Background
Cardiomyopathies are the most commonly acquired heart diseases of cats and are classified according to the underlying pathology. Hypertrophic cardiomyopathy is the most common form of this disease. It is well recognized that cats can develop occult cardiomyopathy and be asymptomatic for years before the onset of clinical signs. What has been unknown is the actual prevalence of this disease in apparently healthy cats. A recently published study helped to answer this question. In this study, 103 privately owned, apparently healthy domestic cats were physically and echocardiographically examined by two board-certified veterinary cardiologists. The results of this study were:
• 15.5% (16 of 103) of privately owned, apparently healthy cats had cardiomyopathy.
• 31.2% (32 of 103) of cats with cardiomyopathy had a heart murmur, whereas 69% (11 of 16) of cats with cardiomyopathy did not have a heart murmur.
• 69% (11 of 16) of cats with a heart murmur did not have cardiomyopathy, whereas, 31.2% (5 of 16) of cats with a heart murmur did have cardiomyopathy.

Changes are neither sensitive nor specific for the diagnosis of feline cardiomyopathy. However, congestive heart failure is diagnosed on thoracic radiographs by the presence of pulmonary edema or pleural effusion.

Electrocardiogram (ECG)—An ECG is the only way to characterize an arrhythmia accurately. Other changes on the ECG may give clues about the underlying etiology of cardiac disease, but an echocardiogram is needed for a specific diagnosis.

Echocardiography—A complete echocardiographic evaluation allows for an assessment of cardiac structure, dimensions and motion of time. Repeat echocardiography be useful as well as an assessment of direction, nature and velocity of blood flow. Most often, a definitive diagnosis as to the etiology of cardiac disease can be made via echocardiography. Because echocardiography is expensive and usually only available in specialty centers, it is not routinely recommended for screening of apparently healthy cats for cardiomyopathy.

Cardiac biomarkers—A biomarker is a biological substance that can be objectively evaluated and serves as an indicator of a pathologic process. The cardiac biomarker NTproBNP is a peptide hormone that is synthesized and released primarily from the myocardium of the heart ventricles. The plasma concentration of NTproBNP increases under conditions that lead to ventricular stretch and stress. Measurement of NTproBNP has been shown to have several clinical applications in cats and dogs for the detection and assessment of cardiac disease (see table 1). Detecting occult cardiomyopathy in cats is one example of the clinical utility of NTproBNP.

The study concluded that cardiomyopathy is common in healthy cats. An equally disturbing finding of this study is that the presence or absence of a heart murmur does not provide a reliable indicator of cardiomyopathy in apparently healthy cats.

Diagnosing Feline Occult Cardiomyopathy
Signalement—Cardiomyopathy is an acquired heart condition that can be found in cats of any age (i.e., reported in cats 3 months to 10 years). Certain breeds are predisposed to developing cardiomyopathy (e.g., Maine coon and Persian).

Auscultation—Careful thoracic auscultation should be part of every routine physical examination. When a cardiac murmur or arrhythmia is detected further cardiac evaluation is warranted. However, as the above study revealed occult cardiomyopathy can be missed if detection of a murmur is relied upon to identify affected cats.

Thoracic radiographs—Alterations of the cardiac silhouette on thoracic radiographs may reveal global cardiac or chamber enlargement and may be suggestive of the presence of cardiomyopathy. Unfortunately, these

Interpreting the Cardiopet proBNP Test Results
The NTproBNP concentration indicates the likelihood that cardiac disease is present. This test helps you to determine if a cardiac workup is indicated. Additional testing to consider may include an echocardiogram, thoracic radiographs and/or an electrocardiogram to determine if cardiac disease is indeed present and to acquire a specific diagnosis and determine appropriate therapy.

The information detailed in table 2 can be used to help interpret Cardiopet proBNP results in apparently healthy cats and what next steps are recommended depending on the results.

Clinical Importance of Early Recognition of Feline Occult Cardiomyopathy
Given its insidious nature, hypertrophic cardiomyopathy is often not diagnosed until late in the disease process when clinical signs are apparent. Early detection of cardiomyopathy allows for close questioning of the owner to ensure absence of clinical signs. The presence of clinical signs, evidence of substantial cardiac disease on ultrasound or signs of pulmonary edema or pleural effusion on thoracic radiographs would indicate the need for therapy.

If minimal cardiac disease is confirmed by ultrasound, early recognition of occult cardiomyopathy allows for close surveillance of the cat. Initial recheck with repeat of the Cardiopet proBNP Test in 3–5 months would be reasonable. At that time an echocardiogram would be indicated depending on whether there was a significant increase in NTproBNP or a significant change in the cat’s clinical history or physical examination findings, which suggests a worsening of the cardiac disease. Future rechecks would depend upon the individual cat, but twice yearly assessments would be advisable at minimum. [ox]

REFERENCES

Table 1.

<table>
<thead>
<tr>
<th>Clinical utility of NTproBNP in cats and dogs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detect occult disease (1)</td>
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<tr>
<td>Differentiate cardiac vs respiratory disease (2)</td>
</tr>
<tr>
<td>Assess patients with signs of heart disease (3)</td>
</tr>
<tr>
<td>Assess patients with signs of heart failure (4)</td>
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Table 2.

<table>
<thead>
<tr>
<th>Likelihood of cardiac disease in apparently healthy cats</th>
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<tr>
<td>0</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>0-50 Unlikely</td>
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<tr>
<td>Heart disease unlikely</td>
</tr>
<tr>
<td>Cats for recheck is 6–12 months</td>
</tr>
<tr>
<td>50-100 Possible</td>
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<tr>
<td>Heart disease possible</td>
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<tr>
<td>Echocardiogram indicated</td>
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<tr>
<td>100-270 Probable</td>
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<tr>
<td>Heart disease probable</td>
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<tr>
<td>Echocardiogram indicated</td>
</tr>
<tr>
<td>270-1000+ Probable</td>
</tr>
<tr>
<td>Heart disease probable</td>
</tr>
<tr>
<td>Echocardiogram indicated</td>
</tr>
<tr>
<td>Consider thoracic radiographs</td>
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Jane Robertson
DVM, DACVIM
Head of Internal Medicine
IDEXX Laboratories

Cats’ Silent Killer
Screening for cardiomyopathy in apparently healthy cats

Further Resources
ARCHIVED WEBINAR, “Canine Heart Disease and Heart Failure” www.idexxlearningcenter.com/cardio

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Screening Apparently Healthy Cats with the Cardiopet proBNP Test
The Cardiopet proBNP Test is a simple blood test that measures NTproBNP. It should be considered as a first-line test for screening cats for cardiomyopathy. Studies have revealed the following:

- NTproBNP has a sensitivity of 90% and specificity of 85% when screening cats for occult cardiomyopathy.
- NTproBNP has a sensitivity of 100% and specificity of 89% for cardiac disease when screening cats that have murmurs or gallop rhythms.

When Should Healthy Cats Be Screened for Cardiomyopathy?
- Yearly as part of an annual health evaluation.
- Prior to anesthesia or surgery as part of your preanesthetic assessment.
- When a murmur, gallop rhythm or other arrhythmia is detected on physical examination to determine the significance of these physical examination findings.

Interpreting the Cardiopet proBNP Test Results
The NTproBNP concentration indicates the likelihood that cardiac disease is present. This test helps you to determine if a cardiac workup is indicated. Additional testing to consider may include an echocardiogram, thoracic radiographs and/or an electrocardiogram to determine if cardiac disease is indeed present and to acquire a specific diagnosis and determine appropriate therapy.

The information detailed in table 2 can be used to help interpret Cardiopet proBNP results in apparently healthy cats and what next steps are recommended depending on the results.

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If minimal cardiac disease is confirmed by ultrasound, early recognition of occult cardiomyopathy allows for close surveillance of the cat. Initial recheck with repeat of the Cardiopet proBNP Test in 3–6 months would be reasonable. At that time, NTproBNP results would be indicated depending on whether there was a significant increase in NTproBNP or a significant change in the cat’s clinical history or physical examination findings, which suggests a worsening of the cardiac disease. Future rechecks would depend upon the individual cat, but twice yearly assessments would be advisable at minimum.

REFERENCES
Feline Cardiomyopathy
Screening for early diagnosis benefits pets and clients

Sonya G. Gordon
DVM, DVSc, DACVIM (Cardiology)

Gus

Patient: Gus, 2-year-old, neutered male domestic shorthair

Presenting reason: Gus presented as part of a prospective study to evaluate the incidence of heart murmurs and structural cardiac disease in apparently healthy cats.

History: No health problems

Initial examination

Physical examination
Gus was bright, alert and responsive. Body condition score was 4/9. Mucous membrane color and capillary refill time were normal. Respiratory rate was 40 breaths per minute; heart rate was 160 beats per minute. Thoracic auscultation revealed a grade 3/6 right ventricular systolic murmur; lungs clear, no gallop rhythm or arrhythmias detected. Abdominal palpation was unremarkable. Pulses were strong and regular.

Diagnostic Plan
As part of the study, Gus had his BUN, creatinine, packed cell volume (PCV), total solids (TS), T4, NTproBNP and systemic blood pressure (Doppler) measured. A heartworm antibody test, thoracic radiographs, electrocardiogram (ECG) and echocardiogram were also performed.

Laboratory findings
Plasma NTproBNP concentration—<25 pmol/L.
Interpretation: NTproBNP concentration was not increased. Clinically significant cardiac disease and/or heart failure is unlikely.

Echocardiogram (figure 1)—Gus’s echocardiographic parameters are listed in table 1. Echocardiogram revealed normal cardiac dimensions and wall thicknesses. Doppler echocardiogram revealed no valvular insufficiency or outflow track turbulence; no cause for murmur identified. Interpretation: normal cardiac ultrasound.

Thoracic radiograph (figure 2)—No evidence of cardiomegaly; lateral ventricular heart score (LVH) of 7.9 (normal <8.1). Interpretation: normal thoracic radiographs.

Electrocardiogram (ECG)—Sinus tachycardia

Biochemistry and T4—Within normal limits. BUN: 24 mg/dL, creatinine: 0.9 mg/dL, PCV: 39%; TS: 6.6 g/dL, T4: 1.9 μg/dL.

Heartworm antibody—Negative

Doppler BP—100 mm Hg systolic

Assessment
Healthy young cat with no evidence of cardiac disease. The cause of the heart murmur was not identified.

Follow-up examination, 17 months later
Gus re-presented for reevaluation and blood sample collection as part of an ongoing evaluation of NTproBNP in cats.

History
No health issues since previous visit. The owner reported Gus continues to be a healthy happy cat.

Physical examination
Gus’s physical examination was unchanged from his previous visit. A grade 3/6 right ventricular systolic heart murmur was still present, but his heart rate and respiratory rate were within normal limits and his lungs were clear. The remainder of his physical examination was unremarkable.

Laboratory findings
Plasma NTproBNP concentration—1200 pmol/L.
Interpretation: NTproBNP concentration was significantly increased. This concentration was consistent with clinically significant cardiac disease and a high risk of congestive heart failure (CHF).

Echocardiogram (figure 3)—Gus’s echocardiographic parameters are listed in table 1. Echocardiogram revealed decreased internal dimensions, increased left ventricular wall thickness, increased size of left atrium, increased fractional shortening and systolic anterior mitral valve motion and very mild pericardial effusion; all of which are consistent with hypertrophic obstructive cardiomyopathy (HOCM). Doppler evaluation revealed a moderate posterior jet of mitral regurgitation and turbulence in left ventricular outflow tract; either or both of which could have been contributing to his murmur. Increased transverse velocity was daggier shaped and consistent with dynamic obstruction due to systolic anterior mitral valve motion. There was no thrombus or spontaneous contrast (smoke) seen within the left atrium. Interpretation: Advanced/severe HOCM.

Thoracic radiograph (figure 4)—Moderate cardiomegaly, lateral VHS of 9.8 (normal <8.1). Mild venous congestion present but no evidence of cardiac pulmonary edema. Interpretation: Consistent with echocardiographic findings of HOCM with evidence of early venous congestion.

Assessment
Hypertrophic obstructive cardiomyopathy with venous congestion and mild pericardial effusion (impending CHF). Gus’s respiratory rate subsequently increased at home that night, and based on that finding, he was diagnosed with CHF

Diagnostic plan
Appropriate therapy was initiated immediately. Gus was treated with furosemide to relieve pulmonary congestion. Once he was stable, the beta-blocker atenolol was administered to address the presence of dynamic left ventricular outflow tract obstruction. The dosage was titrated to achieve a resting heart rate of 160–170 beats per minute. Clopidogrel was also administered to help prevent thromboembolic disease.

Clinical case outcome
Gus was fortunate to have his cardiomyopathy diagnosed before he developed clinical signs of overt CHF or feline aortic thromboembolism (FATE). Awareness of his condition prompted his owner to contact his veterinarian as soon as his breathing became labored. Early recognition and treatment avoided the need for hospitalization and oxygen support. Eight months after diagnosis, Gus has continued to do well on atenolol (12.5 mg twice daily), clopidogrel (one-quarter of a 75 mg tablet once daily) and furosemide (one-quarter of a 12.5 mg tablet once daily).

Gus’s case demonstrates the advantage of screening apparently healthy cats for cardiomyopathy and highlights the risk of progression of feline cardiomyopathies even in patients who have previously had a normal echocardiogram. Early diagnosis may allow avoidance of high-risk procedures (e.g., elective anesthesia), facilitate client education regarding what clinical signs can arise and constitute an emergency, as well as facilitate the institution of cardiac medications that may delay disease progression.

Table 1: Echocardiographic parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial visit</th>
<th>Follow-up</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVIDd (cm)</td>
<td>1.57</td>
<td>1.47</td>
<td>1.3–1.8</td>
</tr>
<tr>
<td>LVFW (cm)</td>
<td>0.43</td>
<td>0.81</td>
<td>&lt;0.6</td>
</tr>
<tr>
<td>LV/S (cm)</td>
<td>0.63</td>
<td>0.87</td>
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</tr>
<tr>
<td>LA (cm)</td>
<td>1.24</td>
<td>2.8</td>
<td>0.8–1.3</td>
</tr>
<tr>
<td>LA/Ao M-mode</td>
<td>1.52</td>
<td>3.7</td>
<td>&lt;1.7</td>
</tr>
<tr>
<td>LA/Ao 2-D</td>
<td>1.4</td>
<td>3.8</td>
<td>&lt;1.4</td>
</tr>
<tr>
<td>FS (%)</td>
<td>46</td>
<td>57</td>
<td>45–55</td>
</tr>
<tr>
<td>Tissue Doppler velocity (m/sec)</td>
<td>1.2</td>
<td>4.7</td>
<td>&lt;2.0</td>
</tr>
<tr>
<td>Transmural Doppler velocity (m/sec)</td>
<td>1.0</td>
<td>1.0</td>
<td>&lt;2.0</td>
</tr>
</tbody>
</table>

Legend: LVIDd—left ventricular internal dimension in diastole, LVFW—left ventricular posterior wall dimension in diastole, LA/LV—left atrial width in diastole, LA/Ao—left atrial to aortic root ratio (measured both by M-mode and 2-D ultrasound), FS—fractional shortening.
Feline Cardiomyopathy
Screening for early diagnosis benefits pets and clients

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As part of the study, Gus had his BUN, creatinine, packed cell volume (PCV), total solids (TS), T4, NTproBNP and systemic blood pressure (Doppler) measured. A heartworm antibody test, thoracic radiographs, electrocardiogram (ECG) and echocardiogram were also performed.

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