



RADIOGRAPHIC MEASUREMENTS (VERTEBRAL HEART SCALE) OF POPULAR BREEDS OF DOGS IN INDIA

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ABSTRACT

The present study was conducted in 250 healthy dogs (120 females and 130 male) to assess vertebral heart size (VHS) in various the breeds and sex. The radiographic measurements recorded were right lateral VHS, left lateral VHS, dorsoventral VHS and cardiothoracic ratio CTR. The mean VHS established were RL (10.21 ± 0.10) LL (9.93 ± 0.14) and DV (10.09 ± 0.13) for Labrador, RL (10.24 ± 0.35) LL (10.03 ± 0.27) and DV (10.30 ± 0.42) for German Shepherd, RL (9.63 ± 0.23) LL (9.46 ± 0.39) and DV (9.73 ± 0.35) for Indian Spitz, RL (10.09 ± 0.22) LL (9.53 ± 0.33) and DV (10.03 ± 0.34) for Pug and RL (9.59 ± 0.31) LL (9.39 ± 0.45) and DV (9.42 ± 0.31) for non-descript native breeds. On RL and LL views, the Labrador and German Shepherd had significantly higher and native non-descript dogs had the lowest mean VHS measurements than other breeds. The findings reflect it is imperative to consider the breed and the side of radiographic view during evaluation of heart size based on thoracic radiographs.

Key words: Breeds, dog, radiography, vertebral heart size

INTRODUCTION

Radiological examination of canine thorax is one of the important frequently performed diagnostic tests for evaluating patients with heart disease in veterinary medicine. Method for measuring the canine cardiac silhouette has been described by Buchanan and Bucheler (1995). The method involves measuring the long and short axis in a lateral radiograph and comparing the sum of these measurements to mid thoracic vertebral bodies and to produce an index called 'vertebral heart score' (VHS). It uses the sum of the length and width of cardiac silhouette which is then translated into the total units of thoracic vertebral length. Studies have revealed correlations between VHS with echocardiographic and electro-cardiographic parameters (Nakayama *et al.*, 2001). There exists a considerable breed variation with regards to normal heart size and shape, so it is essential to consider the breed of dog whenever the heart is evaluated (Root and Bahr, 2002).

Studies have revealed no significant differences between different breeds of dogs, sex and right or left lateral recumbency (Sleeper and Buchanan, 2001). However, recent studies at the Royal Veterinary College have opined that the differences between breeds must be taken into account while interpreting VHS. While evaluating the heart, it may be better to compare the patient's radiographs with those of a normal dog from the same breed (Litster and Buchanan, 2000; Hogan,

2002). Bavegems *et al.* (2002) have emphasized that interbreed differences, and possibly sex, should be considered while evaluating the possibility of cardiomegaly on the basis of VHS. The present study was aimed to determine absolute and relative heart size in clinically healthy dogs by correlating heart size and mid thoracic vertebral bodies and to determine the reference range for the VHS of some popular large breeds of dog in India.

MATERIALS AND METHODS

Ethical approval was sought in advance and all the ethical principles were strictly followed during the course of this study. The research and experimentation was carried out in accordance with the guidelines laid down by the International Animal Ethics Committee and in accordance with the local laws and regulations. Clinically normal dogs (250) of different breeds with 120 females and 130 male dogs were chosen for the study from most common breed of dogs in India (50 German shepherd, 50 Indian spitz, 50 Pug, 50 Labrador and 50 non-descript native dogs). Dogs were 1 to 14 years old with body weight varying between 1 to 30 kg. They were referred for a periodic health examination to teaching veterinary clinical complex. The clinical evaluation of all dogs included physical examination, auscultation of heart, electrocardiography (ECG) and thoracic radiography.

Radiographs were taken at full inspiration with focus to film distance of 100 cm (tabletop technique). Measurements were made with an adjustable calliper on each of the radiographs following the method of Litster and Buchanan (2000). On lateral radiographic views, the long axis of heart was measured from the ventral border of main stem bronchus (cranioventral border of carina) to cardiac apex (the most distant point on ventral contour of cardiac radiographic image). This dimension reflects the combined size of left atrium and left ventricle. The short axis was measured at the widest point of cardiac image on a line perpendicular to the long axis at the level of caudal vena cava (Fig. 1). The measurements were made using a metric ruler. The two measurements (long and short axis) were compared to the vertebrae starting at the cranial edge of 4th thoracic vertebra (T4), and expressed in units of vertebral lengths, for each axis. The sum of the measurements on both axes constituted the VHS.

Chest depth was measured from the caudal margin of 7th sternebra to the closest point on ventral margin of thoracic vertebrae, determined by making an arc with the calliper. Chest width was measured as the maximum distance between right and left interior borders of thoracic cage at the level of ribs. Cardiothoracic ratios (CTR) were calculated by dividing the largest width of heart by that of chest depth on the films (Danzer, 1919).

The data was analyzed using a computerized statistical software package (SPSS). For all measurements, the mean and standard deviation (SD) were calculated. For each breed, a paired t-test was employed to assess differences between mean averages of VHS on RL (right lateral), DV (dorsoventral) and LL (left lateral) views. Similar tests were performed to compare the mean values of LL VHS of each breed to those of other three breeds. These comparisons were repeated for RL VHS in each breed.

RESULTS AND DISCUSSION

In this study, VHS of 150 clinically normal dogs of common breeds were measured and compared in different views (right lateral, left lateral and dorsoventral). The cardiac measurement of different breeds of dogs is given in Table 1. The mean VHS established was RL (10.21 ± 0.10), LL ($9.93 \pm$

0.14) and DV (10.09 ± 0.13) for Labrador, RL (10.24 ± 0.35), LL (10.03 ± 0.27) and DV (10.30 ± 0.42) for German shepherd, RL (9.63 ± 0.23), LL (9.46 ± 0.39) and DV (9.73 ± 0.35) for Indian spitz, RL (10.09 ± 0.22), LL (9.53 ± 0.33) and DV (10.03 ± 0.34) for pug and RL (9.59 ± 0.31) LL (9.39 ± 0.45) and DV (9.42 ± 0.31) F for non-descript native breed dogs. The findings are supported by (Ghadiri *et al.*, 2010) who in Iran found significant influence of breeds on VHS of dogs. Lamb and Boswood (2002) observed that VHS values for heart size are affected by variations in the actual heart size, vertebral length between dog breeds, presence of narrowed disc spaces, variability in the measurements [as described by Hansson *et al.* (2005) and Buchanan (2000)]. However our finding contradicts with findings of Gulamber *et al.* (2005) who found VHS values in Turkish shepherd comparable to other dog breeds.

The LR and LL views revealed that Labrador and German Shepherd breed had significantly higher mean VHS measurements than other breeds. Also the mean DV VHS measurements were higher in German Shepherd than other breeds. Danzer (1919) have attributed such findings to slightly shorter vertebral size in such breeds. Pug breed had non-significantly higher mean values of VHS in LL RL and DV views than other two breeds (Indian Spitz and native non-descript). Native non-descript dogs had lowest VHS in LL, RL and DV view of radiographs than other breeds. These findings are supported by Kumar *et al.* (2011) in India that showed that VHS in clinically normal mongrel dogs was 9.7 ± 0.67 and suggested that the use of breed-specific VHS values is required for VHS method to have a high specificity for normal heart size. The native dogs had a smaller mean VHS than other dog breeds; therefore, the thoracic vertebrae and heart sizes of native dogs might be on average, slightly smaller than the other large breeds of dogs included in this study.

In present study the mean VHS values in left lateral views were non-significantly smaller than in right lateral view in all breeds of dog. Native non-descript dogs had lower VHS than all other breeds on both in left lateral and right lateral radiographs. Buchanan and Bucheler (1995) reported that the choice of right versus left lateral recumbency prior to radiographic examinations did not significantly influence VHS measurements. In contrast to their study, in present study, non-significant differences were seen between mean VHS on RL and LL radiographs in various breeds of dogs. These findings are in concurrence with Bavegems *et al.* (2005) who reported that the mean VHS on lateral right-to-left radiographs was significantly larger than VHS on lateral left-to-right radiographs of whippets.

Table 1: The mean $\pm$ standard deviation cardiac measurements in right lateral left lateral and dorso-ventral views of clinically normal dogs

Measurements	Breeds					Gender	
	Labrador	G. Shepherd	India Spitz	Pug	Non-descript	Male	Female
LL lateral axis	5.57 $\pm$ 0.39	5.67 $\pm$ 0.29	5.44 $\pm$ 0.37	5.53 $\pm$ 0.33	5.37 $\pm$ 0.29	5.47 $\pm$ 0.22	5.52 $\pm$ 0.24
S L lateral axis	4.50 $\pm$ 0.25	4.44 $\pm$ 0.28	4.35 $\pm$ 0.32	4.46 $\pm$ 0.26	4.30 $\pm$ 0.31	4.34 $\pm$ 0.31	4.35 $\pm$ 0.33
LR lateral axis	5.58 $\pm$ 0.32	5.55 $\pm$ 0.41	5.32 $\pm$ 0.27	5.52 $\pm$ 0.34	5.33 $\pm$ 0.32	5.46 $\pm$ 0.36	5.49 $\pm$ 0.38
SR lateral axis	4.48 $\pm$ 0.23	4.46 $\pm$ 0.18	4.32 $\pm$ 0.33	4.41 $\pm$ 0.23	4.29 $\pm$ 0.22	4.39 $\pm$ 0.32	4.33 $\pm$ 0.21
L DV axis	5.26 $\pm$ 0.25	5.40 $\pm$ 0.28	5.13 $\pm$ 0.25	5.32 $\pm$ 0.32	5.22 $\pm$ 0.32	5.25 $\pm$ 0.31	5.32 $\pm$ 0.33
S DV axis	4.74 $\pm$ 0.19	4.49 $\pm$ 0.24	4.32 $\pm$ 0.21	4.54 $\pm$ 0.33	4.29 $\pm$ 0.24	4.51 $\pm$ 0.24	4.43 $\pm$ 0.21
Heart long axis	8.50 $\pm$ 0.22	8.47 $\pm$ 0.34	8.23 $\pm$ 0.32	8.44 $\pm$ 0.42	8.28 $\pm$ 0.37	8.45 $\pm$ 0.34	8.39 $\pm$ 0.35
Chest depth	10.39 $\pm$ 0.41	10.57 $\pm$ 0.27	10.34 $\pm$ 0.33	10.45 $\pm$ 0.39	10.22 $\pm$ 0.31	10.27 $\pm$ 0.34	10.32 $\pm$ 0.33
CTR	0.76 $\pm$ 0.01	0.77 $\pm$ 0.01	0.72 $\pm$ 0.02	0.75 $\pm$ 0.02	0.73 $\pm$ 0.01	0.74 $\pm$ 0.01	0.75 $\pm$ 0.01
Left VHS	9.93 $\pm$ 0.14*	10.03 $\pm$ 0.27*	9.46 $\pm$ 0.39	9.53 $\pm$ 0.33	9.39 $\pm$ 0.45	9.73 $\pm$ 0.32	9.67 $\pm$ 0.37
Right VHS	10.21 $\pm$ 0.10*	10.24 $\pm$ 0.35*	9.63 $\pm$ 0.23	10.09 $\pm$ 0.22	9.59 $\pm$ 0.31	9.89 $\pm$ 0.23	9.91 $\pm$ 0.29
Dorsoventral VHS	10.09 $\pm$ 0.13	10.30 $\pm$ 0.42*	9.73 $\pm$ 0.35	10.03 $\pm$ 0.34	9.42 $\pm$ 0.31	10.01 $\pm$ 0.23	10.07 $\pm$ 0.31

L.L- long left, S.L -short left, L.R- long right, SR-short right, L.DV-long dorso ventral, S.DV-short dorso-ventral, CTR- cardiothoracic ratio and VHS- vertebral heart size.;

Values with superscript * differ significantly ($P < 0.05$) between the group.

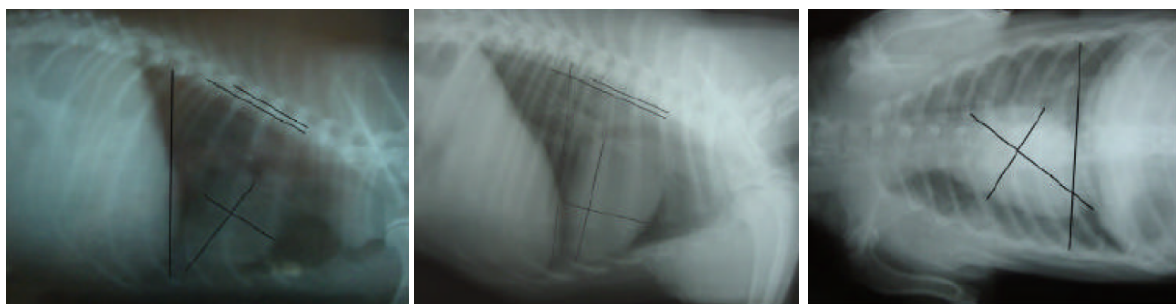


Fig. 1: The vertebral heart size (VHS) in dogs on right lateral thoracic (left), left lateral thoracic (middle) and dorsoventral (right) radiograph

In present study the mean VHS in Labrador and German Shepherd was varying from the mean value of 9.7 for general dog population reported by Ghadiri *et al.* (2010), Bavegems *et al.* (2005) and Buchanan and Bucheler (1995). Similarly, heart long axis, chest depth and cardiothoracic ratio (CTR) were varied non-significantly in common breeds of dogs in India. The findings are supported by Jepsen-Grant *et al.* (2013) who studied VHS in eight dog breeds and reported that VHS in Pug, Pomeranian, Bulldog and Boston Terrier was significantly greater than 9.7 ± 0.5 reported by Buchanan and Bucheler (1995) for general dog population.

A non-significant difference with respect to age of dogs was found in present study. VHS distribution range was 8.4 to 10.9 and non-significant differences were found between males and females in all radiographic views. These findings are in agreement with the reports of Ghadiri *et al.* (2010) and Bavegems *et al.* (2005) who stated that the long and short axis dimensions on RL and LL radiographs were both correlated significantly with T4 to T6 length and the sternebrae 2 to 4 length; therefore, an index of vertebral length has been selected by several authors as an indicator of body size.

Conclusion: Determination of VHS values in our study eliminated breed-specific variations. It is, therefore, important to consider the breed and the side of radiographic view while evaluating heart size in thoracic radiographs to avoid any erroneous interpretation of cardiac enlargement. Altered heart size does not always mean that there is no heart disease, because of the effect of breed on VHS. We conclude that VHS is easy to apply and objective for clinical practice in determining the heart size. Our study can be used as a guide in clinical practice for the evaluation of cardiac disease in common large breeds of dog in India and mixed breeds of German shepherd and Labrador dogs.

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