Feline cardiomyopathies: diagnostic approach

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INTRODUCTION

Cardiomyopathy, or heart muscle disease, describes a heterogeneous group of conditions that affect the heart muscle functionally and/or structurally. The classification and aetiology have been described in a previous article (UK Vet Vol 9 No 4).

DIAGNOSIS

The diagnosis is based on a combination of history, clinical signs, clinical examination and complementary investigations (blood pressure measurement, electrocardiography, radiography and echocardiography). However one has to be aware that many cats do not read the textbooks.

History and clinical signs

Cats, in contrast to dogs, only show clinical signs with advanced disease; many felines will remain without clinical signs for a long time. When they show clinical signs, dyspnoea is the most common complaint, but often non-specific signs like anorexia and lethargy are the only indicators for the presence of heart failure. One has to be aware that in cats cough is not a clinical sign associated with heart disease, it rather indicates the presence of respiratory disease (e.g. feline asthma). Heart disease can present because of a secondary thrombo-embolic event, as posterior paresis/paralysis (Fig. 1) or right front lameness. Syncope and sudden death can be the first clinical signs of heart disease.

Fig. 1: *Domestic shorthair presented with posterior paralysis secondary to an aortic thrombo-embolism.*

Clinical examination

Mucous membrane colour and capillary refill time are often normal, even when the cat is in severe heart failure. Cyanosis is rare and is more often associated with a congenital right-to-left shunt or severe respiratory disease. Occasionally jugular venous distension can be visualised indicating impaired venous return to the right side of the heart. The precordial shock is often prominent in the presence of a cardiomyopathy. Tachycardia (>240 bpm) as well as bradycardia (<130 bpm) can be an indicator for an underlying primary or secondary cardiomyopathy. 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 these is audible is often dependent on the heart rate and 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 (Fig. 2). Variation in murmur intensity is most often heard with dynamic ventricular outflow tract obstruction

Fig. 2: *The sternum is a very useful acoustic enhancer for murmurs in cats.*

(hypertrophic obstructive cardiomyopathy, HOCM), but can be encountered with functional murmurs. Restrictive cardiomyopathy (RCM) and dilated cardiomyopathy (DCM) have very soft systolic murmurs or no audible murmur at all. A thrill is rare and more commonly indicates the presence of a congenital problem. The pulse remains normal in strength except when an arrhythmia is present or when the femoral artery is obstructed by a thrombus.

Cats in left and/or right-sided heart failure can develop pleural effusion as well as pulmonary oedema. Pleural effusion muffles the lung sounds ventrally and creates a discordant dyspnoea. With pulmonary oedema the respiratory pattern is different (expiratory) and the presence of crackles over the lung fields indicates severe, life-threatening pulmonary oedema. It is essential to determine as soon as possible if the dyspnoea is due to a pleural effusion or pulmonary oedema because the former demands thoracocentesis prior to further investigations. A dyspnoeic cat is a critical animal. Handling stress should be minimalised and stabilisation prioritised over diagnosis.

Ascites is extremely rare, even when cats are in right-sided heart failure, and often a non-cardiogenic route should be explored.

Thoracocentesis

Effusions should be tapped to determine their quality and to relieve dyspnoea. Pleural effusions developed as a result of left-sided heart failure are mainly modified transudates, but they can also be chylous. However, chylous pleural effusions are more commonly seen with right-sided heart failure.

Blood pressure

The importance of routine blood pressure measurement is now well established in feline medicine. Hypertension (essential or secondary to chronic renal failure, hyperthyroidism) should always be excluded if HCM has been diagnosed. A retinal examination can give additional information on blood pressure status.

Electrocardiography

The ECG is not specific for the presence of cardiomyopathy but conduction disturbances like bundle branch blocks (mainly left anterior fascicular block, Fig. 3) are strong indicators for myocardial disease. Atrial fibrillation (Fig. 4) is only seen with severe left atrial dilation, stretch or infiltration. Ventricular premature complexes are not uncommon but their aetiology is not always cardiogenic. Tall R-waves can be seen with hyperthyroidism. Atrial standstill can be seen with atrial cardiomyopathy but is more commonly an indicator of hyperkalaemia.

Fig. 3: *Six-lead ECG showing left anterior fascicular block in a cat with HCM.*

Fig. 4: *Six-lead ECG showing atrial fibrillation in a cat with severe atrial dilation.*

Radiography

The vertebral heart size (VHS>8) as described by Buchanan is a useful marker for the presence of cardiomegaly. The heart shape in cats with HCM has a tendency to become elongated (Fig. 5).

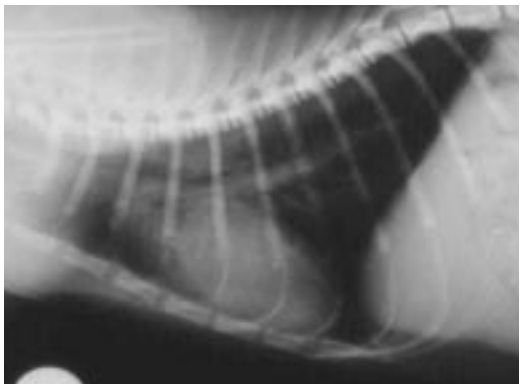

Fig. 5: *Right lateral thoracic radiograph showing an elongated heart shadow in a cat with HCM.*

Despite radiography not being the most sensitive technique for diagnosing the most common feline cardiomyopathy (hypertrophic cardiomyopathy), it remains the only way of diagnosing the presence of congestive heart failure. The distribution of cardiogenic pulmonary oedema in cats is rarely perihilar as in dogs, but is often distributed as fluffy alveolar densities throughout the lung fields (Fig. 6). Pleural effusion is also often present (Fig. 7). Venous distension can be obvious, but its absence does not exclude heart failure. A valentine shaped heart on the dorsoventral radiograph indicates (bi-)atrial enlargement and advanced hypertrophic or restrictive cardiomyopathy (Fig. 8). With dilated cardiomyopathy the heart shadow

becomes globular in shape, similar to that seen in dogs with DCM (Fig. 9). Aortic redundancy has been associated with advanced age, but also as a feature of systemic arterial hypertension. Radiography remains essential to monitor response to therapy.

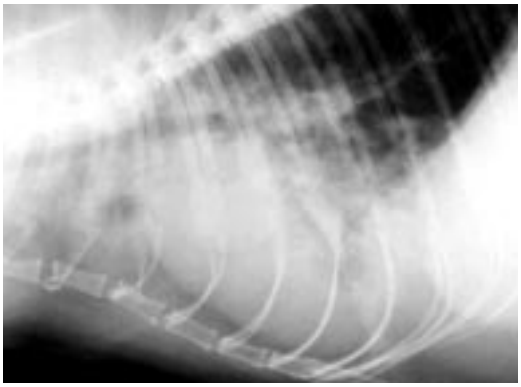

Fig. 6: *Right lateral thoracic radiograph showing fluffy alveolar densities and a mild pleural effusion in a cat with decompensated HCM.*

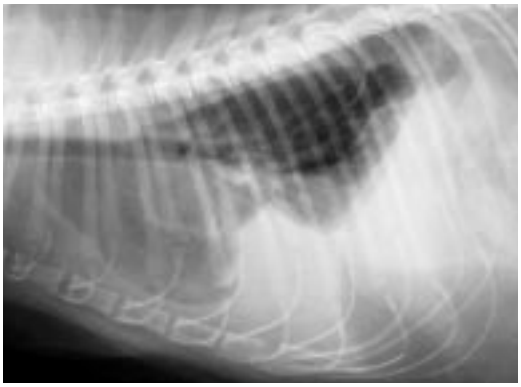

Fig. 7: *Right lateral thoracic radiograph showing a severe pleural effusion in a cat with decompensated RCM.*

Ophthalmology

A thorough examination of the retina is indicated in every cat suspected of heart disease. Tortuous retinal vessels, retinal detachment and retinal haemorrhage might be indicators of the presence of systemic hypertension. In cats with taurine deficient dilated cardiomyopathy concurrent retinal degeneration can be present (band shaped hyperreflective temporal retina).

Fig. 8: *Dorsoventral thoracic radiograph showing the typical Valentine shaped heart indicating bi-atrial enlargement.*

Fig. 9: *Dorsoventral thoracic radiograph showing the globular shaped heart in DCM.*

Serum biochemistry

Prerenal azotaemia is not uncommon. In older cats hyperthyroidism should always be excluded in case of HCM. If DCM is diagnosed serum taurine levels (Idexx laboratories) should be determined.

Doppler echocardiography

Two dimensional echocardiography (B-mode and M-mode) is necessary to confirm the diagnosis. Measurement of myocardial wall thickness, left ventricular diameter and left atrial size help with the classification of the cardiomyopathy (Table 1), but are not definitive.

- Abnormally hypertrophied papillary muscles might be the only feature of HCM (Fig. 10). However, left and right ventricular concentric hypertrophy, symmetrical or asymmetrical in appearance remain the typical echocardiographic feature of HCM. Systolic anterior motion of the mitral valve can be associated with HOCM.
- RCM is characterised by an enlarged left atrium with normal ventricular wall thickness (Fig. 11). Occasionally a hyperechoic endocardium is noticed.
- Cats with DCM have thin ventricular walls, an enlarged left ventricular diameter and poor systolic function (low fractional shortening) (Fig. 12).
- Arrhythmogenic right ventricular cardiomyopathy (ARVC) is characterised by severe right atrial dilation and sometimes aneurysmal right ventricular dilation (Fig.13).

Predisposition for thrombus formation (Fig. 14) can also be determined (enlarged left atrium, sluggish blood flow or smoke) by means of echocardiography. Doppler echocardiography assists in identifying functional anomalies (diastolic dysfunction, dynamic obstruction, valve insufficiency). Mitral inflow patterns can be very useful in classifying the different cardiomyopathies; refer to specialised textbooks for information on this subject.

TABLE 1: Echocardiographic classification of Feline CM (adapted from French 2002)

	Normal	HCM	RCM	DCM
IVSd	3-5 mm	>6 mm	<6 mm	<5 mm
LVPWd	3-4.2 mm	>6 mm	<6 mm	<5 mm
LVs	6.7-9.7 mm	Normal or <6.7	Normal or <6.7	>12 mm
FS	36-52%	Normal or >52%	Normal or <52%	<30%

IVSd: Interventricular septum in diastole
LVPWd: Left ventricular posterior wall in diastole
LVs: Left ventricle in systole
FS: fractional shortening

TABLE 2: Diagnostic classification of Feline CM

HCM: symmetrical/asymmetrical/regional/dynamic obstructive		
	Primary	Idiopathic
	Secondary	Genetic
		Endocrine
		Infiltrative
		Nutritional
		Neuromuscular
		Inflammatory
		Hypertensive
Restrictive Cardiomyopathy (RCM)		
	Primary	Idiopathic endocardial fibrosis
	Secondary	Endomyocarditis
		Infiltrative
Dilated Cardiomyopathy (DCM)		
	Primary	Idiopathic
	Secondary	Taurine deficiency
		Doxorubicine toxicity
		Ischaemic
Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC)		
Moderator band cardiomyopathy		
Persistent atrial standstill		
UCM		

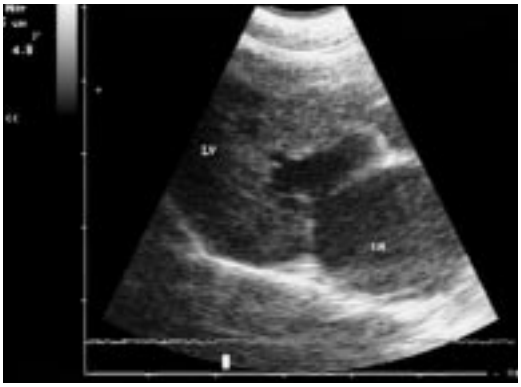

Fig. 10: *Echocardiographic right parasternal long-axis view showing marked ventricular thickening in a cat with HCM.*

Fig. 11: *Echocardiographic right parasternal long-axis view showing normal ventricular wall thickness associated with severe left atrial enlargement in a cat with RCM.*

Fig. 12: *Echocardiographic right parasternal long-axis view showing thinned ventricular wall thickness associated with severe left ventricular dilation in a cat with DCM.*

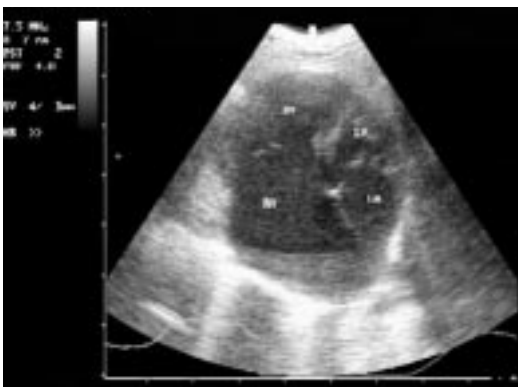

Fig. 13: *Echocardiographic left parasternal four-chamber view showing severe right atrial enlargement and aneurysmal right ventricular dilation in a cat with ARVC.*

Based on the results of all these examinations a diagnosis might be reached (Table 2). However, cats do not read textbooks and many cardiomyopathies might end up in the unclassified group.

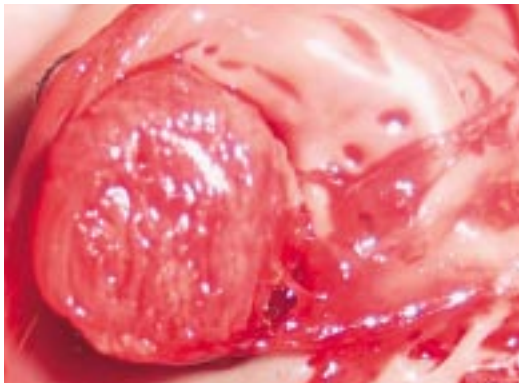

Fig. 14: *Post-mortem specimen showing a thrombus in the left auricle.*

COMMENTS AND CONCLUSION

The diagnosis of a feline cardiomyopathy is not always straightforward and may demand multiple ancillary tests. Pathology remains the only accurate way of classifying the type of cardiomyopathy. In those animals with equivocal results or in breeding stock, repetitive evaluation by experienced individuals is strongly recommended. New techniques like Doppler Tissue imaging are currently under investigation to help in classifying all the feline cardiomyopathies.

FURTHER READING AND REFERENCES

KITTLESON and KIENLE (1998) Small Animal Cardiovascular Medicine (Mosby).

FOX, SISSON, MOISE (2000) Textbook of canine and feline cardiomyopathy (WB Saunders).

FRENCH. Cat heart disease. VCS meeting Nov 2002.

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These multiple choice questions are based on the above text. Readers are invited to answer the questions as part of the RCVS CPD remote learning program. Answers appear on the inside back cover. In the editorial panel's view, the percentage scored, should reflect the appropriate proportion of the total time spent reading the article, which can then be recorded on the RCVS CPD recording form.

1. Which statement is false regarding the diagnosis of a cardiomyopathy in the cat:

a. The mucous membrane colour and capillary refill time are often normal.
b. Ascites is extremely rare.
c. There is always a murmur and/or gallop present.
d. Cats in left and/or right-sided heart failure can develop pleural effusion as well as pulmonary oedema.
e. Cats with heart disease do not cough.

2. Which statement is false regarding radiography as a diagnostic modality in cats with heart disease:

a. It is useless for the diagnosis of HCM.
b. A valentine shaped heart on the dorsoventral radiograph indicates bi-atrial enlargement.
c. Stabilisation of the animal should be prioritised over diagnostic radiography.
d. Aortic redundancy has been associated with advanced age but also as a feature of systemic arterial hypertension.
e. The heart shape in cats with HCM has a tendency to become elongated.

3. Which statement is false regarding electrocardiography in cats with a cardiomyopathy:

a. Left anterior fascicular block is a strong indicator for HCM.
b. Tall R-waves can be seen with hyperthyroidism.
c. Atrial fibrillation is the most common ECG finding.
d. Atrial standstill can be seen with atrial cardiomyopathy but is more commonly an indicator of hyperkalaemia.
e. Ventricular premature complexes are not uncommon but their aetiology is not always cardiogenic.

4. Which statement is false regarding echocardiography for the diagnosis of a cardiomyopathy in the cat:

a. Abnormally hypertrophied papillary muscles might be the only feature of HCM.
b. Right ventricular aneurysmal dilation is a nearly pathognomonic finding for ARVC.
c. It is the only definite way of classifying a cardiomyopathy.
d. An enlarged left atrium, sluggish blood flow or smoke indicates a predisposition for thrombus formation.
e. RCM is characterised by an enlarged left atrium with normal ventricular wall thickness

5. Which statement is false regarding echocardiography for the diagnosis of a cardiomyopathy in the cat:

a. Systolic anterior motion of the mitral valve can be associated with DCM.
b. Cats with DCM have thin ventricular walls and an enlarged left ventricular diameter.
c. Occasionally a hyperechoic endocardium is noticed in RCM.
d. HCM is characterised by concentrically thickened ventricular walls.
e. Cats with DCM have poor systolic function.