The veterinary nurse's diagnostic assessment of the small animal cardiac patient

Veterinary nurses play an important role in small animal practice. This article covers the diagnostic assessment that a nurse may perform on a small animal cardiac patient, from the physical examination to blood tests and advanced imaging. Cardiac patients can present in a variety of situations, including chronic conditions and acute emergencies. The veterinary nurse must be able to work with these patients in a calm manner to prevent creating any additional stress, and must also know when they should refer to a veterinary surgeon.

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Diagnostic tests are often delegated to nurses, but not all nurses are confident doing them, especially when it comes to the sometimes challenging presentation of the cardiac patient. Cardiac patients can present to the practice in a variety of ways; for example, as a puppy or kitten with a heart murmur, an older dog with a classic left apical systolic murmur, in acute life-threatening heart failure or a cat following a thrombotic event. Some patients will require gentle handling, either because they have little myocardial oxygen reserve, are in pain or because their temperament will tolerate little handling. All these patients need to be handled calmly and respectfully, using practice-friendly guidelines to achieve the diagnostic tests required. The importance of creating reliable and repeatable results when assessing the efficacy of medication cannot be underestimated. Guidelines for taking blood pressure measurements in conscious patients have been published, and this calm and measured technique can be transferred to other tests.

Which diagnostic tests might be needed?

Diagnostic tests are needed to either diagnose conditions, assess severity or stage of disease, identify concurrent disease, select appropriate treatment or assess the efficacy of therapy. Physical examination is usually the first step, which is often done when the patient is unstable. Further tests include thoracic-focused assessment with sonography for trauma, triage and tracking (TFAST), full echocardiography, blood sampling, blood pressure and electrocardiography. Radiography or advanced imaging may also be required. Diagnostic tests will depend upon the patient's presentation, history and veterinary surgeon instruction.

Physical examination

Cardiac patients often benefit from a 'less is more' approach, and physical examination can start from initial presentation. Breathing effort and rate can be assessed without touching the patient. Oxygen therapy is never contraindicated, and so nurses can start by providing supplemental oxygen immediately. However, it is important that the patient is not stressed by this. Indications for providing supplemental oxygen are if the patient is in respiratory distress, or showing clinical signs of increased effort, such as orthopnoea, or pale, grey or cyanotic mucus membranes. A veterinary surgeon should be informed immediately if supplemental oxygen is provided, and/or the patient starts to deteriorate. Chest percussion may be performed to assess for pleural effusion, however interpretation requires caution (Corcoran, 2008), and breathing patterns can also be helpful in diagnosis. For example (Johnson and Luis Fuentes, 2010):

- Upper airway disease may cause increased inspiratory effort
- Lower airway disease may present with increased expiratory effort
- Restrictive respiratory patterns may be seen in patients with decreased lung compliance, including pleural space disease
- Paradoxical breathing, when the abdomen moves in as the chest expands, and vice versa, occurs when respiratory muscles are fatigued, and respiration is aided by using the abdomen. Information is also given by the posture of the patient, such

as an extended neck or a wide legged position with elbows abducted to maximise air flow to the lungs. Dyspnoeic patients will prefer to either stand, sit down or lie in sternal recumbency. If the patient is open mouth breathing, then the colour of the mucous membranes can also be assessed. Dyspnoeic patients may have a slight cyanotic or grey tinge to their colour due to hypoxia, and collapsed patients may be pale, as a result of poor circulation. After the physical appearance has been assessed, a hands-on approach can be taken. Auscultation is the next useful technique, as it provides information about chest and heart sounds. Crackles over dorsal lung fields could indicate pulmonary oedema or airway disease, ventral crackles could be indicative of pneumonia and muffled sounds over the ventral sternum could indicate pleural effusion (Johnson and Luis Fuentes, 2010).

Auscultation can also be used to listen to the heart rate and rhythm. Any additional sounds to the normal 'lub' and 'dub', are described as additional heart sounds. These extra sounds are described by location (point of maximal intensity), timing in the cardiac cycle and intensity of the sound. Systolic murmurs are the most common type of heart murmur in small animals, whereas diastolic murmurs are rare (Kvart, 2010). Murmurs that are heard throughout systole and diastole are continuous murmurs.

Taking the temperature of a patient can be problematic. The first question would be to ask if it is truly necessary, and what it would add to a diagnosis. If the patient is stressed by it, the attempt should be aborted. However, rectal temperature can aid in diagnosis. In cats presenting with acute dyspnoea, a low rectal temperature supports a cardiac cause due to poor perfusion, and pyrexia supports non-cardiac disease, particularly pyothorax (Dickson et al, 2018). In cats presenting with aortic thromboembolism, lower rectal temperatures are associated with poorer prognosis (Borgeat et al, 2014a). A temperature should only be taken when the patient has been stabilised, and done calmly with minimal stress.

Blood tests

Blood sampling is often required in cardiac patients. In an ideal world, baseline parameters would be taken before treatment is initiated; however, this needs to be weighed against the stability of the patient, as diuresis might be indicated before attempting venepuncture. Haematology and full biochemistry might be required to rule out concurrent diseases, such as anaemia, hyperthyroidism or renal disease. Due to the often unstable nature of cardiac patients, those who are experienced in restraint and venepuncture should be the ones to take blood samples. Often, this can be delegated to nurses, who can take time to work with the patient. A quiet room, with all equipment prepared and a towel to wrap the cat in are essential to obtaining a stress-free sample. It may even be necessary to take the sample in stages, for example, clipping the fur, allowing the patient to rest, applying a local anaesthetic, allowing rest and then taking the sample when the cream has taken effect.

Other blood tests that may be indicated are biomarkers, such as N-terminal pro-B type natriuretic peptide (NTproBNP) and cardiac troponin I. Both are used widely in human medicine to guide prognosis and guide treatment. NTproBNP is released in response to atrial and ventricular myocardial stretch (Connolly et al, 2009a): therefore, the higher the number on the test, the higher the risk of heart disease. Cardiac troponins are proteins that are found when myocardial cells have been damaged or died (Connolly et al, 2009b).

The main advantage of NTproBNP is that it has been shown to reliably distinguish between respiratory and cardiac dyspnoea (Connolly et al, 2009a). It was also shown that cats hospitalised with congestive heart failure had increased survival times if NTproBNP levels were reduced during hospitalisation (Pierce et al, 2017). Whilst increased circulating NTproBNP has been linked to cats with heart disease in comparison to healthy cats, diagnosis of milder forms of the disease is still difficult (Hsu et al, 2009). NTproBNP cannot distinguish between mild or moderate hypertrophic cardiomyopathy. Furthermore, NTproBNP levels can be increased if the cat is azotaemic, hyperthyroid, or has pulmonary hypertension (Hsu et al, 2009).

Similar problems exist with cardiac troponins. Troponins are also only increased in the later stages of cardiac disease, so are unhelpful for diagnosis of mild to moderate disease (Connolly et al, 2009b). However, cardiac troponin I has been shown to be an independent predictor of cardiac death, independent from congestive heart failure and left atrial dilation (Borgeat et al, 2014b).

To confirm diagnosis of an aortic thromboembolism, comparative blood glucose and lactate can be taken from an affected and non-affected limb. Evidence of an aortic thromboembolism would show lower blood glucose and higher lactate in the affected limb (Klainbart et al, 2014). However, venepuncture in cats with aortic thromboembolisms should be approached with caution, as they can also have heart failure present.

Blood pressure

Blood pressure is used to assess cardiac output, rule out concurrent diseases, such as hypertension and renal disease, and monitor treatment. Despite its usefulness, it is still an underutilised diagnostic tool, and this is where delegating to nurses can be helpful. Nurses can also run clinics to measure blood pressure, take blood samples and talk to owners. This can then be relayed to the veterinary surgeon for assessment. Delegation can help nurses feel more valued and give greater job satisfaction, and working with patients with heart disease is one area where this can happen (CVS, 2023).

Non-invasive blood pressure is best done in a reliable and repeatable method, with notes made on file so that the conditions can be reproduced at the next assessment. The Doppler method, if available, is the preferred technique, although the oscillometric method may benefit patients that cannot tolerate being handled for any period of time. What is important is that whatever method is used, it is repeated so that an accurate trend can be reported. The American College of Veterinary Internal Medicine has produced a consensus statement on hypertension, which includes useful guidelines on how to take blood pressure (Acierno et al, 2018).

Echocardiography – including TFAST

Echocardiography is still considered the gold standard for the diagnosis of heart disease, but it has now been acknowledged how challenging a skill it is to master (Luis Fuentes et al, 2020). Even if it can be practised regularly, patients may not always comply,

either due to the severity of their disease or temperament. Fortunately, point-of-care ultrasound exams can be used to assess for abnormal fluid accumulation, such as pulmonary oedema, pleural or pericardial effusions. It can also be used to estimate left atrial size and left ventricular systolic function (Luis Fuentes et al, 2020).

Nurses may not always necessarily perform echocardiography, although some do, but they can be integral in preparing the patient and monitoring whilst the scan is happening. As with all diagnostic tests, stress should be minimised, and if possible, should be performed in a quiet room. Special attention needs to be paid to the patient with compromised lung capacity, such as those with congestive heart failure or lung disease. Respiratory rate and effort need to be monitored closely if the patient is placed in lateral recumbency. Sedation is not usually recommended for echocardiography because cardiac parameters can be affected (Luis Fuentes et al, 2020).

Electrocardiography

An electrocardiogram can be a vital diagnostic tool in determining heart rate and heart rhythm and is another test that nurses can perform. A good quality trace is important to allow interpretation, and familiarity with the machine is key. Cables should be untangled, and come away from the patient, to avoid crossing the thorax, which will minimise artefacts (Pace, 2016). Best practice positioning recommends right lateral recumbency because it provides a standard for mean electrical axis measurements. However, if the patient is dyspnoeic, then sternal recumbency is recommended. Cats also often prefer to be sternal, so if specific cardiac measurements are not needed, allowing the patient to relax may be preferable. A suitable conduction agent should be used. If defibrillation is an option in the practice, coupling gel should be used. If defibrillation is not an option, surgical spirit is both quicker to

act and easier to clean. *Table 1* provides a brief trouble shooting guide.

Radiography

Thoracic radiography can provide useful diagnostic information to rule out other disease processes, such as lung disease or neoplasia. In dogs with heart disease, chamber enlargement can be identified, especially if used as part of a series, charting disease progression. It is also helpful to diagnose if heart failure is present and to assess efficacy of diuresis. Radiography is not so useful in cats however, because it is insensitive for mild to moderate heart disease (Luis Fuentes et al, 2020), and the pattern of pulmonary oedema in cats is variable. In addition, for both dogs and cats, the diagnostic benefit that may be gained needs to outweigh the safety of taking radiographs, whether that be lying in lateral recumbency when presenting with heart failure, or sedation risk.

Positioning is crucial to enable visualisation of lung fields. If more than one view is required, the dorsoventral view should be taken first and lateral views subsequently, so that the lungs are not compromised. Ideally, radiographs should be taken on inspiration, but if the patient is breathing rapidly or panting, it may be preferable to take the radiograph on expiration to minimise movement blur. The images may not be perfect, but for the purposes of assessing whether heart failure is present, they may be sufficient.

Advanced imaging

Transoesophageal echocardiography is used in referral centres to assist in diagnosis and treatment of congenital heart diseases. The proximity of the heart and oesophagus allows excellent visualisation of structures, especially of the heart base, which are far superior to traditional transthoracic echocardiography. Used in real time, it can guide placement of interventional catheters and deployment of devices, like those used to close patent ductus arteriosus. Domenech and Oliveira (2013) provide more information on transoesophageal uses and techniques.

Cardiac magnetic resonance imaging has been used to assess complex congenital heart diseases in dogs, and to determine neoplastic and non-neoplastic causes of pericardial effusions in dogs. One study used it to evaluate chamber size and heart function in normal canine hearts (Fries et al, 2019). Another assessed myocardial changes in dogs with degenerative mitral valve disease (Clark et al, 2022). Standardising its use is problematic because of the depressant effects of general anaesthesia compared to transthoracic echocardiography. Cardiac magnetic resonance imaging and cardiac computed tomography are similar because they both allow cross sectional views of the heart and reconstruction in multiple planes. Differences occur in that cardiac magnetic resonance imaging allows visualisation of the blood pool without using a contrast agent and provides detailed information on tissue characteristics, but it does not use ionising radiation. As technology advances, so do the uses of advanced imaging in cardiac veterinary medicine.

Conclusions

Nurses can be a genuine asset when diagnostic tests are needed for the cardiac patient. Most tests need to be done in a calm manner,

Table 1: Trouble shooting guide to performing an electrocardiogram	
Issue	Solution
Poor trace	Re-attach electrodes and apply more conduction agent.
Continued poor trace	Where are the cables? Do they cross the thorax? Is the patient moving, or are they being moved (for example, by the operating veterinary surgeon in theatre).
What settings should be used?	Start with lead II, sensitivity 10, paper speed 25.
What if it is a cat and it is a really small trace? Or if it is a dog and the trace is too big?	Change the sensitivity. The bigger the number, the bigger the complexes.
What if the complexes need to be spaced out more?	Change the paper speed. Increase to 50 mm/second if complexes are fast and small, such as in a tachycardic cat.
Does the filter help?	The filter will dampen artefacts but will also reduce visibility of P waves. This may be an issue for cats, as their complexes are smaller.

NB: This list is not exhaustive.

which often takes time. Patients often need to rest between tests, and nurses, working under veterinary surgeon instruction, can prioritise tests to help shape diagnosis and treatment protocols. What all team members need to remember is that tests need to be reliable and repeatable, and so clear instruction should be left on clinical notes. CA

Conflicts of interest

The author declares that there are no conflicts of interest.

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KEY POINTS

- Small animal cardiac patients can present in a variety of ways, including chronic conditions and emergencies.
- Diagnostic tests should be performed over a period of time in a calm manner.
- Veterinary nurses can prioritise tests to help with diagnosis and treatment.
- Diagnostic tests include external physical examination, blood pressure, blood tests, echocardiography, electrocardiography, radiography and other advanced imaging.