Radiographic Cardiac Indices in West African Dwarf Goats

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***Abstract*- In veterinary radiology, determination of cardiac features is necessary in the assessment of animals with clinical signs of heart disease. In this work, thoracic radiographs of 10 clinically normal West African Dwarf Goats (WADGs) without any evidence of cardio-thoracic anomaly were examined. The aim of the research was to approximate reference values for radiographic cardiac indices of normal caprine heart image in dorsoventral, ventrodorsal and right lateral projections. The mean radiographic cardiac index was 0.64±0.01 and 0.67±0.01 in DV views and VD views respectively. In 90 per cent of the patients, the cardiac silhouette was found located between the third and sixth ribs, while in the remaining 10 per cent of the animals, the heart shadow was seen between ribs two and five. The two-thirds rule observed in dogs and cats is also applicable to the WADG. Use of radiographic cardiac indices and cardiac silhouette location in diagnosis is easy and objective in clinical practice.**

***Index Terms*— Heart, Goats, Measurements, Radiography, Views**

I. INTRODUCTION

Radiographic evaluation of cardiac size is used in animals as a primary diagnostic tool in the detection of heart disease (1, 2). Radiographic cardiac ratios reported so far lack suitability for general clinical application due to differences in thoracic conformation between breeds of animals (3). Radiographic ratios determined for Turkish Shepherd (Kangal) Dogs, for instance, was not applicable for clinical use in the beagle dog (4). Cardiac long axis has been found to be 2.5 intercostal spaces for deep-chested dog breeds and 3.5 intercostals for barel-chested breeds (5). Therefore, determination of breed-specific roentgenographic reference values for various animals is a necessity. The goal of the present investigation was to establish reference parameters in WADGs that could be used to categorize normal cardiac silhouette size and to support a diagnosis of cardiac disorder in this breed of goats.

II. MATERIALS AND METHODS

Ten WADGs (6 females) aged between 6 months and 3 years with body weight measuring from 4.8 to 14kg were recruited for this study. The animals were kept together for four weeks to acclimatize. Within that adaptation period, the animals were fed and screened for diseases. The parameters of physical and clinical examinations obtained at the end of acclimatization were normal in all goats and so the animals were considered healthy and appropriate for this research (6). The animals were restrained for radiography with xylazine hydrochloride, a sedative, given at 0.1mg/kg i/m (7).

Dorsoventral, ventrodorsal and right lateral thoracic views of each animal were obtained as described by Ettinger and Suter (1) and Douglas *et al* (8). Cardiac long and short axes and thoracic diameter were measured in centimeters on each radiograph with a metre rule as described by Miller *et al* (9). A radiographic cardiac index was generated by adding the long and short axes together, in DV/VD plane, and dividing the sum by the thoracic diameter (9). 'Two thirds rule' for dogs and cats states that a normal heart width (short axis) should be less than two-thirds the width of the chest (thoracic diameter) (1, 10). In other words, the short axis was measured and compared with two-thirds of the thoracic diameter, in each of the DV and VD radiographs. Location of the cardiac silhouette in the lateral radiographs was determined visually.

Variables were compared with Pearson's Product Moment Correlation Coefficient and Student's t-test statistics. Results were presented as means plus or minus standard error of means (M±SEM). Probability less than 5 per cent were considered significant ($p<0.05$).

III. RESULTS

Figure 1: Method of deriving RCI
RCI = ½(LA+SA)/TD
Key: LA = Long axis; SA = Short axis; TD = Thoracic diameter; RCI = Radiographic cardiac index

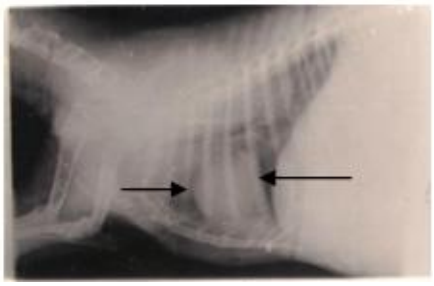

Figure 2: Heart image location. The heart was located between the 3rd and 6th ribs (arrows).

TABLE I. RADIOGRAPHIC CARDIAC INDICES IN DV AND VD VIEWS

		DV Views				VD Views			
Goat	**Sex**	**LA**	**SA**	**TD**	**RCI=½(LA+SA)/TD**	**LA**	**SA**	**TD**	**RCI=½(LA+SA)/TD**
A	F	7.7	7.2	12.0	0.62	10.0	7.6	13.0	0.68
B	M	7.6	6.9	10.9	0.67	9.4	7.6	12,8	0.66
C	F	7.1	7.5	11.2	0.65	9.0	7.9	12.9	0.66
D	F	7.4	7.0	10.4	0.69	9.7	7.5	13.0	0.66
E	F	7.8	7.1	11.4	0.65	9.0	6.3	12.0	0.64
F	M	7.9	7.5	12.1	0.64	10.5	7.8	14.2	0.64
G	F	5.0	5.1	8.2	0.62	7.0	4.9	9.4	0.63
H	M	7.3	7.5	11.5	0.64	10.1	7.9	12.6	0.71
I	M	5.0	4.6	8.7	0.55	6.1	4.6	7.4	0.72
J	F	5.2	5.0	7.8	0.65	6.8	5.4	8.8	0.69
		Mean = 0.64*				**Mean = 0.67***			

***Difference between means not significant (p>0.05).**
Key: LA= long axis; SA= short axis; TD= thoracic diameter (all in centimeters)

TABLE II. TWO-THIRDS RULE IN DV AND VD VIEWS

		DV Views		VD Views	
Goat	**Sex**	**SA**	**2TD/3**	**SA**	**2TD/3**
A	F	7.2	8.0	7.6	8.7
B	M	6.9	7.3	7.6	8.5
C	F	7.5	7.5	7.9	8.6
D	F	7.0	6.9	7.5	8.7
E	F	7.1	7.6	6.3	8.0
F	M	7.5	8.1	7.8	9.5
G	F	5.1	5.5	4.9	6.3
H	M	7.5	7.7	7.8	8.4
I	M	4.6	5.8	4.6	4.9
J	F	5.0	5.2	5.4	5.9
Means		**†6.5**	***7.0**	**†6.7**	***7.8**

†* Differences b/w DV and VD means not significant (p>0.05).

TABLE III. LOCATION OF HEART IMAGE IN RTL VIEWS

Goat	**Sex**	**Location of heart (b/w ribs)**
A	F	3rd and 6th
B	M	3rd and 6th
C	F	3rd and 6th
D	F	2nd and 5th*
E	F	3rd and 6th
F	M	3rd and 6th
G	F	3rd and 6th
H	M	3rd and 6th
I	M	3rd and 6th
J	F	3rd and 6th

***The heart was located b/w 2nd and 5th ribs in 10% of the goats**.

IV. DISCUSSION

Cardiac enlargement is a reliable indicator of heart disease and it may be due to hypertrophy or dilation. The commonest cause of cardiac hypertrophy is related to increased pulmonary and systemic pressure. The extra work of pumping blood against the increased pressure causes the ventricles to thicken over time, the same way a skeletal muscle increases in mass in response to regular weight-lifting (11,3).

Cardiac dilation, on the other hand, is caused by any condition that directly damages heart muscles e.g., heart attack, myocarditis (sometimes of unknown aetiology), long-term alcohol abuse and antiviral drugs used to manage HIV/AIDS both in man, idiopathic dilated cardiomyopathy, and valvular disorders. Healing response of the heart to these diseases results in thinning and stretching out of the myocardium. Conversely, microcardia (small heart) is usually seen in hypovolaemic states due to shock, severe blood loss, dysentery, burn; wasting diseases e.g., malnutrition, tuberculosis, extreme dehydration and constrictive pericarditis (12,13, 14).

Cardiothoracic indices are screening tests for cardiomegaly which is a reliable sign of heart disease. Cardiac enlargement can objectively be measured in thoracic radiographs with the application of reference cardiac indices (2, 15).

From the results (TABLE I), the mean radiographic cardiac index was 0.64±0.01 in DV views and 0.67±0.01for VD radiographs. In lateral views (TABLE II), location of heart can easily be used to evaluate cardiac enlargement in thoracic radiographs (16, 17). This is because an enlarged or globoid heart usually takes up more thoracic and intercostal spaces than normal. In this study, the heart of 90 per cent of the experimental animals was located between the 3rd and 6th ribs while in 10 per cent of the animals the heart occupies between ribs 2 and 5.

In DV projections, mean short axis and mean two-thirds thoracic diameter were 6.5±0.37cm and 7.8±0.11cm respectively (TABLE II). These results agree with the findings in dogs and cats reported by other researchers (1, 10), in each of which cases the cardiac short axis was found to be less than two-thirds of the thoracic diameter.

V. CONCLUSION

Evaluation of radiographic cardiac index and silhouette location is feasible. Subjective assessment of thoracic radiographs by experienced radiologists is a sensitive means of analyzing moderate to advanced cases of heart size disorders. In subtle conditions, cardiac measurement is more accurate especially when used by veterinarians with limited experience. It cannot be ascertained in this study whether sex differences exist in the values obtained because, with only 4 males (40%), gender of the animals was not evenly distributed. Therefore, data from this work should be compared with those of a study that would use even gender distribution. However, similar studies in the dog showed no significant gender and age difference (18, 19, 20). This investigation was carried out in WADGs only and so results of this work should be extrapolated to other goat breeds.

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