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Short communication

Assessment of left atrial size, left atrial volume and left ventricular function, and its relation to spontaneous echocardiographic contrast in cats with hypertrophic cardiomyopathy: A preliminary study

E. Colakoglu[1], K. Sevim[1], U. Kaya[2]

[1] Department of Internal Medicine, Cardiology Unit, Faculty of Veterinary Medicine, Ankara University, 06070, Ankara, Turkey
[2] Department of Biostatistics, Faculty of Veterinary Medicine, Hatay Mustafa Kemal University, 31060, Hatay, Turkey

Correspondence to: K. Sevim, e-mail: ksevim@ankara.edu.tr

Abstract

The aim of this study was to evaluate the association between spontaneous echocardiographic contrast (SEC) and left atrial (LA) parameters such as size, volume, and function in cats with hypertrophic cardiomyopathy (HCM). Cats were assigned into following groups: clinically healthy cats (n=8), HCM without SEC (n=12), and HCM with SEC (n=8). Left atrial shortening fraction (LAFS%) and left atrial fractional area change (LAFAC) had statistical significance between groups. In conclusion, compared to the healthy individuals, the presence of a decreased trend in levels of LAFS% and LAFAC in HCM_{SEC} cats could be a predictive marker for the thromboembolic risk assessment. Further studies enrolling the asymptomatic HCM cats need to be conducted to define a cut-off value of LAFS% and LAFAC before the SEC formation.

Keywords: cat, cardiomyopathy, fractional area change, left atrial fractional shortening, thromboembolism

Introduction

Hypertrophic cardiomyopathy (HCM) is the most common acquired heart disease in cats.

While some affected cats may present with signs of congestive heart failure, arterial thromboembolism (ATE), and sudden death, others can remain subclinical for years (Luis Fuentes et al. 2020). Most cats with ATE have underlying cardiac disease without any pre-signs. ATE in cats is predominantly induced by HCM. Veterinarians should perform adequate risk assessment for thromboembolism in cats with HCM. Risk assessment may have important implications for the therapeutic approach and prevention of complications in cats with HCM (Hassan et al. 2020). Left atrial enlargement and left atrial dysfunction increase the risk of developing thromboembolism in cats with HCM (Schober and Maerz 2006). The aim of this study was to evaluate the association between spontaneous echocardiographic contrast (SEC), left atrial size, left atrial volume, and left atrial function in cats with HCM.

Materials and Methods

A total of 26 non-pregnant, client-owned cats with echocardiographic evidence of HCM diagnosed at the Ankara University, Veterinary Teaching Hospital, were prospectively included in this study. Inclusion criteria in cats with HCM were left ventricle septal and free wall end-diastolic thickness ≥ 6 mm (Fuentes et al. 2020). Cats were excluded from the study if they had a secondary disease affecting left ventricle volume and function. Based on these exclusion criteria, a final total of 20 cats were included in the study. Eight clinically healthy cats were used in the present study. Written consent was obtained from the owners. Cats were assigned into groups: clinically healthy cats (n=8), HCM without SEC (n=12), and HCM with SEC (n=8). In this prospective trial, all cats were examined by a standardized protocol including clinical examination, routine blood analysis, total T4 concentration, and transthoracic echocardiography (Philips Affiniti 50 Echocardiography system with 4-12 phased array probes). Standard right parasternal long and short axis and left apical imaging views were acquired to identify heart disease in all cases. Left atrial dimensions and area were assessed from the right parasternal long-axis view. The presence of SEC in the left atrium (LA) was recorded. Left atrial shortening fraction (LAFS%) and LA fractional area change (LAFAC) were calculated as previously described (Sakai et al. 2001). All statistical analyses were performed using IBM SPSS 23.0. The variables were examined with the Shapiro-Wilk test and Levene test. The differences in echocardiographic measurements between groups were evaluated with one-way ANOVA when parametric test assumptions were met and using the Kruskal-Wallis test when these assumptions were not met. Multiple Dunn tests were used as a post hoc procedure.

Differences with $p<0.05$ were considered statistically significant.

Results and Discussion

Data were collected from 20 cats with HCM and 8 clinically healthy cats. The mean age and gender distributions between groups were not significant. Echocardiographic variables are presented in Table 1. Increased filling pressure as a result of chronic diastolic dysfunction, the degree of left ventricular hypertrophy, left ventricular outflow tract obstruction, tachycardia-related left atrial remodeling, and neurohormonal stimulation in cats with HCM may cause left atrial enlargement (Payne et al. 2015). Progressive diastolic dysfunction in cats with HCM decreases LA mechanical function and increases LA size. These changes contribute to blood stasis as a precursor for SEC formation (Schober and Maerz 2006). The literature data obtained from the studies increase the importance of evaluating thromboembolic risk and the association between left atrial function and SEC. Consistent with a previous study (Trehiou et al. 2012), the left atrial dimensions of cats with HCM were higher compared to healthy ones.

We also observed greater values of left atrial size and area measurements (left atrial septolateral systolic diameter (LAmaxsyst), left atrial septolateral diastolic diameter (LAmaxdiast), maximum LA area in ventricular systole (LAareas), maximum LA area in ventricular diastole (LAaread)) in HCM_{SEC} cats than in cats with HCM. In this study, the presence of SEC was significantly associated with higher diameters of end-diastolic left ventricular septal wall thickness (IVSd) and end-diastolic left ventricular free wall thickness (LVFWd).

The left atrium to aortic ratio (LA/Ao) was also higher in cats with concurrent SEC. Left atrial fractional shortening is a dependent predictor of both preload and afterload, like left ventricular fractional shortening. Left atrial afterload is approximated by end-diastolic left ventricular pressure, and thus LAFS% may reflect ventricular filling pressures and diastolic function (Abbot and MacLean 2006).

Increasing LA volume may be accompanied by morphological and pathological changes, and accordingly, progressive deterioration in LA function may be observed. All of these may occur before symptoms appear and may adversely affect the prognosis. An en-

Table 1. Echocardiographic variables in all cats. IVSd, end-diastolic left ventricular septal wall thickness; LVFWd, end-diastolic left ventricular free wall thickness; LAmaxsyst, left atrial septolateral systolic diameter; LAmaxdiast, left atrial septolateral diastolic diameter; LAareas , maximum LA area in ventricular systole; LAarea d, maximum LA area in ventricular diastole; LAFS% left atrial fractional shortening; LAFAC, left atrial fractional area change; LA, left atrium, Ao, aorta.

Variables	Groups	Mean±SD	P value
IVSd	HCM_{SEC}	7.91±0.92	<0.001
	HCM	7.00±1.31	
	Healthy	4.61±0.15	
LVFWd	HCM_{SEC}	7.53±1.6	<0.001
	HCM	7.84±1.53	
	Healthy	4.21±0.36	
LAmaxsyst	HCM_{SEC}	22.16±4.66	<0.001
	HCM	20.52±5.6	
	Healthy	13.53±1.18	
LAmaxdiast	HCM_{SEC}	20.45±4.86	<0.001
	HCM	17.38±4.62	
	Healthy	9.94±0.55	
LA_{areas}	HCM_{SEC}	3.77±1.32	<0.001
	HCM	3.32±1.53	
	Healthy	1.23±0.14	
LA_{aread}	HCM_{SEC}	3.32±1.41	<0.001
	HCM	2.75±1.34	
	Healthy	0.79±0.07	
LAFS %	HCM_{SEC}	8.03±4.48	<0.001
	HCM	14.99±6.9	
	Healthy	26.02±4.05	
LAFAC	HCM_{SEC}	13.31±5.62	<0.001
	HCM	18.15±6.74	
	Healthy	35.05±6.85	
LA/Ao	HCM_{SEC}	2.42±0.6	<0.001
	HCM	2.18±0.44	
	Healthy	1.17±0.10	

larged and poorly contractile left atrium increases the risk of death from congestive heart failure or thromboembolism. Decreased LAFS% was also found in cats with preclinical HCM and was statistically significant (Spalla et al. 2019). Payne et al. (2015) have reported that cats with HCM with a low LAFS% have a worse prognosis. The determination of low LAFS% and LAFAC values in HCM_{SEC} cats compared to healthy ones in our study is consistent with the literature data (Schober and Maerz 2006).

In conclusion, compared to healthy individuals, the presence of a decreased trend in levels of LAFS% and LAFAC in HCM_{SEC} cats could be a predictive marker for the thromboembolic risk assessment. Further studies enrolling the asymptomatic HCM cats need to be conducted to define a cut-off value of LAFS% and LAFAC before the SEC formation.

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