive, irreversible and terminal illness. The life expectancy depends on the patient and the severity of the heart damage. With effective and supportive treatment, along with regular checks, patients can have a good quality of life. Treatment depends on the severity of the disease

and clinical signs, but often involves the use of furosemide, angiotensin-converting enzyme inhibitors, inodilators, such as pimobendan, digoxin and other antiarrhythmics depending on the case.

PROTECT study

The pimobendan randomised occult DCM trial to evaluate clinical symptoms and time to heart failure (PROTECT) study (Summerfield et al, 2012) is the most significant recent development in veterinary cardiology. Results have proved the administration of pimobendan to Dobermanns with preclinical or occult phase of DCM delays the endpoint for a patient, whether CHF or death.

These positive results have renewed interest in the diagnosis and treatment of preclinical DCM in Dobermanns and other breeds. This is the first time a trial's finding has established preclinical treatment of a disease can change the patient outcome. This knowledge therefore demonstrates the importance of pre-screening and early detection of breeds susceptible to DCM.

Management of heart disease, diagnosis and VN interventions

VNs assist vets with all aspects of heart disease management, from diagnosis to treatment. It is therefore important VNs have a good understanding of the anatomy and physiology of the heart, cardiac and lung auscultation, and the nursing interventions needed in the management of patients with cardiac disease.

ECG is an important adjunctive diagnostic aid in monitoring and diagnosing heart disease. It demonstrates the electrical activity of the heart (depolarisation and repolarisation) and shows the heart's rate and rhythm. VNs should be able to perform an ECG and identify a normal trace.

VNs are often responsible for radiography and should, therefore, have an understanding of the views required for patients with heart disease. Most will require a minimum of one lateral view and a dorsoventral view. VNs will often assist in the restraint of patients for Doppler echocardiography, which is the gold standard for definitive diagnosis of cardiac disease. It is particularly helpful in cases of pericardial effusion or cardiomegaly and can differentiate between MVD, DCM and pericardial effusion from congenital cardiac disease.

Many patients with heart disease are geriatric, so careful thought and planning should be given to their requirements, such as comfort, by providing plenty of padded bedding and the opportunity to stretch limbs to keep mobile. Prevention of stress and keeping a patient cool are often vital during diagnostic tests.

VNs are important in monitoring vital signs and weight in cardiac patients. Subtle increases in respiration, heart rate and bodyweight can indicate changes in their condition. Nurses can also measure the abdominal girth for indications of ascitic changes. Monitoring of resting respiratory

rates is a key indicator to the severity of heart failure and in assessing the development or resolution of pulmonary oedema. Ceva Animal Health launched a pioneering smart phone app, Cardalis, which allows owners to assess their dog's respiratory rate at home.

Other roles for VNs include blood sampling for cardiac biomarkers N-terminal pro-B-type natriuretic peptide and troponin I; placement of intravenous catheters; blood pressure monitoring; placing Holter monitors; providing oxygen therapy; gathering equipment and consumables; preparing for ECG, radiographs and Doppler echocardiography; administering medication prescribed by the vet; and routine nursing aspects of inpatient care.

Increased frequency of walks to allow urination is important for patients on diuretics, which can make all the difference to patient comfort. Patients with CHF may benefit from a diet with restricted sodium to help decrease water retention. Cardiac cachexia is common in patients with CHF, so adequate energy intake is important.

Conclusions

Canine cardiology is rapidly evolving and, as a result, VNs must be aware of developments. VNs can undoubtedly play a crucial role in cardiology cases in terms of planning, diagnostic assistance, patient handling and monitoring. With many VNs running their own clinics and advising clients, it is important they are able to recognise signs of heart disease, such as exercise intolerance, dyspnoea or coughing, and advise owners accordingly. Any concerns raised should be forwarded to the vet for diagnosis.

VNs also have a great deal of responsibility when explaining medical management and home care to clients with cardiac patients. Thus general understanding of the underlying condition is beneficial when managing these patients.

- This article was reviewed by, and all images are from, Mark Overend, MRCVS.

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