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ARTICLE

Vertebral Scale System to Measure Heart Size in Thoracic Radiographs of West African Dwarf Goats

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SUMMARY

In veterinary diagnostic radiology, determination of heart size is necessary in the assessment of patients with clinical signs of cardiac anomaly. In this study, heart sizes were compared with lengths of mid-thoracic vertebrae in 12 clinically normal West African Dwarf Goats (WADGs) (8 females, 4 males). The aim of the research was to approximate reference values for vertebral heart size (VHS) of normal caprine cardiac silhouette. Lateral thoracic radiographs were obtained and lengths of long and short axes of the heart image measured with a ruler in centimetres. The measured dimensions were scaled against the lengths of thoracic vertebral bodies dorsal to the heart starting from the fourth vertebra. Mean ±standard error of mean (M±SEM) VHS was 10.1±0.01 vertebrae. VHS differences between males and females, and right and left lateral (RtL and LeL) recumbencies were not significant. In clinical practice, VHS is easy to apply and objective in assessing cardiac sizes of patients.

KEYWORDS: Radiography, Measurement, Heart, Thoracic vertebrae, Lateral views

INTRODUCTION

Determination of heart size is necessary, in veterinary radiology, for the evaluation of patients with cardiac anomaly. Heart disease should be considered, and cardiac assessment carried out, if any of the following signs are identified on physical examination of a patient: limb abduction, bulging eyes, neck extension, reluctance to lie down, ascites, syncope, (jugular) venous distension, feeble pulse, oedema, hepatomegaly, water-hammer pulse, rales, rhonchi, cough, arrhythmias, bradycardia, tachycardia, etc (The Merck Veterinary Manual, 1991).

Thoracic radiographs are helpful in the diagnosis of heart disease especially when radiographic findings are compared with results of other diagnostic modalities. Various measurement methods have been reported but none of them is suitable for general clinical use due to breed/species differences in thoracic conformations (Gulanber et al., 2005).

Buchanan and Bucheler (1995) described a method for measuring cardiac silhouette in a lateral thoracic radiograph. According to these authors, the long and short axes of the heart image are measured and their lengths summed up after comparing them individually with mid-thoracic vertebrae producing an index called VHS. These

same researchers reported that most normal dogs have a VHS of 8.7v - 10.7v. However, recent studies have shown that differences exist between breeds that must be considered when interpreting VHS (Gulanber et al., 2005; Buchanan and Bucheler, 1995; Litster and Buchanan, 2000; Buchanan, 2000; Pinto et al., 2004).
The objective of the present study was to determine reference radiographic values for VHS of the cardiac silhouette of clinically normal WADGs for clinical use

MATERIALS and METHODS

Twelve selected WADGs with no radiological and clinical signs of cardiovascular and pulmonary diseases were used for this study. The animals' body weights varied from 4.8kg to 14kg and they consisted of 8 females and 4 males. A sedative (xylazine hydrochloride), given at 0.1mg/kg i/m, was used to restrain the patients for radiography (Kumar, 2006).
Survey right lateral (RtL) and left lateral (LeL) thoracic views of each experimental animal were obtained. Cardiac long and short axes were measured with a metre rule as follows: the length of the heart shadow from base to tip was taken as cardiac long axis, and the greatest width of the cardiac silhouette drawn on a line perpendicular to the long axis was recorded as the cardiac short axis (Buchanan and Bucheler, 1995; Forrest, 2006). Measurements were recorded in centimeters. Lengths of the two axes were then compared with the mid-thoracic vertebrae from the cranial edge of the fourth vertebra (T4), and a value described in units of vertebral lengths, was obtained for each axis. Sum of the vertebral units of the two axes gave the VHS. The data obtained were expressed as M±SEM and evaluated using Pearson's Product Moment Correlation Coefficient and Student's t-test. Significance was defined at probabilities less than 0.05.

RESULTS

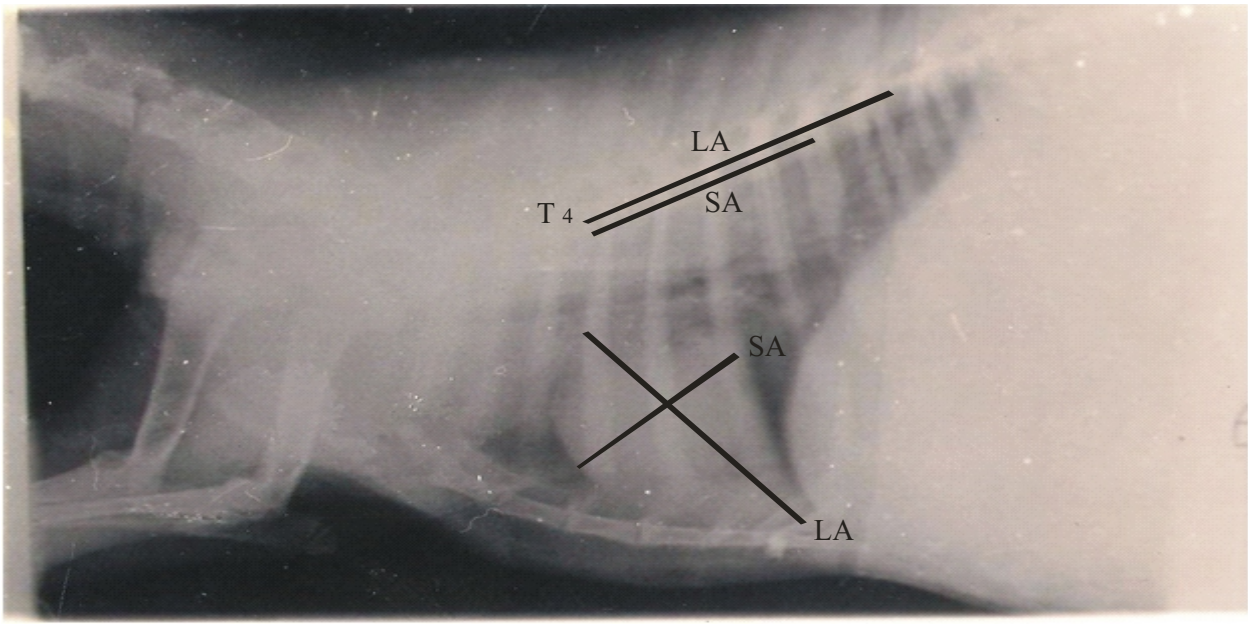

Fig 1:Vertebral Heart Scale Radiograph

Table 1: Vertebral Heart Scale in RtL versus LeL Radiographs

	RtL Projection			LeL Projection		
S/N	LA (v)	SA (v)	VHS (LA+SA) (v)	LA (v)	SA (v)	VHS (LA+SA) (v)
A	6.0	4.0	10.0	6.0	4.0	10.0
B	6.3	4.3	10.6	6.5	4.1	10.6
C	5.5	3.4	8.9	5.6	4.0	9.6
D	6.3	4.3	10.6	6.0	4.3	10.3
E	6.0	4.3	10.3	6.0	4.3	10.3
F	6.2	4.0	10.2	6.0	4.2	10.2
G	6.5	4.0	10.5	6.2	4.0	10.2
H	6.2	3.8	10.0	6.2	3.8	10.0
I	6.1	3.6	9.7	6.0	3.6	9.6
J	6.5	4.0	10.5	6.3	4.1	10.4
K	6.1	4.0	10.1	6.0	4.0	10.0
L	6.1	4.1	10.2	6.1	4.2	10.3

Mean = 10.1v* **Mean = 10.1v***

*RtL and LeL VHS means not significantly different (p>0.05)

Key: v = vertebrae; LA = long axis; SA = short axis; RtL = right lateral; LeL = left lateral

Table 2: Sex Difference in VHS Means (RtL Views)

FEMALES				MALES			
S/N	LA (v)	SA (v)	VHS	S/N	LA (v)	SA (v)	VHS
A	6.0	4.0	10.0	I	6.1	3.6	9.7
B	6.3	4.3	10.6	J	6.5	4.0	10.5
C	5.5	3.4	8.9	K	6.1	4.0	10.1
D	6.3	4.3	10.6	L	6.1	4.1	10.2
E	6.0	4.2	10.2				
F	6.2	4.0	10.2				
G	6.5	4.0	10.5				
H	6.2	3.8	10.0				

Mean = 10.1v* **Mean=10.1v***

*Sex VHS means not significantly different (P>0.05)

Key: v = vertebrae; LA = long axis; SA = short axis

DISCUSSION

Cardiac enlargement is a reliable indicator of cardiac disorder and it can be in terms of hypertrophy or dilation. The most common cause of cardiac hypertrophy is related to increased pulmonary and systemic blood 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 (Toscano, 2003; Hogan, 2002; Lamb and Boswood, 2002).

Cardiac dilation, on the other hand, is caused by any condition that directly damages cardiac muscles, e.g., heart attack, myocarditis, long-term alcohol abuse in man, idiopathic dilated cardiomyopathy, and valvular disorders. Healing response of the heart to the diseases results in thinning and stretching out of the myocardium (Walsh et al., 2002; Brown and O'Connell, 1995; Toscano, 2003).

Conversely, microcardia is usually seen in hypovolaemic states due to shock, severe blood loss, dysentery, burn; wasting diseases, e.g., malnutrition, extreme dehydration, anorexia nervosa, tuberculosis; asthenia; cor pulmonale; cystic fibrosis; hypoadrenocorticism (Addison's disease); senile atrophy; and constrictive pericarditis (The Merck Veterinary Manual, 1997; Preuter, 1993; Reeder and Bradley, 1993). Many researchers (Buchanan and Bucheler, 1995; Buchanan, 2000; Litster and Buchanan, 2000) have carried out VHS studies among different dog breeds. These authors recommended comparing radiographs of patients with radiographs of healthy animals of the same breed and size. But it is easily seen that in practice it is impossible to get a healthy animal of the same breed and size.

In some other VHS studies, lateral versus ventrodorsal (VD) views were used, and no VHS difference was found between the lateral and VD projections (Buchanan and Bucheler, 1995; Litster and Buchanan, 2000; Sleeper and Buchanan, 2001). However, in clinical practice, lateral recumbency is more comfortable and less stressful for animals, especially patients with pneumo-thorax and intra-thoracic fluid (Douglas et al., 1987). For these reasons, only lateral radiographs were evaluated in the present study.

Literature is devoid of VHS report on the goat. But we noticed that our results, to some extent, were similar to other VHS grades obtained for other animal species. For instance, there was no significant mean difference ($p<0.05$) between RtL VHS and LeL VHS in this study just as in other related researches. We equally found no sex VHS difference ($p<0.05$) (Buchanan and Bucheler, 1995; Litster and Buchanan, 2000; Sleeper and Buchanan, 2001; Gulanber et al., 2005).

In conclusion, normal radiographic image does not always overrule the presence of heart disease. In other words, in some situations, determination of VHS alone is diagnostically insufficient for the evaluation of patients with clinical signs of heart disease. In such circumstances, radiographic findings should be compared with, at least, another imaging observation in the light of laboratory results of the patient. However, VHS is easily and objectively applicable in clinical practice for the determination of cardiac size. The present report provides a guide to veterinary radiologists, surgeons, and clinicians for the assessment of cardiac disease in the WADG. Further studies that will extrapolate these findings to other goat breeds are needed.

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