Canine cardiology: conditions, causes, advances and care

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Samantha Frogley RVN, DipAVN (small animal), considers the needs of dogs with heart conditions and looks at advances in nursing care that can be offered to these patients

Summary

This article discusses advances in the treatment of common canine cardiac conditions. These include interventional surgery and progressions in the nursing care that can be provided. Cardiac disease is becoming more easily diagnosed in practice and there are many new developments to be aware of. Nursing of these patients is developing alongside progressions in how these cases are treated. Understanding the anatomy of the heart and the effects heart failure can have is vital in supporting these cases. Understanding the advances in treatment will also be beneficial in providing the best care possible to these patients.

Key words

cardiac, hypertrophic cardiomyopathy, dilated cardiomyopathy, mitral valve disease

To fully understand cardiac diseases and the advances in cardiology it is necessary to have a good understanding of the anatomy and physiology of the heart.

The heart is located in the mediastinum; this is the gap between the two pleural cavities of the thorax. It sits in its own sac called the pericardium that fixes the heart in position, protects it and holds a small amount of fluid to reduce the friction caused by the heart’s constant pumping action.
Within the heart there are four chambers, two atria and two ventricles. The atria receive the blood and the ventricles are responsible for pumping it. The heart can be divided into two sides. The right side (atrium and ventricle) is responsible for receiving blood from the systemic venous circulation and pumping it to the lungs. The left side receives blood from the lungs and pumps it into the rest of the body. Both ventricles are separated from the atria by uni-directional valves (atrioventricular valves) that prevent blood from flowing back into the atria during ventricular contraction.

The heart can be affected by several pathologies and these can be divided in four groups: congenital, valvular, myocardial (primary heart muscle disease) and pericardial.

It is important to differentiate heart disease from heart failure. Heart disease is the presence of any cardiac abnormality that compromises the cardiac function. Heart failure is a clinical syndrome generated by any cardiac disease severe enough to overwhelm the body’s capacity to compensate for the results of the disease, leading to low arterial blood pressure and elevated venous pressure, and extravascular fluid accumulation (ascites, pleural effusion and/or pulmonary oedema).

Not all cardiac diseases progress to a stage of heart failure. It is important to know each function of the two different sides of the heart to be able to understand the types of heart failure. This will guide the nursing care needed and the clinical signs to monitor.

Heart failure can eventually affect both sides of the heart with different results. For example, right-sided heart failure will result in the congestion of the abdominal organs leading to ascites. Left-sided heart failure will result in congestion in the vessels in the lungs and, ultimately, pulmonary oedema.

**Common acquired canine conditions**

**Endocardiosis/mitral valve disease**

Endocardiosis/mitral valve disease is the most common acquired heart disease in dogs. All small breed dogs can be affected but prevalence is greater in the cavalier King Charles spaniel. It is a degenerative condition of the mitral valves, which results in blood flow leaking through the valves when closed.

Patients normally present with a heart murmur, which may progress to left-sided heart failure. Radiographs will show enlargement of the left side of the heart and an echocardiogram will demonstrate distortion of the valves (Dunn and Baines, 2003). There is therapy specific for the valvular degeneration, but when congestive heart failure (CHF) is present, further therapy is necessary to maintain quality of life.

Typically, all these patients will have poor exercise tolerance and, depending on the type of CHF,
varying clinical signs, such as increased respiratory rate and effort, cough or ascites, will be present (Aldridge and O’Dwyer, 2013b).

**Advances**

Surgical mitral valve repair is common in human medicine; however, it is relatively rare in the veterinary field (Uechi, 2012). An article has reported a good recovery rate and increase in life expectancy in canines that have had mitral valve repair. The procedure requires the patients to go on to cardiopulmonary bypass and this is a complicated process available only in a few institutions worldwide, which limits its widespread use. Without surgical treatment patients commonly do not live longer than a year post-heart failure diagnosis, even when on medication (Uechi, 2012). Dr Uechi observed 93 per cent survival of 38 months post-repair of the mitral valve.

A procedure of mitral valve replacement with a specifically designed mitral valve prosthesis for dogs (MitralSeal) is being developed by Avalon Medical. The procedure is not yet available, but a US clinical trial is ongoing at Colorado State University. The biggest advantage is that cardiopulmonary bypass is not required.

**Dilated cardiomyopathy**

Dilated cardiomyopathy (DCM) is seen in medium to large breed dogs, and Dobermanns are over-represented. This disease causes a progressive loss of contractility of the myocardium muscle of the heart and results in chamber enlargement. The condition can result in both left and right-sided CHF.

Radiographs will show an enlarged heart silhouette and an echocardiogram will show reduced contractility of the heart. An electrocardiogram (ECG) may show dysrhythmias and sometimes atrial fibrillation (Dunn and Baines, 2003)

Symptomatic treatment is needed for CHF. This includes the use of diuretics and an inodilator, such as pimobendan, that increases the muscles’ contractility and the provision of oxygen.

**Advance**

The Pimobendan Randomised Occult DCM Trial to Evaluate Clinical Symptoms and time to heart failure (PROTECT) study published in 2012 has shown pimobendan, when given to preclinical Dobermanns, delays the onset of DCM and increases survival time.

**Hypertrophic cardiomyopathy**

Hypertrophic cardiomyopathy (HCM) is common in cats and less common in dogs.
In HCM the heart walls are thickened – most probably due to a genetic mutation. It is important to remember if the heart is put under increased pressure load, such as with hypertension, the myocardial wall will become thicker, but this is a physiological response to the increased workload. HCM is a diagnosis of exclusion when thick myocardial walls are present with no secondary causes (hypertension or marked dehydration) present (Dunn and Baines, 2013).

Radiographic enlargement of the cardiac silhouette is rarely seen in HCM because the hypertrophy is concentric (internal), but the heart may appear enlarged if the left atrium is significantly dilated. ECG abnormalities may be seen and these are often dysrhythmias, most commonly ventricular premature contractions (VPCs). Treatment involves treating any underlying cause and managing the CHF.

**Congenital conditions and interventional cardiology**

Interventional cardiology is becoming more available and has moved on dramatically following advances in the human field.

Two common conditions canines suffer are patent ductus arteriosus (PDA) and pulmonic stenosis. Both conditions can be helped by minimally invasive surgical intervention.

PDA is the failure of the fetal duct to close after birth. This failure leads to over-circulation and enlargement to the left side of the heart. This can lead to heart failure if not detected early. About 70 per cent of affected animals will die in the first 18 months of life (White, 2009). Once the patient has developed heart failure, treatment is normally symptomatic (Dunn and Baines, 2003). These patients normally have a heart murmur, which is often picked up at vaccination (Dunn and Baines, 2003). An echocardiogram will normally confirm the presence of a PDA.

PDAs were previously closed via surgical ligation of the duct, normally via a thoracotomy. Although normally successful, it involves major and invasive surgery. Postoperatively, obvious considerations are for pain relief and the need for a longer term hospital stay. However, there is another method to occlude the fetal duct. Having been developed initially in paediatric medicine, the Amplatz canine ductal occluder was specifically developed for the veterinary market and is now being used routinely to treat PDA in dogs.

The procedure involves passing the occluder through the femoral artery. It is guided into place (the patent ductus) using fluoroscopy and angiography. Fluoroscopy is the use of x-rays to produce real-time moving images. Due to the potential exposure to x-rays during the procedure the team needs to wear protective equipment (lead gowns) under their gowns – this can lead to a rather hot and bothered surgeon.

Administration of contrast agents (angiography) is also necessary to highlight the vascular structures, but this is not without complication as most agents can create damage to the kidneys,
especially in patients with poor cardiac output. This is very rare, but something to be aware of.

**Advances**

Developments have reduced the fluoroscopy time and angiography for these procedures. The most relevant is transoesophageal echocardiography. This is a specifically developed ultrasound probe on an endoscope placed in the oesophagus over the heart that allows for superior and real time visualisation of the structures (Silva et al, 2013).

From a nursing point of view these cases are very exciting, although aftercare can be minimal. Close observation is normally needed postoperatively as many of these patients can have a prolonged recovery from the procedure and suffer arrhythmias. During surgery the patient must be attached to an ECG monitor and any abnormalities reported to the surgeon. Care must be given to the use of fluid therapy, as volume overload should be avoided in all cardiac patients.

The second condition that can be helped with surgery is pulmonic stenosis. The pulmonic valve prevents back flow from the lungs in the pulmonary artery and this can be narrowed, as can the pulmonic artery itself. This is congenital and patients will present with a murmur.

The condition can progress to right-sided heart failure and thoracic radiographs will show enlargement of the right side of the heart (Dunn and Baines, 2003).

Pulmonic stenosis should be corrected interventionally if it is severe. This is the procedure known as balloon valvuloplasty. It involves a similar procedure to that of the PDA. A balloon is used rather than the occluder and it is passed down the jugular rather than the femoral artery to gain access to the right side of the heart. The balloon is then inflated in place to relieve the stenosis and subsequently removed. An angiogram is normally carried out to check the size of balloon needed, but again, transoesophageal echocardiography can be used in many situations (Pace, 2011).

General nursing considerations for cardiac patients include:

- minimising stress;
- providing oxygen therapy;
- close patient monitoring;
- administration of medication; and
- assisting with diagnostic procedures.

**Nursing problems and advances in nursing care**
Often, the main problem encountered when nursing cardiac patients is the requirement to provide a stress-free, oxygen-enriched environment, which also allows constant or at least frequent monitoring. To provide all this is often challenging. However, there have been a few advances that make it easier.

For example, administering medication to these animals is always a challenge as many of the medications are oral, but there are developments in intravenous forms of these. Most excitingly, pimobendan has been brought out in an injectable form. This enables it to be given through an intravenous catheter until the patient is eating. Intravenous medications are always preferred in cardiac patients as they prevent unnecessary handling (Aldridge and O’Dwyer, 2013b).

**Nasal oxygen**

Typically, oxygen is administered by the use of an oxygen cage/kennel or by using a buster collar and cling film. The first method can be expensive and also create a hot environment for the patient. It also limits monitoring of these patients and isolates them (Waddell and King, 2007). Nasal prongs have their use, but often they are not well-tolerated and are easily displaced (Aldridge and O’Dwyer, 2013a).

An alternative method is the placement of a nasal catheter. This is a simple technique that can increase inspired oxygen levels by 50 per cent (Aldridge and O’Dwyer, 2013a). If a second catheter is placed this can increase the levels to 70 per cent. These can be left in while the patient is in hospital, but the oxygen administered must be humidified to prevent the nares drying and not administered at a high flow rate.

**How to place a nasal catheter**

- Measure the distance between the medial canthus and the nostril. Mark this on the tube with a permanent pen.

- Apply the local anaesthetic to the nostril, then allow sometime for this to take effect.

- Gently restrain the patient and then insert the catheter. This should be aimed ventromedially (towards the base of the ear on the other side) to ease placement.

- If it is not in the right place it will not advance to the measured distance. Remove and retry (Aldridge and O’Dwyer, 2013).

- Once in place, staple using a butterfly made out of tape. The author avoids tissue glue due to the bald and sometimes sore spots it can leave.

Nasal catheters can be really useful; although some fiddling around with endotracheal tube bits and
bobs can be needed. They are generally well tolerated; although once the patient starts feeling better a buster collar can be needed to prevent patient interference. Catheters allow the patient to be disconnected if desired, but also to remain on oxygen while procedures are taking place.

**Oxygen converters**

The development of reasonably priced oxygen condensers is very helpful in managing cardiac cases. These allow administration of oxygen without the worry of running out overnight or at the weekend. They are excellent for use with nasal catheters.

**Urinary catheters**

Often, one of the key issues when nursing cardiac patients is minimising their stress. The author has experienced many animals becoming stressed when they need to pass urine. Often these patients are limited to cage rest in an oxygen kennel and being administered diuretics, and so have no choice but to toilet in the kennel. This can be distressing for them, especially if they normally toilet in private.

Placing a urinary catheter serves two purposes. Firstly, it is easy to monitor urine output and thus monitor kidney function. Secondly, it relieves patient stress. The need to remove the patient from sometimes much-needed oxygen is reduced. Placing a urinary catheter is straightforward in a male dog, but there is always the risk of ascending infection so the catheter must be connected to a closed drainage system and good hygiene must be observed, this includes wearing gloves when handling the drainage system.

**Presence of multimodal monitors**

From a nursing perspective the use of a monitor can be invaluable. Continuing monitoring of the cardiovascular system in cardiac patients is essential to detect early problems (Aldridge and O'Dwyer, 2013b). Happily, these monitors seem to be more common in veterinary practice and allow frequent or constant monitoring of the heart rate and rhythm and electrical activity in the heart. Any abnormal complexes or rhythms can be detected more quickly and this is beneficial to the patients as cardiac arrhythmias can contribute to morbidity (Aldridge and O'Dwyer, 2013b).

The monitors can also measure oxygen saturation, which can be a good indicator of the need to oxygen supplement. These monitors create a more hands-off approach to nursing, which can benefit easily stressed patients. However, they do not replace the hands-on nursing that is needed with these cases.

Often ECG pads are poorly tolerated and can be uncomfortable for the patients to walk on. By clipping a small area on the front of the paws the ECG pads can be placed on the front, where they are much better tolerated. Be mindful the tape is not too tight, as this will cause paws to swell.
In summary, there are many developments being made in the nursing care we can provide to cardiac patients and the options available to them. The availability in practice of equipment enables closer monitoring of these patients and with developments in drug formulations, such as the combination benazepril and spironolactone, and injectable pimobendan, means we are moving to more stress-free nursing to these patients. Consideration should be given to every aspect of their nursing care, including urination and the ability to move about. With techniques such as nasal oxygen this is becoming more achievable.

References


Reviewed by João Loureiro DVM, CertVC, DipECVIM-CA (cardiology), MRCVS
The Pulmonic Valve - Can be narrowed, in cases of pulmonic Stenosis

The left AV valve, also known as the 'Mitrail Valve'
An oxygen converter.
Equipment to place a nasal oxygen catheter.

A dog with attached ECG pads.
<table>
<thead>
<tr>
<th>Part of the heart</th>
<th>Function</th>
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</thead>
<tbody>
<tr>
<td>Right atrium</td>
<td>Receives blood from the body via the cranial and caudal vena cava</td>
</tr>
<tr>
<td>Right ventricle</td>
<td>Receives blood from the right atrium and pumps it to the lung for oxygenation</td>
</tr>
<tr>
<td>Pulmonary artery</td>
<td>Carries blood from the right ventricle to the lungs. The pulmonic valve is between the ventricle and the artery</td>
</tr>
<tr>
<td>Pulmonary veins (both left and right)</td>
<td>Receive oxygenated blood from the lungs into the left atrium</td>
</tr>
<tr>
<td>Left atrium</td>
<td>Receives oxygenated blood from the pulmonic veins</td>
</tr>
<tr>
<td>Left ventricle</td>
<td>Pumps the oxygenated blood into the aorta, which carries it to the body. The aortic valve separates these two</td>
</tr>
<tr>
<td>Aorta</td>
<td>Carries oxygenated blood to the body</td>
</tr>
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**TABLE 1.** Parts of the heart and function (see left)