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Diagnostic and prognostic utility of surface electrocardiography in cats with left ventricular hypertrophy

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Abstract *Objectives:* To assess the ability of electrocardiography (ECG) to predict left ventricular hypertrophy (LVH) in the cat and to investigate the prognostic value of selected ECG variables in cats with LVH.
Animals: Fifty-seven privately owned cats: 22 clinically healthy cats and 35 cats with LVH.
Material and methods: This is a clinical cohort study. Echocardiographic diagnosis and surface ECG were available. Electrocardiography analysis included rhythm diagnosis and specific electrocardiographic measurements. In cats with LVH, cause of death and outcome data were recorded and analyzed using Kaplan–Meier curves.
Results: The presence of arrhythmia had sensitivity and specificity of 31% and 100%, respectively, for identifying LVH. Among ECG measurements, duration of QT interval (QT) and QT interval corrected for heart rate (QTc) was statistically different between healthy cats and cats with LVH ($p = 0.007$). Overall, the most accurate cutoffs to identify LVH were QT $>$ 170 ms (sensitivity and specificity 48.3% and 91%,

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respectively) and QTc > 188 ms (sensitivity and specificity 62% and 77%, respectively). In healthy cats, the highest QT and QTc values were 180 ms and 200 ms, respectively. Mean survival time was 58 days and indeterminable for cats with QT > 180 ms and QT ≤ 180 ms, respectively ($p = 0.042$) and 125 days and indeterminable for cats with QTc > 200 ms and QTc ≤ 200 ms, respectively ($p = 0.017$). *Conclusions:* Arrhythmias as well as prolonged QT and QTc are useful ECG parameters in identifying LVH and predicting survival in affected cats.

Abbreviations

ATE	arterial thromboembolism
AVB	atrioventricular block
CHF	congestive heart failure
ECG	electrocardiography
HCM	hypertrophic cardiomyopathy
HR	heart rate
HT	hyperthyroidism
LA	left atrium
LV	left ventricle
LVH	left ventricular hypertrophy
QT	QT interval
QTc	QT interval corrected for heart rate
ROC	receiver operating characteristic
SAH	systemic arterial hypertension
SBP	systemic arterial blood pressure
VPC	ventricular premature complex
VT	ventricular tachycardia

Introduction

Feline hypertrophic cardiomyopathy (HCM), which by convention is morphologically defined by concentric hypertrophy of a non-dilated left ventricle (LV), represents the most common heart disease in the cat [1,2]. This condition exhibits a broad spectrum of severity and a heterogeneous outcome, with some cats having a subclinical disease course and long survival time, while others experience severe complications, such as congestive heart failure (CHF), arterial thromboembolism (ATE), and cardiac arrhythmias [1—4]. Many authors have previously described the association between feline HCM and different types of cardiac rhythm disturbances. A large retrospective study of 282 cats with HCM identified arrhythmias in 31% of cats, and ventricular premature complexes (VPCs) were overrepresented compared to supraventricular tachyarrhythmias and bradyarrhythmias [3]. A recent 24-hour Holter analysis in 17 cats with asymptomatic HCM revealed VPCs in all cats studied, with 14 cats exhibiting complex arrhythmias (couplets, triplets, or ventricular tachycardia [VT]). Additionally, 15/17 cats with HCM had supraventricular arrhythmias, with only four cats exhibiting complexity [5]. Although generally less common than ventricular arrhythmias, supraventricular arrhythmias tend to be more frequent in cats with structural heart disease associated with atrial enlargement, as demonstrated by a retrospective study of 50 cats with atrial fibrillation and underlying cardiomyopathies including left ventricular hypertrophy (LVH) [6]. Various types of conduction disturbances have been also identified in cats with HCM, including bundle branch blocks and different degrees of atrioventricular block (AVB) [1,7,8]. Additionally, a retrospective analysis of electrocardiographic tracings from 61 cats with HCM demonstrated changes of waveform morphology in 49% of subjects, with LV enlargement pattern (QRS complexes >40 ms and R waves >0.9 mV) being overrepresented (25% of population) [1]. In human cardiomyopathies, surface electrocardiography (ECG) is known to have predictive utility and is frequently used to stratify the risk of the affected individuals, especially in the case of HCM [9—19]. Despite the abundance of descriptive data on rhythm abnormalities in cats with cardiomyopathy, no prior study has specifically addressed the predictive utility of ECG in identifying feline LVH or its possible prognostic use.

The aim of this study was to determine the ability of 2-min ECG analysis to distinguish healthy cats from cats with LVH and to evaluate the ability of selected ECG variables to predict survival in the affected population.

Animals, materials, and methods

Study population

The clinical archive of the Veterinary Teaching Hospital of the University of Bologna was

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