



Comparison of four echocardiographic methods to determine left atrial size in dogs

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KEYWORDS

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Abstract Objectives: To compare a linear and three volume-based two-dimensional echocardiographic methods for measuring LA size: left atrium to aorta ratio (LA/Ao ratio), biplane area-length, biplane modified Simpson and monoplane area-length.

Animals: One hundred seventy-six client-owned dogs of different breeds, 88 healthy dogs and 88 dogs with myxomatous mitral valve disease of different disease severity.

Methods: The left apical four- and two-chamber views were used to measure LA volumes. The right parasternal short-axis view at the level of the heart base was used to measure the LA/Ao ratio.

Results: The biplane area-length method yielded 2.8% larger values than those of the biplane modified Simpson method, consistent across the full range of LA volumes. The monoplane area-length method derived on average 5.8% larger values of LA volume than the biplane area-length method. The difference between these two methods was most pronounced at larger LA volumes. The relation between the LA/Ao ratio and LA volume was curvilinear and with increasing LA size these two methods derived very dissimilar values.

Conclusions: All methods showed good feasibility and reproducibility, with the volume-based methods having the most favourable intra- and inter-observer variabilities.

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The LA/Ao ratio underestimates at higher values of LA size compared to the biplane area-length method. LA volume methods may be superior to the LA/Ao ratio in quantification of LA size. The biplane area-length method and biplane modified Simpson method can be used interchangeably. The monoplane area-length measurement may be used as a quick and reliable method for assessment of LA size in clinical practice.

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Abbreviations

2D	two-dimensional
3D	three-dimensional
Ao	aorta
LA	left atrial/atrium
MMVD	myxomatous mitral valve disease

Introduction

The left atrium (LA) is a valuable marker of the presence and severity of cardiac disease and has been recognised as a strong predictor of outcome in dogs with chronic degenerative mitral valve disease [1].

Numerous echocardiographic methods of measuring LA diameter, circumference and cross-sectional area using either M-mode or two-dimensional (2D) dimensions from parasternal short- or long-axis views have been reported [2,3]. In veterinary clinical practice and in research studies the left atrial to aortic root ratio is the most commonly used method [4].

The LA is a three-dimensional (3D) structure and its enlargement may occur in an asymmetrical way. Thus, volume-based methods have the potential to provide more accurate estimates of LA size than one-dimensional linear or area measurements. The Guidelines and Standards Committee of the American Society of Echocardiography recommends biplane 2D volume determination using either the modified Simpson or the area-length method for measurement of LA size in humans [5]. Echocardiographic biplane 2D and 3D measures of LA volume in humans have been compared with cine computed tomography and magnetic resonance imaging. These studies have demonstrated either good agreement [6–8] or a tendency for echocardiographic measurements to underestimate comparative LA volumes [9].

Tidholm et al. [10] recently described a real-time 3D method for assessment of LA volume in dogs.

Although 3D methods theoretically may provide the most accurate measurements, they are time consuming and specialized equipment is needed [10]. In the clinical setting, a robust and convenient non-invasive echocardiographic method of estimating LA volume is desirable. We recently described the biplane 2D area-length method for assessment of LA volume in dogs [11]. To our knowledge the biplane modified Simpson method for assessment of LA volume has not been formally reported in dogs. Thus, it is unclear how the LA/Ao ratio, the biplane area-length and biplane modified Simpson method compare in terms of LA size assessment and reproducibility in the dog.

The objectives of this study were (1) to assess how the different methods compare in terms of reproducibility; (2) to evaluate the relation between LA size derived from measurement of the LA/Ao ratio and 2D biplane methods; (3) to determine potential systematic differences in LA volume quantification by the biplane area-length, the biplane modified Simpson and the monoplane area-length method.

Materials and methods

Study population

This prospective cross-sectional study included 176 privately owned dogs—88 dogs with myxomatous mitral valve disease (MMVD) and 88 healthy control dogs. Dogs were considered healthy based on the absence of owner-reported clinical signs and unremarkable serum biochemical results, together with normal findings on physical examination, electrocardiography (ECG), M-mode, 2D and Doppler examinations.

Diagnostic criteria for MMVD included thickened and/or prolapsed mitral valve leaflets and mitral regurgitation detected on colour Doppler [12]. Dogs with MMVD were staged according to the American College of Veterinary Internal Medicine (ACVIM) classification system [13].

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