Introduction

Hypertrophic cardiomyopathy (HCM) is the most commonly diagnosed form of cardiac disease in cats, affecting approximately 15% of the population. HCM is characterized by the focal or concentric thickening of the left ventricle myocardium in the absence of other hemodynamic or metabolic disease (Fig. 1). Feline HCM frequently leads to congestive heart failure, arterial thromboembolism, or sudden cardiac death. The factors that underlie a greater risk for sudden cardiac death in subclinical HCM are unknown but may be related to the development of arrhythmias and/or reduced heart rate variability.

Recent publications have investigated arrhythmia prevalence and complexity in cats with subclinical HCM with conflicting results. It is possible that in one of these studies, environmental stress resulted in a significantly greater arrhythmia presence in cats with subclinical HCM, suggesting that subclinical HCM cats may be more susceptible to arrhythmia development when faced with cardiac stress. Furthermore, human research shows a correlation between reduced heart rate variability (HRV) and a more severe disease state in people with HCM. This study used 48-hours of continuous Holter electrocardiography (ECG) to evaluate the frequency and severity of arrhythmias in cats with subclinical HCM compared to normal cats, both in a normal state and a state of cardiac stress via oral terbutaline sulfate administration. This study also investigated the degree of HRV and its relation to disease status.

Methods

20 Maine Coon cross cats of known genotype for the A31P mutation in the MYBPC3 gene underwent 48 hours of continuous ambulatory Holter ECG recording. Cats were classified as either having subclinical HCM or no disease based on a complete cardiovascular exam and echocardiogram (echo) conducted at the UC Davis VMTH within the previous 6 months.

Subclinical HCM Group:
- Left ventricular hypertrophy on echo:
  - Diastolic free wall and/or interventricular septum ≥26mm
- A31P MYBPC3 heterozygous or homozygous
- No clinical signs or other systemic disease

Control Group:
- No evidence of HCM on echo
- A31P MYBPC3 wild type or heterozygous
- No clinical signs or systemic disease

All cats were sedated for Holter placement and removal (Fig. 2) and were administered 0.2-0.3 mg/kg of terbutaline sulfate orally at 9:30am and removal (Fig. 2) and were administered. All cats were sedated for Holter placement and removal (Fig. 2) and were administered.

Hypothesis

Cats with subclinical hypertrophic cardiomyopathy (HCM) have more frequent and complex arrhythmias, and a reduced heart rate variability (HRV), in both a resting and stressed state, compared to healthy cats.

Results

- All data for the study has been collected. Analysis for the ectopy portion of the study is complete and the HRV portion will be completed this Fall.
- Results for the study population can be seen in Table 1.
- Ectopy found in the ECGs include both ventricular premature complexes (VPCs) and supraventricular premature complexes (SVPCs) (Fig. 4).
- Preliminary analysis of heart rate and HRV show that terbutaline is an effective stress test in cats and produces the desired response (Fig. 5).
- No significant differences were found between groups (Table 2) or within groups for any of the analyzed arrhythmia parameters.

Discussion

Our results show that cats with subclinical HCM do not have a greater susceptibility to arrhythmia development in the face of stress. It is important clinically to know that arrhythmia prevalence is not diagnostic or prognostic of the likelihood of sudden death for cats with subclinical HCM. A reduced HRV may be of prognostic value when evaluating the severity of disease in cases of subclinical HCM which will be evaluated in the continuation of the study. Further research is needed in this area. Long-term longitudinal studies to monitor for sudden cardiac death events would be most beneficial.

The limitations of this study include the small sample size and the possibility that wearing the Holter device alone induced a stress response in all cats.

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All cats were sedated for Holter placement and removal (Fig. 2) and were administered 0.2-0.3 mg/kg of terbutaline sulfate orally at approximately 24 and 36 hours (Fig. 3). All ECGs were analyzed and summarized with the investigator blinded to the subject.

Figure 1. Right parasternal long-axis echocardiogram photos of a cat with severe hypertrophic cardiomyopathy. Concentric thickening of the left ventricle myocardium is evident both in A) systole and B) diastole.

Figure 2. Two subjects wearing the ambulatory Holter ECG device. A) shows a sedated cat with the ventral thorax shaved. Three electrodes were placed on the right ventral thorax and two on the left. Leads were connected to each electrode and the Holter monitor device. B) shows a cat outfitted with a wrap used to hold the monitoring device in place for 48 hours.

Figure 3. Timeline of subject Holter ECG recording. Each subject underwent 48 hours of continuous Holter ECG monitoring with oral terbutaline sulfate administered at approximately 24 and 36 hours.

Figure 4. Examples of arrhythmias. Shown above are ectopic beats found during the ECG analysis. A) shows a single ventricular premature complex (VPC). B) shows a couplet of VPCs and C) shows a paroxysm of five VPCs. D) shows a single supraventricular premature complex (SVPC).

Table 1. Study population parameters. A mutation at the A31P MYBPC3 gene is known to be associated with the development of HCM in Maine Coon cats. Age was not normally distributed and was significantly different between groups (Table 2) or within groups for any of the analyzed arrhythmia parameters.

Table 2. Ectopy results between groups. There were no significant differences in any arrhythmia parameter between the two groups.

References


Acknowledgments

This study was supported by the ARF and the VMTH. We thank Dr. Andrew Skelly for his help with the statistical analysis and Dr. Andrew Skelly for his help with the statistical analysis. Our results show that cats with subclinical HCM do not have a greater susceptibility to arrhythmia development in the face of stress. It is important clinically to know that arrhythmia prevalence is not diagnostic or prognostic of the likelihood of sudden death for cats with subclinical HCM. A reduced HRV may be of prognostic value when evaluating the severity of disease in cases of subclinical HCM which will be evaluated in the continuation of the study. Further research is needed in this area. Long-term longitudinal studies to monitor for sudden cardiac death events would be most beneficial.

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Figure 5. Plot of heart rate over recording time. Heart rates are shown over the entire recording time for the 11 subjects. It is clear that terbutaline at each dose marked by the (•) elevates heart rate in both the control (n=14) and subclinical HCM (n=7) groups.

Figure 6. Photograph of a Main Coon cross cat.