



Echocardiographic assessment of right ventricular systolic function in Boxers with arrhythmogenic right ventricular cardiomyopathy

S.M. Cunningham, DVM ^{a,*}, B.D. Aona, DVM ^b, K. Antoon, CVT, VTS ^a, J.E. Rush, DVM, MS ^a, B.A. Barton, Ph.D. ^c

^a Department of Clinical Sciences, Cummings School of Veterinary Medicine at Tufts University, 200 Westboro Road, North Grafton, MA, USA, 01536

^b Department of Clinical Sciences, College of Veterinary Medicine, North Carolina State University, Raleigh, NC, USA, 27607

^c Department of Quantitative Health Sciences, University of Massachusetts Medical School, Worcester, MA, USA, 01605

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Abstract Objectives: To determine whether there are differences in measures of longitudinal right ventricular (RV) systolic function among Boxers with arrhythmogenic right ventricular cardiomyopathy (ARVC) compared with healthy control Boxer dogs. To explore relationships between markers of RV systolic function and age, body weight, gender, arrhythmia frequency, and markers of left ventricular (LV) systolic function in Boxer dogs.

Animals: The study included 50 client-owned Boxer dogs.

Methods: This is a retrospective echocardiographic study. Tricuspid annular plane systolic excursion (TAPSE) and pulsed wave tissue Doppler imaging–derived systolic myocardial velocity of the lateral tricuspid annulus (S') were measured in healthy control Boxers ($n = 18$), Boxers with ARVC and normal LV systolic function ($n = 19$), and Boxers with ARVC and reduced LV systolic function ($n = 13$).

Results: Tricuspid annular plane systolic excursion ($p=0.002$) and S' ($p=0.001$) were significantly different between affected and control groups. Significant correlations were found between measures of left heart size and function and both TAPSE and S' . No correlations were found between RV function parameters and age, gender, or body weight in this fairly homogeneous, single-breed population. Receiver

* Corresponding author. Suzanne Cunningham
E-mail address: suzanne.cunningham@tufts.edu (S.M. Cunningham).

operating characteristic curve analysis revealed that both TAPSE and S' had an area under the curve of 0.77 in distinguishing healthy Boxers from those with ARVC.

Conclusions: Tricuspid annular plane systolic excursion and S' are reduced in Boxers with ARVC. In contrast to prior studies evaluating these parameters in dogs of different breeds and body types, no correlation was found between markers of RV function and body weight in this population of Boxer dogs.

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Abbreviation

ARVC	arrhythmogenic right ventricular cardiomyopathy
CHF	congestive heart failure
FS	fractional shortening
LV	left ventricle
RV	right ventricle
TAPSE	tricuspid annular plane systolic excursion
S'	pulsed wave tissue Doppler imaging derived systolic myocardial velocity of the lateral tricuspid annulus
VPC	ventricular premature complex

Introduction

Arrhythmogenic right ventricular cardiomyopathy (ARVC) is an inherited cardiomyopathy of Boxer dogs which predominantly affects the right ventricle (RV) [1,2]. The pathophysiology of the disease is characterized by progressive replacement of normal ventricular myocardium with fatty or fibrofatty tissue, frequently accompanied by inflammatory infiltrates. The resulting electrical instability manifests in ventricular tachyarrhythmias, which may lead to syncope or sudden cardiac death. In advanced disease, the left ventricle (LV) can also be affected, and progressive systolic dysfunction and biventricular dilation appearing grossly indistinguishable from dilated cardiomyopathy (DCM) may result in congestive heart failure (CHF).

In people, echocardiography plays an important role in the evaluation of patients with ARVC [3–5]. Echocardiographic evidence of LV dysfunction has been associated with adverse outcomes in both people [4–8] and Boxers with ARVC [9,10]. Left ventricular involvement may represent an end-stage complication of ARVC in people, manifesting after a prolonged period of cardiac arrhythmias and/or RV dilation and dysfunction [11]. The natural history and progression of structural cardiac

changes and systolic dysfunction in Boxers with ARVC is less well characterized [12,13]. Echocardiographic assessment of RV systolic function in dogs with ARVC may allow for earlier detection of structural cardiac abnormalities and aid in the diagnosis, monitoring, and prognostication of the disease.

Right ventricular dysfunction has been documented in many cardiovascular disease states in people, and the echocardiographic assessment of RV function plays an important role in the evaluation of patients with cardiac disease. Historically, clinical assessment of RV function via echocardiography has been infrequently reported in animals [14–18]. Tricuspid annular plane systolic excursion (TAPSE) and pulsed wave tissue Doppler imaging–derived systolic myocardial velocity of the lateral tricuspid annulus (S') are easily obtained echocardiographic measures of longitudinal RV systolic function that have been well validated in people with cardiac disease [4,6,19–23]. Recent studies have established reference ranges and shown that measurement of these indices is both feasible and repeatable in healthy dogs [24–26] and may have utility in the evaluation of animals with cardiac disease [18,27–32]. In people, both TAPSE and S' have been shown to correlate well with other measures of global RV systolic function [33–36] and have shown utility in the screening and monitoring of ARVC [3,4,6,37–39]. A recent study suggested that reduced TAPSE may serve as a negative prognostic indicator in Boxers with arrhythmias [30]; however, to date, there are no studies comparing TAPSE or S' in healthy Boxers and Boxers with ARVC.

The aim of this study was to determine whether Boxers with ARVC have differences in TAPSE and S' compared with healthy control Boxer dogs and to explore relationships between these indices and age, body weight, gender, arrhythmia frequency, and markers of LV systolic function. We hypothesized that both measures of RV systolic function would be reduced in Boxer dogs with ARVC in comparison to normal control Boxer dogs and that

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