

Normal Echocardiographic Findings in Four Month Old Male Ostrich (*Struthio camelus*)

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Summary

Echocardiography in birds is a useful and competent technique for morphological and functional cardiac assessment. The aim of this study was to establish normal reference echocardiographic values for ostrich. Echocardiographic parameters from 25 apparently healthy male and almost 4 month old ostrich were chosen for this experiment. Echocardiography was prepared from the second and third intercostals space and over the sternum. The mean and standard deviation was calculated for each parameter. The values obtained are: The left ventricular internal diameter at end systole and end diastole was 1.50 ± 0.2 and 2.70 ± 0.16 cm; left ventricular free wall at end systole and end diastole was 0.89 ± 0.04 and 0.62 ± 0.03 cm; inter ventricular septum at end systole and end diastole was 0.99 ± 0.81 and 0.65 ± 0.11 cm, respectively. The stroke volume was 20.98 ± 2.56 cm³ and fractional shortening was $44.41\pm 0.53\%$. Normal echocardiographic values in the healthy birds may be used as early diagnostic and prognostic values in ostriches with cardiac diseases.

Keywords: Ostrich, Echocardiography, Male, Age

Dört Aylık Erkek Devekuşu (*Struthio camelus*) Normal Ekokardiyografik Bulguları

Özet

Kuşlarda ekokardiyografi morfolojik ve fonksiyonel olarak kalbin değerlendirilmesinde yararlı ve geçerli bir tekniktir. Bu çalışmanın amacı devekuşu için normal ekokardiyografik değerleri ortaya koymaktır. Çalışmada görünüşte sağlıklı 4 yaşlı 25 adet erkek devekuşunun ekokardiyografik bulguları kullanıldı. Ekokardiyografi sternumun üzerinden ikinci ve üçüncü interkostal aralıktan sağlandı. Her parametre için ortalama ve standart sapma hesaplandı. Elde edilen değerler: sol ventrikül iç çapı sistol ve diastol sonunda sırasıyla 1.50 ± 0.2 ve 2.70 ± 0.16 cm; sol ventrikül serbest duvarı sistol ve diastol sonrasında sırasıyla 0.89 ± 0.04 ve 0.62 ± 0.03 cm; interventriküler septum sistol ve diastol sonunda sırasıyla 0.99 ± 0.81 ve 0.65 ± 0.11 cm olarak kaydedildi. Kalp atım hacmi 20.98 ± 2.56 cm³ ve fraksiyonel kısalma $44.41\pm 0.53\%$ olarak belirlendi. Sağlıklı devekuşlarının normal ekokardiyografik değerleri bu hayvanların kalp hastalıklarında erken tanı ve prognostik amaçlı kullanılabilir.

Anahtar sözcükler: Devekuşu, Ekokardiyografi, Erkek, Yaş

INTRODUCTION

Cardiac ultrasonography or echocardiography is considered as a noninvasive and valuable method for evaluating structural and functional values of the cardio-

vascular system and has been used in veterinary medicine since about 30 years ago and echocardiography is a useful technique for diagnosing cardiovascular disease



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in animals [1]. Whereas, vascular diseases in birds are not uncommon, according to findings from postmortem surveys but cardiovascular diseases are common in avian species [2-6] which can be diagnosed with echocardiography in antemortem period. In veterinary medicine, echocardiographic examination has become a very important diagnostic tool, and is indicated for assessment of cardiac function and the structure of the heart. Several years ago echocardiography of birds due to position of the air sac and anatomical peculiarities was difficult but in recent years it is used for the diagnosis of cardiac complications in birds [7,8], horses [9,10], dogs [11], and cats [12]. Echocardiography as a noninvasive method for assessment of cardiac turkeys and other species of birds have been used [13]. Also reference Values from clinically normal animals by use of 2D and M mode echocardiography have been reported in human [14] and a variety of animals, including ferrets [15,16], chinchillas [17], hamsters [18] and rabbits [19], cats [20,21], dogs [22-25], rat [26], horse [27], however, to the author's knowledge, reference values for ostrich have not been published in English veterinary literature. The aim of the study was to establish normal reference echocardiographic value in the ostrich.

MATERIAL and METHODS

In this study, 25 healthy male almost 4 month years old ostrich were selected (In this study only four months old male ostriches has been used). Echocardiographic examinations were performed with an EX8000 Medison ultrasound system, using a 2-4 MHz Phased array transducer. Echocardiography was prepared from the second and third intercostals space and over the sternum (as a new approach in author's experience). Fasting and general anesthesia have not be needed and the birds were enclosed in standing position. Left ventricular end-diastolic and

end-systolic measurements were taken at the largest and at the smallest dimensions between the interventricular septum and the left ventricular free wall, respectively.

The following M-mode measurements were performed: Interventricular septal thickness at end-diastole (IVSd), interventricular septal thickness at end-systole (IVSs), left ventricular internal diameter at end-diastole (LVIDd), left ventricular internal diameter at end-systole (LVIDs), left ventricular posterior wall thickness at end-diastole (LVPWd), left ventricular posterior wall thickness at end-systole (LVPWs). Right ventricular internal diameter at end-diastole (RVIDd), right ventricular internal diameter at end-systole (RVIDs). In addition, fractional shortening (FS) was calculated [28-30].

Statistical Analysis

Maximum, Minimum, Mean, Range and Standard deviation of measurements were calculated.

RESULTS

Echocardiography was prepared from the second and third intercostals space and over the sternum (Fig. 1 and Fig. 2). Values obtained with 2-dimensional and M-mode in all 25 ostrich were summarized (Table 1). Fractional shortening was significantly lower than the reference value.

DISCUSSION

Echocardiography is considered as noninvasive and valuable method for evaluating structural and functional values of the cardiovascular system. It has been used for many animals and birds but there is limited information about normal echocardiographic measurements in

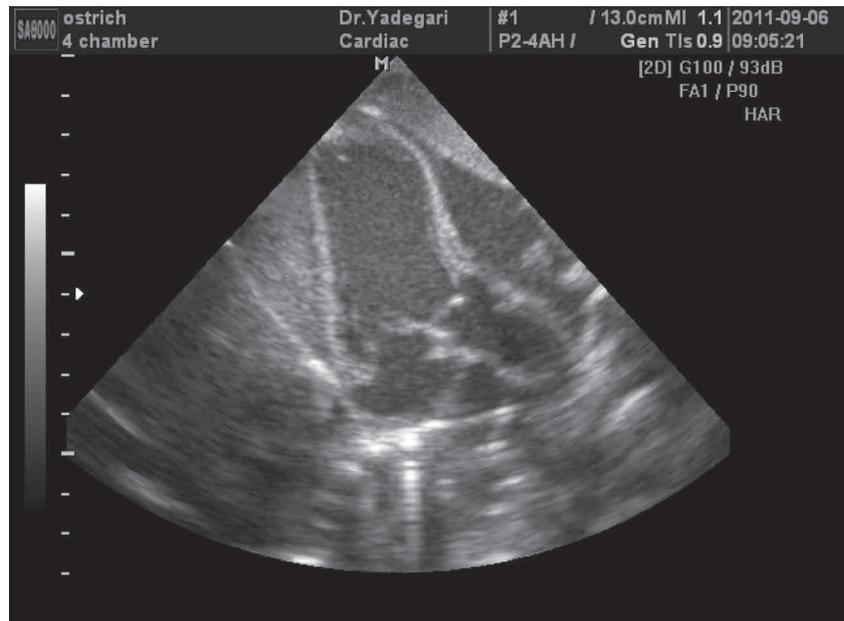


Fig 1. Left ventricle inflow tract and four-chamber view

Şekil I. Sol ventrikül giriş yolu ve dört-odası görünümü

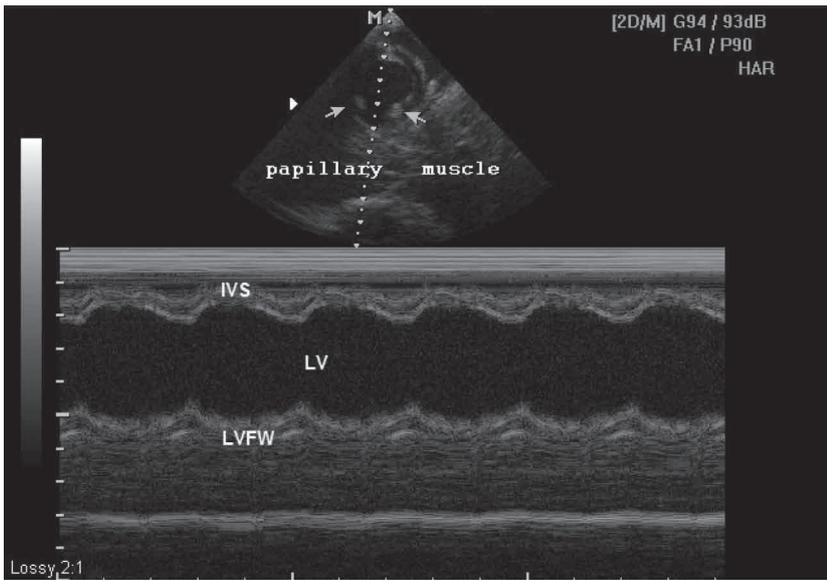


Fig 2. 2D and M-mode echocardiography

Şekil 2. 2D ve M-mode ekokardiyografi ile değerlendirilmesi

Table 1. Mean and Standard deviation (S.D) of the total echocardiographic parameters calculated for 25 healthy ostriches

Tablo 1. 25 sağlıklı devekuşu için hesaplanan total ekokardiyografik parametrelerin ortalama ve standart sapmaları (S.D)

Parameters	Min	Max	±S.D	Mean
Weight (kg)	36.24	44.96	4.36	40.6
RVIDd (cm) ¹	1.38	1.5	0.06	1.44
RVIDs (cm) ²	0.33	0.43	0.05	0.38
IVSd (cm) ³	0.81	1.03	0.11	0.92
IVSs (cm) ⁴	1.29	1.61	0.16	1.45
LVIDd (cm) ⁵	2.76	3.12	0.18	2.94
LVIDs (cm) ⁶	1.17	1.39	0.11	1.28
LVFWd (cm) ⁷	0.84	1.02	0.09	0.93
LVFWs (cm) ⁸	1.59	1.79	0.10	1.69
FS% ⁹	53.61	58.97	2.68	56.29

1- Right ventricular internal diameter at end-diastole, 2- Right ventricular internal diameter at end-systole, 3- Interventricular septal thickness at end-diastole, 4- Interventricular septal thickness at end-systole, 5- Left ventricular internal diameter at end-diastole, 6- Left ventricular internal diameter at end-systole, 7- Left ventricular posterior wall thickness at end-diastole, 8- Left ventricular posterior wall thickness at end-systole, 9- Fractional shortening

ostriches. The heart is the one vital organ in living things. In ostrich it one of the biggest organs in respect body, because in adult ostrich, height receive to 1.5-2 meters thus heart should be able to pumping the blood to this distance. One of the confident procedures for notification about structural and functional status of the heart is echocardiography. Existence of having the normal echocardiographic indicators values in any breed of birds has special importance.

The recognition of a high incidence of atherosclerosis in birds [2,3,31] has generated an interest in developing imaging modalities that will help identify lesions antemortem. Atherosclerosis has been reported in many avian orders,

but Psittaciformes [32] and Anseriformes such as ducks and geese [32] appear to be particularly susceptible. Atherosclerosis has also been seen in other species such as ostrich, penguins, cormorants, free-ranging owls and various Passeriformes, including birds of paradise [32,33]. As well as aortic aneurysms are also found occasionally in poultry, specifically chickens and turkeys and anecdotally in ostriches [34,35] can be diagnosed with echocardiographic procedure.

Echocardiography may be useful for diagnosis of the arteriosclerotic processes of the large vessels close to the heart, but no systematic studies have been done to date. In a white cockatoo, an aneurysm of a coronary artery associated with arteriosclerosis has been diagnosed by echocardiography [36].

Martinez Lemus et al.[37], in 1998 studied on echocardiographic evaluation of cardiac structure and function in broiler and Leghorn chickens. This study was conducted to validate echocardiography in chickens and to compare cardiac structures and function between broiler and Leghorn chickens. Diameters of the right and left ventricles and the thicknesses of the left ventricular free wall and the interventricular septum were measured echocardiographically in 5 and 7-wk-old chickens from both lines. In this study suggested the broiler chickens have relatively smaller structural and functional heart than Leghorn chickens. Also right ventricular fractional shortening did not differ between the chicken lines, but difference in left ventricular fractional shortening was established Pees et al.[38] Belief 2D-echocardiography measurements demonstrate a strong correlation between the sternal length/the body mass and the length of the left ventricle in psittacines. Standardized views and protocols for mammals recommended by the American College of Veterinary Internal Medicine cannot be used in birds and comparisons of the measurements with those in mammal

or human medicine are not valid. However, in recent years, case reports regarding the use of echocardiography for diagnosis of cardiac disease in birds have demonstrated the potential of this diagnostic procedure. Initial studies have been conducted and standardized protocols for echocardiographic examination in avian patients have been established [38]. There is scant information about the cardiovascular system in ostrich. However, MacAlister [39], Bezuidenhout [40] studied ostrich heart and its associated arteries and veins. Krautwald-Junghanns et al. [41] examined the heart of 108 racing pigeons of the breed Bricoux. The birds were divided in two groups. One group those kept in aviaries (untrained) and other group, racing birds. Heart dimension and/or the heart work in these 2 groups have significant differences. Thus, for the first time, prove the information of athletics' heart in birds and the adaptation of the avian heart to appropriate performance were requirements. Pees et al. [42] in one examination of using echocardiography in 39 pigeons, which divided in 3 groups (control group, receiver 5 mg/kg enalapril group and receiver 10 mg/kg enalapril group) show an improvement of cardiac function from 26.8% (day 1) to 36.6% (day 140) could be seen, that means right ventricular FS increased. The effect of age on fractional shortening was reported. In avian species, previous reports of fractional shortening exist such as turkeys, reported left ventricular fractional shortenings varied from 38.8% to 81.9% in apparently healthy turkeys ranging in age from 17 to 161 days, with the lowest percentage occurring in the oldest birds [43]. Gyenai et al. [44] use echocardiography in turkey poults from hatch to 28 days of age. The parameters evaluated included Left Ventricular Internal-Diastolic dimension (LVIDd), Left Ventricular Internal-Systolic dimension (LVISd), Interventricular Septal End-Diastolic (IVSEd), Interventricular Septal End-Systolic (IVSEs), Left Ventricular Wall End-Systolic (LVWEs) and Left Ventricular Wall End-Diastolic (LVWEd). To induce DCM, feed containing Furazolidone (Fz) was fed to turkey poults from one to 28 weeks-of-age and compared between the LVIDd and LVISd were the most consistent indicators of DCM [44].

To our knowledge, there is no previous study on normal echocardiographic findings in ostrich. In one study exhibited, because of the avian anatomy suitable echocardiographic windows to the heart are limited. There are two possibilities: the ventromedian and the parasternal approach [45], but in our study we try to exert another simple and convenient style approach for this reason. Therefore, we suggested carrying out echocardiography procedure from the second and third intercostals space and over the sternum is an applicable method and it may be stated that the achieved values presented here, are primary echocardiographic parameters of the heart in ostrich.

Obtained data in this research demonstrates that it is possible to use a new simple and different approach for achieve suitable echocardiogram in ostrich and

perhaps other birds. Normal echocardiographic values in the healthy birds may be used as early diagnostic and prognostic values in ostriches with cardiac diseases.

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