Role of the physical exam in decision making in cardiac disease

N. Van Israël, DVM, CESOpht, CertSAM, CertVC, DECVIM-CA (Cardiology), MSc, MRCVS

The general practitioner (GP) should be familiar with the most common cardiac diseases (congenital and acquired), their associated clinical signs, the need for ancillary tests and the possibilities of curative or palliative treatment. The diagnosis will always be based on a combination of history, clinical signs, physical examination and complimentary investigations like blood tests, blood pressure measurement, electrocardiography, radiography and echocardiography. Where canine cardiology appears to be reasonably straight forward in most of the cases, one has to be aware that not many cats read the textbooks.

1. OBSERVATION

Initial observation at presentation is very important to determine the presence of dyspnoea (mild, moderate, severe), to characterise the dyspnoea (inspiratory, expiratory, discordant, restrictive) and to determine the urgency for supplemental oxygen therapy and/or thoracocentesis. Additionally the animal's posture will also give an idea of his respiratory capacity. Cats in respiratory distress should be handled with extreme care. Therefore in cats focused assessment of the thorax (FASTx) by sonography might be preferred over thoracic radiography for initial assessment.

2. PHYSICAL EXAMINATION

2.1. Weight

Because many animals with congestive heart failure (CHF) will have some degree of fluid accumulation, not the weight of the animal, but merely its body condition score (BCS) should be followed over time. Muscle wasting is noticed in the advanced cases of CHF and has been attributed to the release of cytokines (TNF-alpha and interleukins) and poor muscle perfusion.

2.2. Head

Examination of the head includes oral inspection for accuracy of age (teething), mucous membrane colour (pink, pale, dark red, cyanosis) and capillary refill time. Pallor of the mucosae with sluggish capillary refill time is a common finding in advanced canine heart failure. Dark red mucous memebranes might indicate polycythemia. In cats mucous membrane colour and capillary refill time are often normal, even when the cat is in severe heart failure. Cyanosis in the absence of visible dyspnoea is rare in acquired heart disease and is more often associated with a congenital right-to-left shunt or severe respiratory disease. R-PDA can give differential diagnosis. Cyanosis always indicates a critical situation and oxygen supplementation should be considered.

2.3. Neck

The jugular veins are a direct reflection of what is happening at the right side of the heart. Their inspection might warrant clipping or wetting of the hair. Patients with overt right-sided CHF failure may have jugular veins, but this is also seen with pericardial tamponade (occasionally pleural effusion in cats) and cranial mediastinal masses impairing venous return. The hepatojugular reflex might accentuate the

presence of subtle heart failure. Pulsating jugular veins can be seen with decreased right ventricular compliance as in severe right ventricular hypertrophy or with severe tricuspid regurgitation. Pulsation can also be seen with atrioventricular dissociation (3rd degree AV-block) because the atria contract against a closed AV-valve (canon a-waves).

2.4. Thorax

The thorax should be palpated and any abnormalities in thorax shape (eg pectus excavatum) should be noted. The precordial impulse should be felt in the region of the left apex. Feeling a strong apex beat is commonly but wrongly interpreted as a strongly contracting heart. The apex beat is not the heart striking against the thoracic wall but the tension generated by the myocardium. This wall tension is calculated by multiplying the left ventricular chamber pressure times the left ventricular chamber diameter. Consequently a dog with a dilated ventricle will have a stronger apex beat. In cats the precordial shock is often prominent in the presence of a cardiomyopathy. Additionally in cats is the cranial mediastinum very compliant. Absence of this compliance might indicate the presence of a mediastinal mass.
The thorax should also be palpated with the tips of the fingers for the presence of a thrill. A thrill is the ability to feel a murmur and is therefore always located in the region where the heart murmur is heard best. Percussion is very underused and undervalued in small animal practice. It can help in confirming the presence of pleural effusion. Effusions should be tapped to determine their quality. Thoracocentesis is required to alleviate respiratory distress due to severe pleural effusion. Pleural effusions developed as a result of right-sided heart failure are mainly modified transudates but they can also be chylous.

2.5. Abdomen

The abdomen should be inspected for the presence of free fluid or organomegaly. Right heart failure commonly produces ascites in dogs and the aspirated fluid can be a modified transudate or even a chylous effusion. Effusions should be tapped to determine their quality. It is not advisable to drain all the ascites unless the effusion is compromising respiration. Real transudates are rare in case of right-sided congestive heart failure and more commonly indicate hypoproteinemia or portal hypertension. In cats ascites is extremely rare, even when cats are in right sided heart failure, and often a non-cardiogenic route should be explored. However hepatomegaly of the caudate lobe is not an uncommon finding in cats with RCHF and is often misinterpreted as liverpathology.

2.6. Extremities

The femoral pulse should be carefully evaluated for its quantity (pulse rate), quality, synchronicity and symmetry. The pressure felt on digital palpation of the pulse is the systolic arterial blood pressure (BP) minus the diastolic pressure.
A decrease in pulse pressure (weak pulse) can occur if the stroke volume is decreased (myocardial failure, severe aortic stenosis, severe pulmonic stenosis) or if peripheral vascular resistance is decreased or arterial compliance increased.
An increase in pulse pressure (bounding pulse) can occur with an increase in systolic BP, a decrease in diastolic BP (aortic insufficiency), or a combination of both (PDA),
Alteration in pulse formation might also occur. Dogs with severe aortic stenosis may have a pulse that peaks later into systole. Dogs with mitral regurgitation might have a brisk pulse because the left ventricle ejects blood at a higher velocity and the ejection time is shortened.

Pulse deficits occur with tachyarrhythmias (ventricular and supraventricular) because the left ventricle has not enough time to fill. An ECG is essential to characterise the arrhythmia.

Pulsus paradoxus is an increase in pulse pressure on expiration and a decrease in inspiration. This occurs normally but is exaggerated with pericardial tamponade. Pulsus alternans is alternating strong and weak pulse and can be seen with myocardial failure (Cocker Spaniels) and some tachyarrhythmias (atrial fibrillation) but is extremely rare.

In cats the pulse often remains normal in strength except when an arrhythmia is present or when the femoral artery is obstructed by a thrombus.

The extremities should also be examined for their temperature (if cold suggesting poor cardiac output) and the presence of peripheral oedema. The latter is very uncommon in small animals but can occur with right-sided heart failure. Cats with ATE might present with hypothermia.

3. THORACIC AUSCULTATION

Thoracic auscultation should be performed in a systematic fashion. Failure to do so will result in mis- or non-diagnosis.

3.1. Cardiac auscultation

Traditional areas of auscultation include the heart apex and heart base ant both sides of the chest (left and right). More experienced auscultaters will try to narrow these areas down to mitral, tricuspid, aortic and pulmonic valve areas. Normal rhythms in dogs include sinus rhythm (a regular rhythm) and sinus arrhythmia (regular irregular rhythm). Sinus arrhythmia is due to high vagal tone and is most commonly observed in brachycephalic breeds. It is represented by alternating periods of slower (expiration) and more rapid (inspiration) heart rates, which are usually, but not always, related to respiration. The intensity of S1 and S2 will vary with sinus arrhythmia. This vagal tone will disappear with heart failure. In cats only regular sinus rhythms are considered normal in the consult room. In cats tachycardia (>240 BPM) as well as bradycardia (<130 BPM) can be an indicator for underlying cardiac disease. The presence of a sinus arrhythmia is often associated with a pathological elevated high vagal tone (eg obstructive resp disease).

In dogs with significant heart disease a murmur, gallop sounds or an arrhythmia are nearly always present. The only exceptions are the congenital R-L shunts. In cats thoracic auscultation will often, but not always, reveal the presence of a systolic heart murmur (left and/or right ventricular outflow tract obstruction, mitral insufficiency because of systolic anterior motion of the mitral valve) and/or a gallop (diastolic filling impairment, restrictive filling, increased left atrial pressure). Which of the latter being present is often dependant on the heart rate and of the haemodynamics created by the underlying pathology. Feline murmurs are often best heard at the level of the sternum which works as an acoustic enhancer. Variation in murmur intensity is most often heard with dynamic ventricular outflow tract obstruction (hypertrophic obstructive cardiomyopathy, HOCM), but can also be encountered with functional murmurs. Restrictive cardiomyopathy (RCM) and dilated cardiomyopathy (DCM) have very soft systolic murmurs or no audible murmur at all.

3.1.1. Variations in intensity and rhythm of heart sounds

First heart sound S1
The first heart sound is loudest in young, thin animals and in those with high sympathetic tone, tachycardia, systemic hypertension, or anaemia.

The first heart sound can be diminished in intensity in obese animals or when there is obscuring for other reasons (pleural and pericardial effusions, diaphragmatic or pericardial hernia). Decreased myocardial contractility or prolonged P-R intervals can also give diminished S1 sounds. Splitting of S1 can be heard with asynchronous valve closure (3rd degree AV block) or conditions that delay either mitral or tricuspid valve closure (mitral and tricuspid stenosis, bundle branch blocks, ectopic beats).

Second heart sound S2
Physiological audible splitting of S2 is sometimes heard in healthy large breed dogs on inspiration. Pathological splitting of S2 is caused by asynchronous closure of aortic and pulmonic valves. This can be heard with pulmonary hypertension (varying with respiration), atrial septal defects (fixed) and bundle branch blocks.

Third heart sound S3
The third heart sound is of low frequency and is generated by rapid ventricular filling. It is not auscultable in most healthy dogs. The intensity is determined by the rapidity of early diastolic filling, the pressure in the atrium, and the distensibility of the ventricle during early diastole. Loud S3 often implies early systolic dysfunction.

Fourth heart sound S4
The fourth heart sound is produced by atrial systole. Vibrations initiated by forceful ejection of the blood into an already distended or non-compliant ventricle will generate a low-pitched, low frequency heart sound.

Gallops
A gallop rhythm is a sequence of three sounds consisting of S1 and S2 combined with S3 and/or S4. In the dog, they often indicate advance myocardial disease or heart failure. In cats they are common with the different forms of cardiomyopathy. They are classified as protodiastolic (S3), presystolic (S4), or as summation gallops (fusion of S3 and S4).

Abnormal rhythms
An arrhythmia means the absence of a normal rhythm. It can be an irregular rhythm, but a regular bracycardia or a regular tachycardia is also called an arrhythmia.
The intensity of S1 and S2 will vary with most arrhythmias. These alterations are produced by variations in the location of the valves and by the different degrees of filling of the ventricles.
Premature heart beats are heard as early low intensity heart sounds followed by a pause. They are often associated with a pulse pressure variation or deficit. It is impossible to differentiate by the means of auscultation only if the beats are ventricular or supraventricular in origin. Only an ECG will differentiate them.
Atrial fibrillation (AF) is the most chaotic heart rhythm. It is characterised by an irregular, irregular rhythm. It is often fast (and indicates severe pathology), but can occasionally, in large breed dogs, be of normal heart rate (slow AF). Most animals with slow AF will develop dilated cardiomyopathy later in life.
Supraventricular and ventricular tachycardias are characterised by bursts of rapid beats that usually cease abruptly. Differentiation by auscultation only is impossible. In case of an arrhythmia an ECG is always indicated. Holter monitoring can be indicated when paroxystic arrhythmias are suspected.

3.1.2. Descriptive characteristics of cardiac murmurs

Murmurs represent sounds of longer duration than the normal heart sounds. They are generated from turbulent blood flow created by abnormal communications between cardiac chambers or through insufficient valves or stenotic in/outflow tracts, or by alterations in blood viscosity. Doppler echocardiography is highly valuable for confirmation and prognostication of a murmur heard during auscultation.

3.1.3. Timing and intensity profile

Systolic

A murmur is called holosystolic when S1 and S2 can still clearly be distinguished. A murmur is called pansystolic when S1 and S2 cannot be distinguished.

PLATEAU MURMURS

1. Atrioventricular valve regurgitation: mitral and tricuspid insufficiency
2. Left-to-right shunting ventricular septal defects

EJECTION MURMURS (CRESCENDO-DECRESCENDO)

1. Aortic: obstructive (fixed or dynamic) (aortic stenosis)
     increased flow (anaemia, stress, fever) (physiological murmur)
2. Pulmonic: obstructive (Pulmonic stenosis)
     increased flow (ASD, R-L PDA)

Diastolic (very uncommon)

EARLY DIASTOLIC MURMUR

1. Aortic regurgitation
2. Pulmonic regurgitation

MID-DIASTOLIC MURMUR

1. Mitral stenosis
2. Tricuspid stenosis

Continuous

1. Patent Ductus Arteriosus (99%)
2. Aorticopulmonary window
3. A-V shunts in the thorax

To and fro (rare)

1. VSD with aortic insufficiency
2. Aortic stenosis with significant aortic regurgitation
3. Pulmonic stenosis and significant pulmonic regurgitation

3.1.4. Location and radiation

The left ventricular area is centred at the cardiac apex. This is a good location to hear mitral murmurs (regurgitation). Also gallop sounds generated at the left side of the heart will be best heard in this area. The murmurs of mitral regurgitation (mitral dysplasia, mitral endocardiosis, DCM) often radiate to the left atrial area, slightly dorsal and caudal to the left ventricular area.
The aortic area consists of the traditional aortic valve area on the left side at the level of the mid-heart to heart base. It also includes another area on the right cranial thorax and sometimes the murmur of aortic stenosis is louder on the right hand side.
The murmur of aortic insufficiency is usually best heard in the area of the traditional aortic valve area on the left side at the level of the mid-heart to heart base often radiating to the left heart apex.

The pulmonic area consists of the traditional pulmonic valve area cranially at the left heart base but also includes a corresponding area on the right cranial thorax. The murmurs of pulmonic stenosis and pulmonic insufficiency are usually best heard in the pulmonic area on the left, as is the pulmonic component of the second heart sound.
The murmurs of a ventricular septal defect (and tricuspid stenosis) are usually best heard in the right ventricular area, as are gallops generated in the right side of the heart.
The right atrial area, located dorsal to the right ventricular area, is where the murmur of tricuspid regurgitation is best heard.

3.1.5. Loudness

Murmurs are currently graded from I to VI.

> I: very soft and is only detected in a quiet room after prolonged auscultation
> II: faint but easily heard
> III: moderately loud
> IV: very loud but no associated thrill
> V: same as grade 4 in loudness but with associated thrill
> VI: can be heard with the stethoscope removed from the chest wall

Although the intensity of a heart murmur is not directly correlated with the severity of a lesion, in certain diseases such as aortic and pulmonic stenosis a rough correlation exists. The murmur heard in mitral insufficiency in dependant on the regurgitation volume and the pressure that generates it. Therefore severity of MI murmurs are not linearly correlated with severity of disease (DMVD versus DCM). And in certain diseases such as ventricular septal defect the murmur will be louder the smaller the defect. Atrial septal defects are only associated with a heart murmur when the defect is large and the volume overmload trough the right ventricular outflow tract is important. No exact correlation between heart murmur grade and severity has been established in patent ductus arteriosus, although low frequency continuous murmurs are more frequently associated with small ducti.

3.2. Respiratory auscultation

It is considered normal to hear some degree of laryngeotracheal sounds reflected in the chest by pulmonary auscultation. Abnormal respiratory sounds can be differentiated in continued (wheezes) and discontinued sounds (crackles). Crackles can indicate the presence of pulmonary oedema but are absolutely non specific in dogs. They are often heard with pulmonary fibrosis and severe chronic broinchitis. Respiratory rate is an important indicator for the presence of pulmonary congestion. Radiography remains essential for the confirmation of congestive heart failure.

References and additional reading

KITTLESON, M.D. & KIENLE, R.D. (1998) Small Animal Cardiovascular Medicine. Mosby.

FOX, P.R., SISSON, D. & MOISE, N.S. (1999) Textbook of Canine and Feline Cardiology.

Second Edition. W.B. Saunders company.