

# M-Mode echocardiographic examinations in show-jumping and Arabian race horses

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### Summary

In this study, show-jumping horses (n = 80) and Arabian race horses (n = 80) from different work groups were examined, with the guidance of 2-D, by M-Mode echocardiography, to establish the reference values and to determine the differences in the cardiac structural measurements. Measurements were performed in four different planes by obtaining M-Mode cross-sections from M. papillaris, C. tendinei, mitral valves and aorta root levels, with the guidance of 2-D in the 4<sup>th</sup> intercostal space. Left ventricle, right ventricle, left atrium, aorta root, interventricular septum, left ventricle posterior wall and heart wall movements were observed and end-systolic and end-diastolic diameters with left ventricle function evaluations were performed. Subsequently, all of these values were compared between the two groups. The results indicated statistical significance of  $P < 0.001$  in end-diastolic volume (EDV) and ejection fraction (EF), and  $P < 0.005$  in diastolic left ventricle internal diameter (LVIDd), diastolic interventricular septum thickness (IVSd), diastolic right ventricle internal diameter (RVd), diastolic aorta internal diameter (Aod), fractional shortening (FS) and cardiac output (CO). It has been concluded that Arabian race horses are more advantageous with their powerful left ventricle functions, while show-jumping horses have the benefit of possessing wider left ventricles, indicating the probability that exercise improves the left ventricle functions in horses.

**Keywords:** M-Mode, echocardiography, horse

Attempts to set up the echocardiographic methodology in horses had been carried on for the last few decades and since 1980, echocardiography has been used to detect structural alterations and valve defects in the horse heart (4-6).

The diagnostic value of echocardiography is based on a global evaluation of the heart and on comparison between the visible structures which, in conjunction with the cardiologist experience, gives a preliminary general impression of the heart function (1, 19). Echocardiography allows an accurate quantitative assessment of cardiac morphology and function, based on morphological echocardiographic, blood flow velocities and systolic time intervals measurements (6, 16). For echocardiography to allow such an accurate measurement of cardiac dimensions and indices of cardiac function in any species, the reference values must be determined by using standardized measurement guidelines. Moreover, in most species, echocardiographic data had been shown to be affected by several physiological factors such as breed, body size and shape, growth, aging, training and heart rate (2, 21, 24).

M-Mode echocardiography has been accepted as a reliable and non-invasive cross section technique, which supplies information about the structure and the diameters of heart (20). It has been reported that M-Mode echocardiography technique is more reliable than B-Mode echocardiography technique in estimation of the axial diameter (6, 7). In addition, it is possible to examine the ejection phase index and moving heart structure during the heart cycles with M-Mode echocardiography (3, 19, 20).

Lescure and Tamzali (10) and Reef (16) used 1.9 MHz, Pipers and Hamlin (15) used 2.25-2.5 MHz, Lombart and others (11) and Stewart and others (23) used 3.5 MHz transducer for M-Mode echocardiographic examinations in adult horses. Yamaga and Too (25) reported that inadequate image profundity was achieved with B-Mode echocardiographic examinations and the costal shadow negatively affects the image quality. Lescure and Tamzali (10) and Lombart and others (11) whom carried out M-Mode echocardiographic examinations in the 4<sup>th</sup> intercostals space, and Pipers (14), and Stadler and Deegen (21) from the 3<sup>rd</sup>

**Tab. 1.** Rank means of age, height, body weight, body surface area and sex of the horses investigated in this study (mean  $\pm$  rank score)

Parameters	Show-jumping Horses (n = 80)	Arabian Race Horses (n = 80)
Age (year)	9.46 $\pm$ 5.36	3.22** $\pm$ 1.12
Height (cm)	160.80 $\pm$ 11.78	145.17 $\pm$ 10.11
Body weight (kg)	438.74 $\pm$ 81.79	362.16* $\pm$ 21.0
Body surface area (m <sup>2</sup> )	4.43 $\pm$ 0.55	3.9 $\pm$ 0.11
Stallion (%)	35	57
Mare (%)	50	43
Castrate (%)	15	-

Explanation: \* – P < 0.005, \*\* – P < 0.001

and 4<sup>th</sup> intercostals spaces reported echocardiographic windows. Some researchers recommended to shave bristles for a good image quality (9, 21).

The purpose of this study was to determine the normal values of echocardiographic dimensions, functional indices and quantitative reference values of echocardiography in clinically healthy Arabian race and show-jumping horses, and to determine the differences in the cardiac structural measurements.

### Material and methods

The first group, identified as show-jumping horses were consisted of English horses (n = 10), half blood English horses (n = 34), thoroughbred Akalteke horses (n = 5), thoroughbred Irish horses (n = 7), thoroughbred KWPN horses (n = 12), thoroughbred Frizeen horses (n = 7), half blood Belgium horses (n = 3), a thoroughbred Arabian horse (n = 1) and a thoroughbred Sel de France horse (n = 1) which were examined in the Military Veterinary School and training centre commandership. The second study group was consisted of 80 Arabian race horses in Bursa Orhan Gazi Hippodrome. The horses were clinically examined and sex, age, body weight, body surface area and height of the animals were recorded (tab. 1).

The M-Mode echocardiographic analyses were performed using 3.5 MHz micro convex transducer (Schimadzu SDU 350 A). Measurements were obtained from the 3-4<sup>th</sup> intercostal spaces (acoustic windows) as described by Stadler et al. (22), at the level of transducer I (*m. papillaris*), transducer II (*chordae tendineae*), transducer III (mitral valve) and transducer IV (aortic root).

Statistical procedure involved mean  $\pm$  rank score for the racing and show-jumping horses and Kruskal Wallis Chi-Square John (8).

### Results and discussion

The echocardiographic measures, LVID, LV mass and function and RVd were evaluated. Descriptive analysis of body weight, age, height, body surface area and sex of the horses are presented in tab. 1 and internal diameters, thickness, volume and function of heart are presented in tab. 2. The echocardiographic measu-

**Tab. 2.** Rank means of internal diameters, thickness, volume and function of heart determined for show-jumping horses and Arabian race horses (mean  $\pm$  rank score)

Parameters	Show-jumping Horses (n = 80)	Arabian Race Horses (n = 80)
LVIDd (mm)	85.66 $\pm$ 12.20	69.4* $\pm$ 11.66
LVIDs (mm)	57.49 $\pm$ 11.23	41.35 $\pm$ 11.24
IVSd (mm)	55.66 $\pm$ 12.20	30.21* $\pm$ 5.42
IVSs (mm)	41.48 $\pm$ 5.94	38.46 $\pm$ 10.10
LVPWd (mm)	22.36 $\pm$ 4.17	23.88 $\pm$ 3.46
LVPWs (mm)	30.23 $\pm$ 7.49	31.36 $\pm$ 5.68
ET (ms)	635.25 $\pm$ 164.45	633.13 $\pm$ 141.15
RVd (mm)	72.94 $\pm$ 9.88	66.5* $\pm$ 8.10
Lad (mm)	42.83 $\pm$ 6.08	37.21 $\pm$ 5.20
Aod (mm)	69.98 $\pm$ 9.60	63.10* $\pm$ 4.20
LAd/Aod	0.61 $\pm$ 0.2	0.56 $\pm$ 0.1
EDV (ml)	551.64 $\pm$ 126.65	501.21** $\pm$ 66.10
ESV (ml)	226.95 $\pm$ 57.97	217.62 $\pm$ 41.20
SV (ml)	325.91 $\pm$ 98.34	294.42 $\pm$ 44.61
CO (l/m)	16.20 $\pm$ 4.82	13.0* $\pm$ 3.40
EF (%)	51.74 $\pm$ 8.01	66.3** $\pm$ 8.70
FS (%)	33.13 $\pm$ 5.90	36.4* $\pm$ 3.21

Explanation: as in tab. 1.

rements of the two groups revealed significant differences.

In the present study, left ventricular internal diameters (end-systolic, end-diastolic), myocardial wall thicknesses, movement of mitral valves and left ventricular functions were evaluated at transducer I, II and III positions. It has been proved by the previous reports that, M-mode technique is effective in measuring the internal diameter, determining the myocardial wall thickness and measuring the amplitudes for clinical diagnosis of cardiomyopathy (20, 24). Right atrium end-diastolic internal diameters, right ventricle end-diastolic internal diameters and internal diameters of aortic root were measured at transducer IV position (1, 15). Some researchers proclaimed that measurements may be obtained on M-Mode cross section imaging taken from 2-D guided transducer positions (6, 19). Until now, M-Mode echocardiographic examinations performed on horses revealed different cardiac measurements (10, 15). These variances in the measurements are attributed to differences in breed, age and bodyweight (12). Other important reasons are dilatative and hypertrophic cardiomyopathies of adult horses due to excessive exercise and unconscious drug usage. On the other hand, it has been stated that bodyweight is correlated with internal heart diameters and myocardial thicknesses, but has no relation with gender (22). These parameters are perceived differently according to the transducer position (5, 15).

Intense training is often associated with morphologic changes in heart, including increases in LV chamber size, wall thickness, and mass as stated by Rewel (19), whom compared the heart diameters and heart structures of healthy race horses, riding horses and show jumping horses.

In the present study, a tendency for presenting a wider left ventricle in the show-jumping horses compared to the Arabian race horses was observed. Although show-jumping horses are superior from the aspect of left ventricle mass and volume, due to an eccentric left ventricle hypertrophy, left ventricle function values (EF, FS, CO) are more beneficial ( $p < 0.005$ ) in Arabian race horses. This eccentric left ventricle hypertrophy could be a physiologic response to the type of exercise the animals are submitted to, but to confirm this hypothesis, further studies are required using animals of similar biotype for different types of work. This physiological state progresses with the changes arising with exercise in sporting horses, as also mentioned by Bilal and Meral (2). It is intended to designate that left ventricle functions reflects valuable information about the activity history of the heart, regardless of the different biotype and different labour type of the examined horse.

It was emphasized that dilate cardiomyopathy, pericardial effusion, rupture of chordae tendineae, aortic stenosis and prolapsus of mitral valve can be determined by M-Mode echocardiographic examinations (13, 17, 18). Similar to the literature, in this study rupture of chordae tendineae and mitral valve prolapsus were encountered 5% in show-jumping horses and 2.5% in Arabian race horses.

Generally, it was reported that the ratio of left atrium end diastolic diameter to aortic root diameter should be less than 1 (1, 6). If this ratio is greater than 1, it reflects increasing of left atrium end diastolic diameter which indicates pulmoner arterial stenosis. If this ratio is less than 0.4, it is accepted as a document for aortic root stenosis. Vorös et al. (24) declared this ratio as 1.4, for horses with 483.3 kg average body weight. This ratio was found less than 1 at M-Mode trace and an increase is considered as left atrial enlargement which is accepted a good parameter (1, 6). In our study, we established this ratio as  $0.61 \pm 0.2$  in show-jumping horses and  $0.56 \pm 0.1$  in Arabian race horses. In 5 horses (3.13%), this ratio was higher than 1, and this was evaluated as left atrial enlargement.

Possible reference values for the investigated horses' heart and differences in the cardiac structural measurements are established with this study and when Arabian racehorses and show-jumping horses are compared from the aspect of the quality and the quantity of heart structural characteristics by using M-Mode echocardiography, it is concluded that Arabian race horses are more advantageous with their powerful left ventricle functions, where show-jumping horses has the benefit of possessing wider left ventricles, indica-

ting the probability that exercise improves the left ventricle functions in horses.

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