

VERTEBRAL HEART SIZE IN RETIRED RACING GREYHOUNDS

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The vertebral heart size (VHS) is used to objectively assess cardiac dimensions on thoracic radiographs. A high VHS suggest the presence of cardiac pathology, such as dilated cardiomyopathy, degenerative atrioventricular valvular disease, pericardial effusion, pericardioperitoneal diaphragmatic hernia, tricuspid dysplasia, ventricular septal defect, or patent ductus arteriosus, among others. However, breed or body conformation can influence the VHS. Because Greyhounds have a high prevalence of physiologic systolic murmurs associated with high aortic velocity, and large cardiac dimensions when compared with dogs of similar size, they are frequently suspected of having heart disease. The purpose of this study was to compare the VHS in normal Greyhounds with those in Rottweilers, and a group of dogs from various other breeds using both analog and digital radiology. The VHS was significantly higher in Greyhounds ($P < 0.0001$), when compared with Rottweilers and to other dog breeds. The mean VHS on lateral radiographs for Greyhounds was 10.5 ± 0.1 , for Rottweilers it was 9.8 ± 0.1 , and for mixed breed dogs it was 10.1 ± 0.2 . This study confirms that the relative cardiomegaly reported in necropsy and echocardiographic studies in Greyhounds is easily detected using plain radiography and the VHS. *Veterinary Radiology & Ultrasound*, Vol. 48, No. 4, 2007, pp 332–334.

Key words: cardiomegaly, dog, Greyhounds, heart, thoracic radiology, VHS.

Introduction

CARDIAC SIZE CAN be quantified from lateral thoracic radiographs using the vertebral heart size (VHS), as proposed by Buchanan and Bucheler.¹ In clinical practice, a VHS above the reference range on lateral thoracic radiographs suggests cardiomegaly but there may be breed-related variations of the VHS.² Thus, to better apply the VHS across breeds, reference ranges for different breeds (or for different breed conformations) need to be established. Boxers, Labrador Retrievers, Cavalier King Charles Spaniels, Doberman Pinschers, whippets and poodles have been reported to have VHS values outside the published range.^{3–5}

Adopted retired racing Greyhounds now outnumber those in active racing. Because of their unique physiology, reference ranges for hematology and biochemistry in Greyhounds are frequently different from those for dogs of other breeds (reviewed in Couto et al.⁶). In addition, Greyhounds have large cardiac dimensions and a high

prevalence of physiologic systolic murmurs associated with high aortic velocity when compared with dogs of similar size.^{7,8} Therefore, there are often referrals of Greyhounds suspected of having heart disease when indeed they are normal. To our knowledge, there are no published reports of the VHS in Greyhounds. In this study we compared the VHS in normal Greyhounds (a deep-chested breed) with those in Rottweilers (a barrel-chested breed), and a group of dogs from various other breeds. We hypothesized that Greyhounds would have a mean VHS higher than the standard VHS reference range.

Materials and Methods

A search of the medical records of dogs without evidence of cardiopulmonary disease examined by the Oncology/Hematology Service between January 2004 and September 2006 was conducted. This population of dogs was selected based on the fact that most Greyhounds evaluated had osteosarcoma of the appendicular skeleton, or other neoplasms. Therefore, they were likely to have a complete physical examination, thoracic radiographs, and echocardiographic evaluation before instituting doxorubicin-based chemotherapy. Rottweilers were selected as a control group due to their high prevalence of neoplasia⁹ that resulted in a similar evaluation; the Rottweilers included in the study did not have auscultable murmurs, gallops, or arrhythmias. The non-Greyhound, non-Rottweiler population consisted of dogs with normal thoracic radiographs (either analog or digital) and echocardiograms evaluated during the same period, and included both dogs with neoplasia and other diseases, ranging in weight between 20 and 40 kg.

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Dogs were included in the study if they had lateral and dorsoventral (or ventrodorsal) thoracic radiographs without evidence of cardiopulmonary disease, echocardiograms within the reference range for the breed (Greyhounds) or species (other breeds). Group 1 included 42 retired racing Greyhounds (25 neutered males, two intact males, and 15 neutered females); 17 dogs had analog thoracic radiographs and 25 digital thoracic radiographs. Eighteen of the Greyhounds had echocardiograms, and the results were within the reference range for the breed.^{8,10,11,12} The two groups of Greyhounds (i.e., those with echocardiograms and those without) were statistically compared with determine if there were differences between these groups.

Group 2 included 38 Rottweilers (15 neutered males, six intact males, and 17 neutered females); 18 had analog thoracic radiographs and 20 digital thoracic radiographs. Three dogs had echocardiograms within the reference range.¹²

Group 3 consisted of 16 dogs (seven neutered males, one intact male, and eight neutered females) of different breeds (mixed breed, Boxer, Weimaraner, Golden Retriever, Samoyed, and Bouvier des Flandres); all were evaluated by means of digital thoracic radiographs, and 13 had echocardiograms within the reference range.¹²

All radiographs, whether analog or digital, were evaluated for appropriate positioning and for the presence of pulmonary, pleural, or spinal abnormalities that may have affected VHS determination. There were right lateral and left lateral views of the thorax for each dog.

VHS measurements were performed by multiple observers with different levels of experience (an American veterinary student, a foreign veterinarian, a radiology resident, and a senior radiology faculty member). Both right lateral and left lateral projections for each dog were used for VHS measurements. The long axis of the heart was measured from the heart base to the apex using the ventral margin of the carina and mainstem bronchi as a dorsal landmark. The short axis of the heart was measured perpendicular to the long axis, from the cranial to caudal border of the widest portion of the heart, approximately at the level of the caudal vena cava. Individual measurements were then transposed to the thoracic spine, beginning at the cranial margin of T4 and extending caudally. Measurements were translated into vertebral number to the nearest 0.1 vertebral unit, with a single vertebral unit consisting of a vertebral body and caudal intervertebral disk space. Vertebral numbers were then summed for the total VHS.

Echocardiograms were obtained before doxorubicin administration, and were performed by multiple individuals in a standard fashion using a GE Vivid 7 Echocardiographic System* with a continuous electrocardiogram, as described previously.⁷ The report and images were re-

viewed by one of us (R.B.) to confirm that left ventricular diastolic and systolic dimensions were within the reference range.⁷

Statistical Analyses

Nonparametric statistical analysis (ANOVA) was used to compare differences in VHS among dogs in groups 1, 2, and 3, and to detect interobserver variability. A nonpaired Student's *t*-test was used to compare VHS in Greyhounds with and without echocardiograms, to compare VHS between male and female Greyhounds, to compare VHS in each group and in all groups for analog vs. digital radiographs, and to compare VHS scores obtained in right lateral and left lateral views among the three groups.

Results

The VHS was significantly higher in Greyhounds ($P < 0.0001$) than in Rottweilers and other dogs (Fig. 1). The mean VHS on lateral radiographs for Greyhounds was 10.5 ± 0.1 (Fig. 2), for Rottweilers it was 9.8 ± 0.1 (Fig. 3), and for mixed breed dogs it was 10.1 ± 0.2 . In Greyhounds, there was no statistically significant difference in VHS between right lateral and left lateral views ($P = 0.17$), between males and females ($P = 0.16$), between Greyhounds with and without echocardiograms ($P = 0.58$), or between digital and analog radiographs ($P = 0.32$).

There were no significant differences in VHS between Rottweilers (Group 2) and breeds other than Greyhounds (Group 3) in this study ($P = 0.18$).

Finally, there was no significant difference in the VHS among multiple observers ($P = 0.43$).

Discussion

The purpose of this study was to determine whether the VHS in retired racing Greyhounds was outside the reference range for published results in the dog. Because Greyhounds have a high prevalence of left basilar systolic murmurs associated with high peak aortic velocity⁷ and seemingly large hearts on thoracic radiographs, they are frequently referred to cardiologists or internists for cardiac evaluation. Establishing reference ranges for VHS in this breed, as it has been done for other cardiovascular parameters such as arterial blood pressure and echocardiography (reviewed in Fabrizio⁷), will facilitate interpretation of cardiac size on survey thoracic radiographs and decrease the number of healthy Greyhounds that are referred for evaluation.

The statistical comparison between the Greyhounds with and without echocardiograms ($P = 0.58$) was used to validate the VHS in the Greyhound group. Greyhounds had mean VHS of 10.5 ± 0.1 , significantly higher than the across-breed normal VHS of 9.7 ± 0.5 published by Buchanan and Bucheler,¹ and in normal Rottweilers

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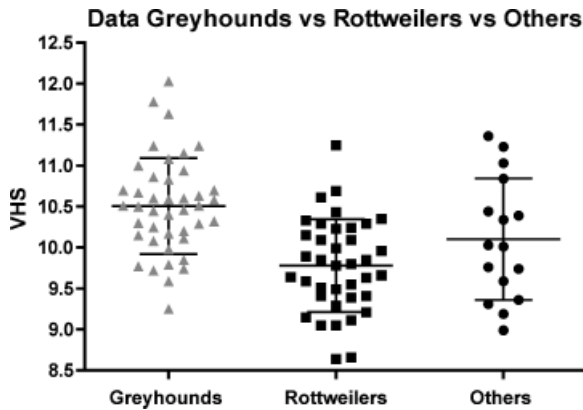


FIG. 1. Vertebral heart size (VHS) in Greyhounds, Rottweilers, and dogs of other breeds; lines depict mean and SD.

(9.8 ± 0.1) and other breeds (10.1 ± 0.2). The published reference range for VHS in dogs is 8.5–10.6; 36% of the VHS in Greyhounds were above the reference range, whereas only 5% of the VHS in the Rottweilers and 25% of the other dog breeds were above the reference range (Fig. 1). The four non-Greyhounds, non-Rottweilers with VHS above the reference range were Boxers, a breed known to have high VHS.³

As one of the potential limitations of the VHS method is the inability to select the correct measurement points, in this study the measurements were performed by multiple observers with different levels of experience to test its variability. As recently reported, there was no significant difference in the VHS obtained by either a veterinary student, foreign-trained veterinarians, a radiology resident, and a radiology faculty member.¹³

A major limitation of this study is that echocardiograms were not available for all dogs. However, all dogs had normal thoracic radiographs and had no clinical or physical examination signs of cardiovascular disease. Moreover, there were no significant differences in the VHS between Greyhounds who had echocardiograms and those who did not.

This study confirms that the relative cardiomegaly reported in necropsy and echocardiographic studies in Greyhounds is verified using survey radiography and the VHS. As proposed by a recent study in Whippets,⁴ sight hounds likely have a VHS above the reference range for other breeds. This should be taken into account when interpreting thoracic radiographs from dogs of any of these breeds.

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