



## Echocardiographic Indices and their Values of Healthy Adult Malabari Goats

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### ABSTRACT

The study was carried out to establish standard echocardiographic values and indices for adult Malabari goats. Twelve healthy non-pregnant adult Malabari goats from Goat and Sheep Farm, Mannuthy aged one to two years and body weight ranging from 20-25 Kg were utilized to establish standard echocardiographic indices for Malabari goat. The standard echocardiographic values and indices obtained were Left Ventricular Internal Diameter at Diastole and Systole ( $2.73 \pm 0.07$  cm and  $1.66 \pm 0.08$  cm), Interventricular Septum at End Diastole and Systole ( $0.80 \pm 0.02$  cm and  $1.07 \pm 0.02$  cm), Left Ventricular free wall thickness at End Diastole and Systole ( $0.78 \pm 0.02$  cm and  $1.33 \pm 0.03$  cm), Fractional Shortening and Ejection Fraction ( $40.78 \pm 2.66\%$  and  $71.61 \pm 2.89\%$ ), respectively. Left Atrium to Aortic ratio in B were  $1.07 \pm 0.01$  cm. The study established the normal echocardiographic parameters in female adult Malabari goats which can be used as a reference for studies pertaining to cardiovascular disease diagnosis and for longitudinal research studies in future.

**Keywords:** Echocardiography, Malabari goat

Echocardiography, the ultrasonography of heart uses the principle of ultrasound to display the images of a heart. Echocardiography has become a routine procedure in the diagnosis, management and follow-up of small animal patients with any suspected or known heart diseases in tertiary care centres. The technique provides valuable information on size and shape of the heart and functional capacity using 2-Dimensional (2-D) and M-mode techniques (Gazi *et al.*, 2015). Two dimensional study allows the subjective assessment of the cardiac chambers and the valves, whereas M-mode is used to assess the size of the cardiac chambers and thickness of walls at specific times in the cardiac cycle as required (Berger, 2000). Although extensively employed and studied in small animals, horses and cattle, reports regarding use of echocardiography in goats to assess the cardiac variations, if any in India, are scarce. Therefore the present study

was designed to establish standard parameters of cardiac indices for Malabari goats.

### MATERIALS AND METHODS

Twelve apparently healthy non-pregnant adult Malabari goats of 1-2 years and body weight of 20-25kg from Goat and Sheep Farm, Kerala Veterinary and Animal Sciences University, Mannuthy were selected. These animals were free from haemoparasites and helminth infestation. All the animals were maintained under uniform feeding and management conditions. No abnormalities were detected on clinical examination of cardiovascular system of the animals.

### Instrumentation

Routine echocardiographic examination were done by two-



dimensional and M - mode echocardiography using a 3.2 - 3.5 MHz phased array transducer, Mindray Z 6 ultrasound scanner. 2-D and M-mode echocardiograms were recorded and analyzed in accordance with the recommendations of the American Society of Echocardiography.

### Scanning protocol

The 2<sup>nd</sup> to 6<sup>th</sup> right intercostal space (ICS) area caudal to the triceps muscle mass, 3 to 5 cm below the right olecranon to 5 to 10 cm above including the axillary region was shaved. The echocardiographic examination was performed by placing the animal on the right lateral recumbency with all the four limbs extending outward and forward on a specially constructed table for echocardiographic examination, enabling all the examination to take place from below the patient as for canines (Boon, 2011). The forelimbs were moved cranially to facilitate better contact between the transducer and the ICS. After application of the ultrasound gel, the transducer was placed on the animal's chest at a point where intense apex beat was felt. The examination was carried out making sure that animals were calm and relaxed.

### Transducer positioning

Examinations were made from the right parasternal window, in right lateral recumbency following the description of Allaam *et al.* (2013). Right parasternal long-axis four chamber view were visualized at the 4th right ICS with the transducer directed towards the spine. Right parasternal short-axis views were visualized at 4th right ICS towards the elbow. The different views were recorded by angling the transducer between 0° and 90°. M-mode examination of the left ventricle were carried out in the right parasternal short axis view and M-mode measurements were recorded by changing to M-mode by positioning the cursor perpendicularly to the septum in which the interventricular septum and left ventricular free wall were bisected at right angle, at the level of chordae tendinae close to papillary muscles.

### Measurements

All M-mode measurements were done using 'leading edge' method (Lang *et al.*, 2015). Following parameters were measured from the left ventricle namely, Left Ventricular

Internal Diameter at End Diastole (LVIDd) and Systole (LVIDs), Interventricular Septum at End Diastole (IVSd) and Systole (IVSs) and Left Ventricular free wall at End Diastole (LVFWd) and Systole (LVFWs). In the short axis view, measurement of left atrium and aorta at B-mode was carried out at the level of aortic valve. A transverse measurement of the aorta (AO) was done by connecting the line from the midpoint of the wall of the right aortic sinus to the intersection of the aortic wall and the merging point of the aortic non-coronary and left coronary cusps. LA were measured using the same intersection point and extending the line to the lateral wall of the LA. These measurement were done at ventricular diastole, when the aortic valves were closed visually (Olsson *et al.*, 2001). Values for each parameter were determined by the average of three to five cardiac cycles (Boon, 2011). Reference values for each parameters was estimated as mean and standard error after eliminating outliers and checked the observations for consistency and normality. Consistency was tested by using coefficient of variation (CV) and normality was tested by using Kolmogorov Smirnov (KS) test. Data analysis was done statistically by using the software SPSS Version 24.0

### RESULTS AND DISCUSSION

In the right parasternal long axis view, all the four chambers right atrium (RA), right ventricle (RV), left atrium (LA) and left ventricle (LV) were visualised. In between the right and left ventricle interventricular septum were positioned as the curved hypoechoic structure. The chamber of the left ventricle and left ventricular wall appeared as hypoechoic structure. The size of the left ventricle was larger in size compared to right ventricle. The pericardium appeared as hyperechoic line around the ventricles. Mitral valve and tricuspid valve appeared as hypoechoic structures. The chordae tendinae and papillary muscles were also visualised. The right parasternal short axis view was obtained by rotating the transducer in the direction of the elbow. The prominent view of the left atrium (LA) and aorta (AO) was achieved by tilting the probe. Aortic valves namely non, right and left coronary aortic valves in inverted Y position at diastole, also referred to as Mercedes sign were observed. With this view, left atrial to aortic ratio were recorded at diastole. In M-mode, different patterns of motions of different structures of the heart were visualized in M-mode in

the study. Interventricular septums were characterized by relatively low to medium amplitude waves. The left ventricle had waves of high amplitude sharp tips in the echocardiogram. The pericardium appeared highly echogenic beyond the left ventricle free wall. The CV for all the parameters were less than 20 per cent except for FS denoting consistency of the observation. The KS test was done for testing the normality of the observation in each variable and was found to be non-significant in all the cases. The standard echocardiographic values and indices of Malabari goats recorded are as tabulated in table 1.

**Table 1:** Standard echocardiographic values and indices for adult Malabari goats

Parameters	Mean±SE	CV (%)	Kolmogorov-Smirnov Z test
LVIDd (cm)	2.73±0.07	9.41	0.51
LVIDs (cm)	1.66±0.08	16.98	0.51
IVSd (cm)	0.80±0.02	10.27	0.53
IVSs (cm)	1.07±0.02	8.01	0.45
LVPFWd (cm)	0.78±0.02	8.05	0.45
LVPFWs (cm)	1.33±0.03	7.26	0.58
FS (%)	40.78±2.66	22.57	0.47
EF (%)	71.61±2.89	13.96	0.49
LA/AO B mode (cm)	1.07±0.01	4.85	0.61
LA/AO M mode (cm)	0.74±0.02	7.21	0.46

Echocardiography permits investigation of the morphology and function of the cardiac structures and measurement of cardiac dimensions which aids in assessing severity and prognosis of heart diseases (Tharwat *et al.*, 2012). Awareness of normal appearance and cardiac dimensions are essential, they improve identification, quantification and assessment of cardiac diseases and thus facilitate earlier diagnosis and intervention when abnormal findings were encountered. Perusal of literature did not reveal any studies involving echocardiographic evaluation of Malabari goats. The EF and FS in Malabari goats were found to be lower than that of Black Bengal goats and higher than that of Pantja goats and as opined could be associated with variations in body weight (Sankariah and Kumar, 2017 and Singh *et al.*, 2017). The results of echocardiography in small ruminants have indicated its use as animal model for studying human cardiovascular diseases (Locatelli *et al.*, 2011). Right lateral position

produced better images as compared to examining the animal in standing position as the heart was adjacent to the thoracic wall minimizing interference of the lungs (Dennis *et al.*, 2010). Use of phased array transducer as in the present study helped in overcoming difficulties associated with width of intercostals space (Hallowell *et al.*, 2012). In 2-D echocardiography, left ventricle was larger in size compared to right ventricle at right parasternal long axis view. In this view, the right ventricular chamber and wall of a normal animal were one-third to one-half the size of the left ventricle (Dennis *et al.*, 2010). Various patterns of motions of different structures of the heart were visualized in M-mode in the study. Left ventricular free wall was characterized by slightly rounded tips as suggested by Acorda *et al.* (2005). In buffaloes, left ventricular free wall had relatively high amplitude waves (Acorda and Pilapil, 2008). This correlated the description of Boon (2011) stating that during early systole, the IVS begins to move downwards and then move upward at the end of systole. Pericardium was visible with high echogenic pattern at the bottom of the M-mode echocardiograms due to the high acoustic impedance difference between the lungs and the pericardial tissue. Kolmogorov-Smirnov Z test values and coefficient of variance (%) values of the study indicated the normality and consistency of observation respectively. Except for FS, CV in the present study was less than 20 per cent. El-Khodery *et al.* (2010) and Leroux *et al.* (2012) had reported CV values of 6-11.9 per cent and 10.1-38.9 per cent respectively. The normalized values thus obtained in the present study can be used to assess the cardiac changes in any cardiovascular disease condition. The dimensions of the IVS and LVPFW were greater in systole than in diastole (Allam *et al.*, 2013; Obedencio and Acorda, 2014). 2-D mode measurements, incorporates a more representative dimension of the atrial body and were more specific as LA body could be visualized clearly (Rishniw and Erb, 2000). The present study has established reference values of the echocardiographic parameters studied for healthy non-pregnant female Malabari goats.

## CONCLUSION

From the results of this study, it can be concluded that it is possible to obtain good quality echocardiograms from Malabari goats. The established normal cardiac dimensions can be used as reference for further studies concerning goats with cardiac diseases.



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