Radial Strain and Strain Rate Assessed by Speckle-Tracking Echocardiography in Turkish Kangal Dogs

Osman Safa TERZI[1], Hasan ALBASAN[1]

[1]Department of Internal Medicine, School of Veterinary Medicine, University of Ankara, Ankara, Turkey

ABSTRACT

Objectives: Mitral valve disease and dilated cardiomyopathy are common acquired cardiac diseases in dogs. Standard echocardiography is commonly used on dogs to non-invasively evaluate myocardial function. The aim of this prospective study was to provide results about variabilities of peak systolic radial strain and strain rate at the level of the papillary muscles using two-dimensional speckle tracking echocardiography in a population of healthy and dogs with cardiologic disorders.

Materials and Methods: Study Groups of A and B consisted of 3 dogs with dilated cardiomyopathy and 4 dogs with valve disease, respectively. Control Group (C) consisted of 7 healthy dogs. These dogs were presented for cardiac screening at the Veterinary Medical Hospital of Ankara University in Turkey and were analyzed retrospectively

Results: It is revealed that for strain evaluation, Group A was significantly (P<0.05) different from Group C and Group B.

Discussion: According to the literature, this is the first study from Turkey where speckle tracking echocardiography is used to assess the left ventricular function of Turkish Kangal dogs with naturally occurring dilated cardiomyopathy and mitral valve disease. Two-dimensional speckle tracking echocardiography revealed decreased left ventricular myocardial systolic performance in dogs with dilated cardiomyopathy compared with strain levels of healthy dogs and dogs with valve disease.

Keywords: Dog, Speckle Tracking Echocardiography, mitral valve disease, dilated cardiomyopathy.

INTRODUCTION

Mitral valve disease (MVD) (Suzuki et al., 2013b) and Dilated cardiomyopathy (DCM) (Pedro et al., 2017) are common acquired cardiac diseases in dogs. Large breed dogs such as German Shepherds (Chetboul and Tissier, 2012), Irish Wolfhounds (Westrup and McEvoy, 2013), and Great Danes (Pedro et al., 2017) can be affected by the heart diseases.

Standard echocardiography is commonly used on dogs to non-invasively evaluate myocardial function. Several M-mode measurements like systolic left ventricular diameter and volume, fractional shortening (%FS) often provide information about myocardial performance (Chetboul et al., 2007). Speckle tracking echocardiography (STE) is a technique based on recognizing a pattern of speckles in a marked area on myocardium and then following their movement during a cardiac cycle (Westrup and McEvoy, 2013). Recently, STE has been used to evaluate normal and

Corresponding author: Hasan ALBASAN   *E-mail*: dralbasan@gmail.com

abnormal myocardial function, such as mitral valve disease and dilated cardiomyopathy (Spalla et al., 2016)

The aim of this prospective study was to provide results about variabilities of peak systolic radial strain (St) and strain rate (SR) at the level of the papillary muscles using two-dimensional (2D) STE in a population of healthy and dogs with cardiologic disorders.

echocardiographic system and transducer, and simultaneous ECG limb lead II was recorded and displayed on the images. The presence of mitral valve prolapse, mitral valve thickening and mitral regurgitation was evaluated from the right parasternal long-axis view, the right parasternal 4-chamber view and left apical 4-chamber view.

After completion of the standard conventional 2D, M-mode and Doppler examinations, 2-dimensional

Table 1 . Characteristics of 14 included dogs

	DCM - A	MVD - B	Control - C
n	3	4	7
Age (Years)	3.83 ± 2.89	5.50 ± 2.06	3.28 ± 2.78
Gender (m/f)	2/1	4/0	4/3
Body weight (kg)	42 ± 6.48	45 ± 3.81	47.29 ±9.69
IVSd (mm)	9.67 ± 1.89	12 ± 3.08	11.63 ± 2
LVIDd (mm)	63.33 ± 8.18	35.50 ± 11.41	45.13 ± 5.62
LVPWd (mm)	9 ± 0.82	16 ± 8.28	12.88 ± 2.42
IVSs (mm)	10.33 ± 1.25	13.25 ± 2.86	15.13 ± 4.04
LVIDs (mm)	57.33 ± 8.99	17 ± 6.48	33.75 ± 5.47
LVPWs (mm)	11 ± 0.82	21.50 ± 9.55	16 ± 2.40
HR (bpm)	233 ± 7.48	113.25 ± 34.71	134 ± 23.06
EDV (ml)	206.67 ± 56.96	62 ± 32.86	99.25 ± 26.75
ESV (ml)	169.33 ± 58.38	10.90 ± 9.65	47.75 ± 15.37
CO (l/m)	5.84 ± 1.16	5.82 ± 4.24	6.16 ± 2.66
EF (%)	19.60 ± 8.29	80.28 ± 11.24	51.68 ± 11.89
FS (%)	9.17 ± 4.00	49.95 ± 12.79	26.95 ± 7.42

MATERIALS AND METHODS

Study Groups of A and B consisted of 3 dogs with dilated cardiomyopathy and 4 dogs with valve disease, respectively. Control Group (C) consisted of 7 healthy dogs. These dogs were presented for cardiac screening at the Veterinary Medical Hospital of Ankara University in Turkey and were analyzed retrospectively. All dogs underwent a complete cardiac examination, electrocardiography, thoracic radiography, and transthoracic echocardiography.

Data from examinations were collected into an Excel (Microsoft Office Excel 2010, Microsoft Corp., USA.) sheet and analyzed using standard commercial statistics software. (GraphPad Prism 7. GraphPad Software, Inc.). Basic standard descriptive statistics were applied. All groups were compared with one-way ANOVA, Holm-Šídák test were used for multiple comparisons.

Conventional 2D, M-mode, and Doppler examinations were performed by an investigator, an

mode and Doppler examinations, 2-dimensional digital cine loops with a minimum of 6 cardiac cycles were acquired in the right parasternal short axis view at the level of the papillary muscles (SAX). All of the dogs were imaged awake. Images were analyzed by 1 of 2 trained observers using off-line workstation

RESULTS

A total of 14 dogs (4 females and 10 males) with a mean age of 3.83 ± 2.89 (Group A), 5.50 ± 2.06 (Group B) and 3.28 ± 2.78 (Group C) respectively were included in the study (Table 1). All dogs were accepted by the software algorithm with good quality of image, resulting in a total of 14 dogs being included in the study. The characteristics and results of 2D, M-mode examinations in dogs are shown in Table 1.

Myocardial segments for the short-axis radial strain images were included in the statistical analysis. Time
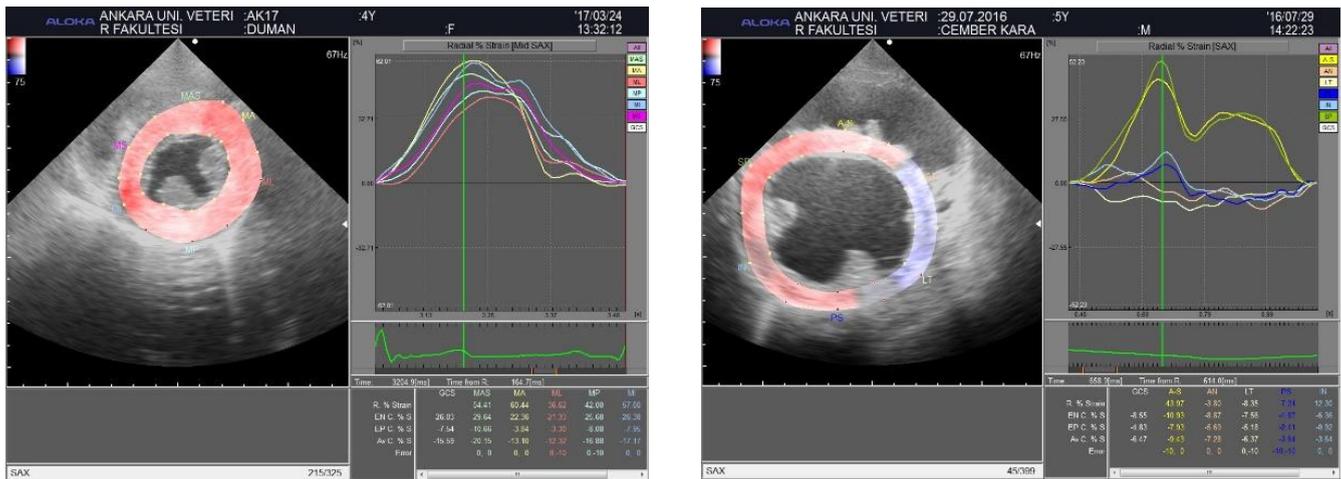
Figure 1. Example views of short axis radial strain evaluation of dogs.

used per dog to obtain the views for STE was approximately 2 minutes. Off-line evaluation time was approximately 5 minutes for each dog. Results of left ventricular speckle tracking echocardiography in all 3 groups are shown in Table 2.

It is revealed that for strain evaluation, Group A was significantly ($P<0.05$) different from Group C and Group B. However, there was no significant difference between Group C and Group B. For strain rate, there is no difference between all groups.
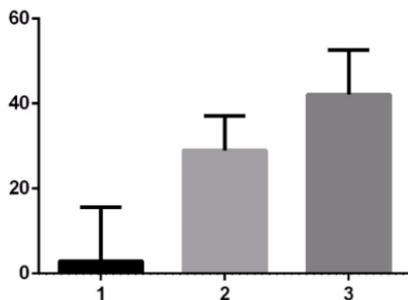

Table 2. Holm-Šídák Multiple Comparison test radial peak systolic strain animals from Group A (1), B (2) and C (3)
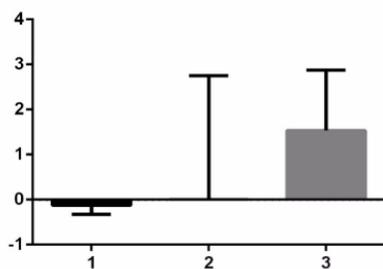

Table 2. Holm-Šídák Multiple Comparison test radial peak systolic strain rate animals from Group A (1), B (2) and C (3)

DISCUSSION

According to the literature, this is the first study from Turkey where STE is used to assess the LV function of Turkish Kangal dogs with naturally occurring DCM and MVD. Study results show that St levels of systolic function appear to be affected with DCM while these levels were seen to be normal in dogs with valve disease. SR levels were not different between groups. It is considered that the number of animals in Group A and B is not sufficient for this evaluation. It will be possible to evaluate the SR values in more detail in future studies that involve more animals.

This study has some limitations. The total number of dogs included in the study was not enough. A single cardiac cycle cine-loop with the best image quality was selected and worked on. If consecutive cycles were selected, a mathematically stronger results could be achieved. Dogs did not have a Holter monitor, so arrhythmias could not be completely ruled out, which can affect left ventricular mechanics. Since thyroid function tests are not performed, hormonal diseases also could not be ruled out.

In a recent study conducted at Japan, (Suzuki et al., 2013a) obtained normal values for 2D-STE variables in young and old Beagle dogs and concluded both groups have similar myocardial deformation values while diastolic deformation variables were found to be significantly different between two groups. It is highlighted the need for using age-matched control subjects in studies of diastolic function and these results can be used as preliminary data for the establishment of reference intervals of 2D-STE in the dog. Unfortunately, reference intervals of 2D-STE are not specified for Kangal dogs. For this reason, STE data from healthy dogs have not been evaluated according to the reference range in our study. Only dogs without cardiological clinical signs were included in the group of healthy animals.

As shown before in human studies, (Bogaert and Rademakers, 2001; Saito et al., 2009) some variables measuring magnitude and rate of deformation in the radial axes increase from the base towards the apex of the left ventricle in Kangal dogs. When compared to normal Group C, an overall decrease in St and SR is noted in Group A and B; some of these variables achieved a statistically significant difference.

The results of this study show that systolic function appear to be affected with both DCM and MVD. Although the direct assessment of myocardial function offered by STE was thought to be useful in early detection of Kangal Dogs with preclinical DCM, inter- and intra-observer measurement variabilities must be taken into account.

Conclusion

Two-dimensional speckle tracking echocardiography revealed decreased left ventricular myocardial systolic performance in dogs with dilated cardiomyopathy compared with strain levels of healthy dogs and dogs with valve disease. There is no difference about strain rates during the time of peak systole. Therefore, this procedure can be applied to detect dilated cardiomyopathy in dogs with cardiac disease.

REFERENCES

Bogaert J, Rademakers FE, Regional nonuniformity of normal adult human left ventricle, *American Journal of Physiology - Heart and Circulatory Physiology*. 2001; 280; H610-H620.

Chetboul V, Tissier R, Echocardiographic assessment of canine degenerative mitral valve disease, *Journal of Veterinary Cardiology*. 2012; 14; 127-148.

Pedro B, Stephenson H, Linney C, Cripps P, Dukes-McEwan J, Assessment of left ventricular function in healthy Great Danes and in Great Danes with dilated cardiomyopathy using speckle tracking echocardiography, *Journal of Veterinary Cardiology*. 2017; 19; 363-375.

Saito K,Okura H,Watanabe N,Hayashida A,Obase K,Imai K,Maehama T,Kawamoto T,Neishi Y,Yoshida K, Comprehensive Evaluation of Left Ventricular Strain Using Speckle Tracking Echocardiography in Normal Adults: Comparison of Three-Dimensional and Two-Dimensional Approaches, *Journal of the American Society of Echocardiography*. 2009; 22; 1025-1030.

Spalla I, Locatelli C, Zanaboni A M, Brambilla P, Bussadori C, Echocardiographic Assessment of Cardiac Function by Conventional and Speckle-Tracking Echocardiography in Dogs with Patent Ductus Arteriosus, *Journal of Veterinary Internal Medicine*. 2016; 30; 706-713.

Suzuki R, Matsumoto H, Teshima T, Koyama H, Effect of age on myocardial function assessed by two-dimensional speckle-tracking echocardiography in healthy beagle dogs, *Journal of Veterinary Cardiology*. 2013a; 15; 243-252.

Suzuki R, Matsumoto H, Teshima T, Koyama H, Noninvasive Clinical Assessment of Systolic Torsional Motions by Two-Dimensional Speckle-Tracking Echocardiography in Dogs with Myxomatous Mitral Valve Disease, *Journal of Veterinary Internal Medicine*. 2013b; 27; 69-75.

Westrup U,McEvoy F J, Speckle tracking echocardiography in mature Irish Wolfhound dogs: technical feasibility, measurement error and reference intervals, *Acta Veterinaria Scandinavica*. 2013; 55; 41-41.