



Echocardiographic indices of age- and gender-dependent cardiac remodeling over the adult lifespan in Irish Wolfhounds

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Received 14 December 2017; received in revised form 31 May 2018; accepted 4 July 2018

KEYWORDS

Left ventricular dimensions;
Left and right atrial size;
Aging;
Dog;
Shortening fraction

Abstract *Introduction:* Characterizing age- and gender-dependent cardiac remodeling over the adult lifespan in Irish Wolfhounds (IW) by echocardiography. In people, a life-long cardiac remodeling process has been demonstrated.

Animals, materials, methods: Irish Wolfhounds (56 males, 90 females) with no indication of cardiac disease at final assessment (>7.0 years old). For each dog, four transthoracic echocardiographic studies were analyzed. Left ventricular (LV) systolic and diastolic internal dimensions (LVIDs, LVIDd), LV fractional shortening (FS) and ejection fraction (EF), LV free wall and interventricular septal thickness, right ventricular diastolic dimension, and left atrial (LA) and right atrial systolic diameters were compared at time points in the following age categories (years): 1.0–2.5; 3.0–4.0; 4.5–6.0; and 7.0–10.5 and related to age, body weight, and heart rate.

Results: Over the adult life course, males had statistically significant increases in LV internal dimensions, atrial diameters, and decreases of FS and EF. From youngest to oldest age of examination means \pm standard deviations were as follows: LVIDs, 32.7 ± 2.9 vs. 36.5 ± 2.9 mm; LVIDd, 49.6 ± 4.7 vs. 53.4 ± 3.8 mm; right atrial diameter, 36.8 ± 3.3 vs. 42.6 ± 3.3 mm; LA, 49.0 ± 3.6 vs. 55.0 ± 3.7 mm; and FS, 34.6 ± 3.7 vs. 31.0 ± 3.2 . In females, LV internal dimensions did not change significantly, increases in right atrial (38.1 ± 3.7 mm to 40.0 ± 5.2 mm) and LA diameter (48.8 ± 3.6 to 52.4 ± 4.3 mm) were attenuated, as were decreases of FS (33.4 ± 3.7

Presented as an abstract at the 26th ECVIM-CA Congress in Gothenburg, Sweden 2016.

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<https://doi.org/10.1016/j.jvc.2018.07.001>

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Please cite this article in press as: Brungs A, et al., Echocardiographic indices of age- and gender-dependent cardiac remodeling over the adult lifespan in Irish Wolfhounds, Journal of Veterinary Cardiology (2018), <https://doi.org/10.1016/j.jvc.2018.07.001>

to 31.5 ± 4.4 , $p = 0.02$). LV wall thicknesses did not significantly change in both genders.

Discussion and conclusions: Over the adult life course, echocardiography demonstrated increasing LV dimensions in male IWs only. In both genders, FS and EF decreased, and atrial diameters increased. Females showed an attenuated remodeling process.

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Abbreviations

BW	body weight
DCM	dilated cardiomyopathy
EF	ejection fraction
FS	fractional shortening
HR	heart rate
IW	Irish Wolfhound
LA	left atrial
LV	left ventricular
LVIDd	diastolic left ventricular internal diameter
LVIDs	systolic left ventricular internal diameter

Introduction

In humans, management of heart disease in asymptomatic patients increasingly emphasizes strategies intended to reduce cardiac morbidity and mortality [1–5]. Irish Wolfhounds (IW) are commonly affected by dilated cardiomyopathy (DCM) and atrial fibrillation [6,7]. In dogs with DCM, two clinical studies performed in Doberman Pinschers and in IWs showed that early diagnosis and initiation of medical treatment in the pre-clinical phase of DCM significantly prolongs the time to onset of congestive heart failure or sudden death [8,9].

It is important to distinguish cardiac disease from normal age-related changes. In people, studies assessing the effect of age on left ventricular (LV) systolic function as well as on LV volumes and LV wall thickness and mass reported some contradictory results. In some studies with quite small numbers of human patients included, aging did not alter LV cavity dimensions or fractional shortening (FS) [10–13]. Other studies using cardiac magnetic resonance imaging observed an increasing LV ejection fraction (EF) with advancing age and a higher EF of women compared to men [14,15]. In the Framingham Heart Study, cardiac

remodeling with aging was characterized by a distinct pattern of increasing LV wall thickness, decreasing LV dimensions, and increasing FS with an attenuated remodeling process in females [16]. In a Swiss population study including 5307 subjects, an increase of LV systolic function and a decrease of LV volumes with age were demonstrated, with alterations more pronounced in women than in men [17].

In dogs, there are published reference values for echocardiographic measurements for different breeds including the IWs and for the diagnosis of DCM in this breed [18,19]. However, longitudinal data evaluating cardiac remodeling over the adult lifespan are lacking in dogs including IWs.

Methods

Study sample

Client-owned, purebred, IW dogs ($n = 1588$; 738 males; 850 females) were recruited between May 1990 and March 2016 through cardiovascular screening clinics in Belgium, Germany, and the Netherlands. Dogs were longitudinally followed, and owners were instructed to report date and circumstances of death. At each examination, each dog had a medical history, complete physical examination, 6-lead at least three-minute ECG recorded in right lateral recumbency, and echocardiography performed. Other examinations of blood, urine, or by radiography were carried out on a case by case basis in collaboration with the owner and referring veterinarian, and especially if indicated by medical history or examination findings. Data of each examination and all survival information were continuously updated in Excel files. Out of this database, 146 dogs (56 males, 90 females) that had four normal cardiovascular examinations including transthoracic echocardiography performed with no evidence of cardiac disease at the time of their final assessment and with no evidence of systemic internal disease

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