Journal of Veterinary Cardiology (2018) ■, ■–■

ELSEVIER

Journal of Veterinary Cardiology
ESVC

www.elsevier.com/locate/jvc

# Assessment of longitudinal systolic function using tissue motion annular displacement in healthy dogs

**Marcela Wolf, MSc*, Stephany B. Lucina, MSc, Bruna C. Brüler, MSc, Giovana L.R. Tuleski, MSc, Vinícius B.C. Silva, DVM, Marlos G. Sousa, PhD**

*Laboratory of Comparative Cardiology, Department of Veterinary Medicine, Federal University of Paraná (UFPR), Rua dos Funcionários 1540, Curitiba, 80035-050, Brazil*

Received 14 June 2017; received in revised form 28 March 2018; accepted 3 April 2018

**KEYWORDS**
Echocardiography;
Speckle tracking;
Longitudinal contractility;
Strain imaging;
Left ventricle

**Abstract** *Introduction:* Left ventricular systolic function is one of the main parameters studied in echocardiography. Longitudinal systolic function, however, is less commonly evaluated in routine examinations but may provide early information on systolic dysfunction. The movement of the mitral annulus toward the apex has already been determined as a method for evaluation of longitudinal systolic function in dogs, but the study of this movement by speckle tracking with the tissue motion annular displacement (TMAD) technique has not yet been evaluated.
*Animals:* One hundred fifty-three client-owned healthy dogs.
*Methods:* Cross-sectional study. One hundred fifty-three client-owned healthy dogs underwent physical examination, electrocardiography, blood pressure measurement, and a standard and speckle tracking echocardiography. Systolic function was evaluated by global longitudinal strain (GLS) and TMAD. These parameters were compared with the standard echocardiographic data.
*Results:* A correlation was found between GLS, TMAD, and body weight. Tissue motion annular displacement and GLS were significantly correlated ($p < 0.001$) with other surrogates of systolic function, including ejection fraction and fractional shortening. There were no differences in TMAD between sexes. The coefficient of variation (CV) of the intraobserver evaluation in the global TMAD (CV 4.44) was slightly higher than that in the GLS (CV 3.74). Also, TMAD was not influenced by heart rhythm and could be acquired more rapidly than GLS.

This study was performed at the Veterinary Teaching Hospital of the Federal University of Paraná, Curitiba, Brazil.

* Corresponding author.
*E-mail address:* marcelawvet@gmail.com (M. Wolf).

https://doi.org/10.1016/j.jvc.2018.04.004


Please cite this article in press as: Wolf M, et al., Assessment of longitudinal systolic function using tissue motion annular displacement in healthy dogs, Journal of Veterinary Cardiology (2018), https://doi.org/10.1016/j.jvc.2018.04.004

*Conclusions:* Tissue motion annular displacement is a rapid and reproducible method for the assessment of left ventricle longitudinal function in healthy dogs. However, more studies are needed to validate the real clinical applicability of TMAD in animals with heart diseases.


**Abbreviations**

| | |
|---|---|
| AP4 | apical 4-chamber |
| AP2 | apical 2-chamber |
| BSA | body surface area |
| BW | body weight |
| EF | ejection fraction |
| FS | fractional shortening |
| GLS | global longitudinal strain |
| HR | heart rate |
| LSt | longitudinal strain |
| MAM | mitral annulus motion |
| ROI | region of interest |
| SBP | systolic blood pressure |
| TMAD | tissue motion annular displacement |

## Introduction

Left ventricular systolic function may be evaluated by measurement of several parameters in conventional echocardiography [1]. However, measurements such as fractional shortening (FS) and ejection fraction (EF) obtained by M-mode specifically evaluate the circumferential myocardial fibers. It is thought that ventricular contraction is mainly driven by circumferential myocardial fibers [2,3], but longitudinal fibers also play a relevant role in systole [4,5]. Interestingly, Jones et al. [6] reported that the longitudinal myocardial fibers are the first to be impaired in systolic dysfunction. In dogs, standard echocardiography provides information on systolic function using parameters that are known to be affected by volume overload, as well as being highly influenced by the operator's experience and image quality [7,8]. Thus, evaluation of longitudinal fibers may assist in echocardiographic assessment of systolic function.

In addition to the conventional assessment of systolic function by standard echocardiography, several echocardiographic techniques are used to evaluate the longitudinal systolic function in dogs. The difference of the mitral annular displacement in systole and diastole obtained by M-mode in septal and lateral parts of the mitral annulus corresponds to the mitral annulus motion (MAM), a technique that provides information on long axis' systolic function [9]. Also, the longitudinal shortening fraction is another method of evaluation of the longitudinal contraction which can be acquired by the ratio between MAM and left ventricular internal dimension at end-diastole obtained from the apical 4-chamber (AP4) view [10]. Other techniques obtained by speckle tracking, such as longitudinal strain (LSt) and strain rate, have also been investigated in dogs and evaluate the percentage of myocardial deformation and the velocity of such deformation [11–14].

Recent studies in man have shown that tissue motion annular displacement (TMAD) is a rapid technique that is less dependent on high-definition imaging and significant operator experience when compared with measurement of EF [15,16]. Moreover, TMAD provides information on systolic function encompassing longitudinal fibers by the degree of displacement of the annulus toward the apex. Tissue motion annular displacement of the mitral valve is obtained from the definition of three regions of interest (ROIs): two in the mitral annulus and one at the apex of the left ventricle and provides information of longitudinal systolic function based on the distance of the excursion of the points of the mitral annulus toward the cardiac apex during systole[a] [15].

At least in people, TMAD is believed to allow the early diagnosis of systolic dysfunction because individuals with early systolic impairment may have a preserved EF when evaluated with conventional echocardiography, although the TMAD may already be reduced [15]. Because a compensatory increase in circumferential shortening can maintain normal systolic indices despite the decreased longitudinal systolic function, a multidirectional myocardial evaluation might be rewarding for diagnostic purposes [15,17,18]. Interestingly, although other techniques that evaluate the distance of mitral

[a] Iwakura K, Okamura A, Koyama Y, Inoue K, Nagai H, Toyoshima Y, Tanaka K, Oka T, Iwamoto M, Fujii K. Assessment of left ventricular global systolic function by tissue mitral annular displacement: comparison with global longitudinal strain [Abstract]. J Am Coll Cardiol 2016; 67:1716.

Please cite this article in press as: Wolf M, et al., Assessment of longitudinal systolic function using tissue motion annular displacement in healthy dogs, Journal of Veterinary Cardiology (2018), https://doi.org/10.1016/j.jvc.2018.04.004