



## Radiographic Evaluation of Normal Heart Size in Native Dog of Khorasan Province Using VHS Method

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### Abstract

**Objective-** to describe the vertebral heart score (VHS) measurement in the lateral view of the clinically normal native dog in khorasan province, Iran

**Design-** Descriptive study

**Animals-** 30 clinically healthy native dog

**Material and Methods-** Normal dogs in clinical, laboratory, electrocardiography and radiography examination were recruited in this study. Both true lateral view of thoracic cavity were imaged. VHS was measured in both left and right lateral projection.

**Results-** Mean±SD of the VHS in right-to-left and left-to-right projection was about  $9.76\pm 0.68$  and  $9.78\pm 0.42$ , respectively. Statistical analysis showed no significant difference between VHS in lateral views. Weight, age and stage of respiratory phase showed no significant correlation with VHS.

**Conclusion and Clinical Relevance-** Mean VHS in native dog in khorasan province was in the general reference range reported previously. It is important to take into account the breed specific data in evaluation of cardiac size in radiography.

**Keywords-** Radiography, VHS, Native dog, Khorasan province, Iran.

### Introduction

Knowing the importance of a healthy heart and advances in veterinary cardiology, mostly in areas of diagnostic imaging, gives us the opportunity to add to our understanding on cardiac diseases in small animals. Cardiac diseases during recent years have been considered as highly important health threatening problems of cats and dogs. Therefore, different ways of diagnosing were provided.<sup>1</sup> VHS (Vertebral Heart Score) as an independent index of measuring heart size relative to vertebral length has become a popular method since it was first introduced by Buchanan in 1995.<sup>2,3</sup> In adult dogs, the mean VHS reported by Buchanan was  $9.7\pm 0.5$  vertebrae in lateral radiographs.<sup>1,2</sup> VHS was calculated in several breeds.<sup>4-18</sup> Higher mean VHS values have been reported in several breed (boxer, Labrador retriever, cavalier king Charles spaniel and Doberman) in comparison with value reported by Buchanan and Bucheler.<sup>2,19</sup>

There are native large breed dogs in khorasan province, Iran which considered first as a sheep dog and the second for guarding. In our knowledge no published data for normal VHS was present for this native dog. Therefore the objectives of this study were to determine VHS on left and right lateral projection and analysis its correlation with the effects of age, weight, sex and respiratory phase.

### Material & Methods

#### Dogs

30 clinically healthy dogs between 6 months and 7 years of age were selected for this study from common native dogs of Khorasan province. They were of various sizes with body weight ranging between 40 to 69 kg. The study group included 2 females and 28 males. Clinical evaluation of all dogs was performed based on physical examination, heart auscultation, electrocardiography (ECG) and thoracic radiography which all had been done by experienced specialists of that field.

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### *Radiographic measurements*

The radiographic examination included left-to-right and right-to-left lateral thoracic radiography without sedation using conventional radiography system. Because of the influence of the positioning in heart shape, avoiding to rotation considered in radiography. VHS was measured based on the method previously described in both right and left lateral projection in each dog.<sup>2</sup> The long axis of the heart was measured from the heart base to apex using ventral margin of the carina as landmark dorsally. Short axis of the heart was measured perpendicular to the long axis nearly at the level of caudal vena cava in widest portion. Each measurement was then transported individually to the thoracic vertebra beginning of the cranial portion of the T4 and extending caudally based on vertebral number to the nearest 0.1 vertebral unit and then summed as VHS. Respiratory phase was determined based on the position of the diaphragm related to the caudal border of the heart. Marked overlapping of the diaphragm and heart border, slight overlapping and presence of space between diaphragm and heart were considered as inspiratory, expiratory and mid phase, respectively.

### *Statistical analyses*

Descriptive and regression analysis was done with SPSS V.21 and reference ranges/intervals were determined by ROBUST method using Medcalc V.13. All data was analyzed at the 5% significant level and Confidence interval 95%.

## **Results**

The sample population consists of the 30 clinically healthy dogs. Both lateral projections were used for VHS calculation. The Mean and SD value of VHS in right-to-left lateral view was  $9.76 \pm 0.68$  and in left-to-right lateral view was  $9.78 \pm 0.42$  (Table 1).

No significant correlation was found between VHS in right and left lateral views ( $P=0.867$ ). Age, weight and respiratory phase showed no significant relation with VHS.

## **Discussion**

Quantifying heart size using heart/vertebrae ratios have been become popular in recent years to overcome the limitations caused by variable chest conformation and heart/animal size ratio. The vertebral scale system has gained attention because it is simple to measure and explain.<sup>2,20,21</sup> In addition to providing a reference for normal heart size, it can be useful to monitor sequential changes in heart size during the process of treatment or progression of heart disease.<sup>3</sup> Normal heart silhouette of varying canine breeds represent different appearance. Variation due to respiratory phase, projection is often

greater than difference between normal and diseased heart. Opacity of the heart can be altered in training, obesity and emaciation.<sup>22</sup> VHS method is reliable because as previously reported it is repeatable when used by the multiple observers with different levels of experience.<sup>7,21</sup>

The goal of this study was to determine whether the VHS in native dogs from Khorasan province, Iran was similar to the published data for other large breed dogs. Results of our study indicates normal native dogs of Khorasan province had a range of value that was in the normal range,  $9.7 \pm 0.5$  vertebrae, reported by Buchanan and Bucheler.<sup>2</sup> VHS data was published in different studies.<sup>4-18</sup>

Although left to right projection is standard and preferable view to evaluate cardiac silhouette and provides more accurate information than the right to left lateral<sup>23</sup>, we used both lateral view for calculation of VHS and no statistical difference was seen between VHS measured in both view, the same results were reported by some authors.<sup>2,7,13,24</sup> Greco et al assessed VHS in 63 healthy dogs in order to comparison between right vs. left recumbency and showed that he VHS was significantly higher in right lateral recumbency ( $9.8 \pm 0.6$  vs.  $9.5 \pm 0.8$ ;  $P < 0.0004$ )<sup>25</sup>, the same results was also found by others.<sup>5,9,24</sup> The angle of the x-ray beam in right lateral recumbancy causes higher magnification of the cardiac shadow and it can be explain this difference.<sup>5,25</sup>

A major limitation of this study is that diversity of the population in male and female is not good enough for statistical analysis; most of the dogs were male because the owner in this area thought that the male dogs are better to herding sheep and guarding. This observation is similar to findings reported by several authors,<sup>2,5-7,9,10,13,14,16</sup> but Lamb et al. represented significant correlation between VHS and sex.<sup>19</sup>

Using breed specific VHS values is required for the VHS method to have high specificity for normal heart size.<sup>19</sup>

Similar studies have done in this subject and varieties of different values were reported for several breeds. It is highly recommended to take into consideration the normal specific range by clinicians while interpreting of the chest radiographs.

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**Table 1.** Vertebral Heart Score (VHS) in native dog in Khorasan province, Iran.

Parameter	n	Mean	Minimum	Maximum	SD	Reference Interval (95%)	
						Lower limit (90%CI)	Upper limit (90%CI)
VHS(L)	30	9.78	8.90	11.80	0.42	8.88(8.68-9.12)	10.65(10.44-10.87)
VHS(R)	30	9.76	9.00	10.70	0.68	8.19(7.65-8.59)	11.12(10.58-11.57)

L: Left-to-right lateral projection, R: Right-to-left lateral projection, CI: Confidence interval

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## چکیده

### ارزیابی رادیوگرافیک اندازه قلب طبیعی در سگ‌های محلی استان خراسان رضوی با استفاده از روش VHS

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**هدف-** ارائه VHS نرمال در رادیوگرافی نمای جانبی در سگ‌های محلی از نظر بالینی سالم در استان خراسان رضوی

**طرح مطالعه-** مطالعه توصیفی

**حیوانات-** ۳۰ قلاده سگ محلی از نظر بالینی سالم.

**روش کار-** سگ‌هایی که در بررسی‌های بالینی، آزمایشگاهی، الکتروکاردیوگرافی و رادیوگرافی طبیعی بودند وارد مطالعه شدند. دو نمای استاندارد جانبی از قفسه سینه تهیه شد. VHS در هر دو نمای جانبی خوابیده به راست و چپ اندازه‌گیری شد.

**نتایج-** انحراف معیار  $\pm$  میانگین در نمای جانبی خوابیده به راست و چپ به ترتیب  $9/76 \pm 0/68$  و  $9/78 \pm 0/42$  گزارش شد. آنالیز آماری اختلاف معنی‌داری بین VHS در دو نما نشان نداد. همچنین وزن، سن و مرحله تنفس ارتباط معنی‌داری با VHS نشان ندادند.

**نتیجه‌گیری و کاربرد بالینی-** میانگین VHS در سگ‌های محلی استان خراسان در محدوده طبیعی که بصورت کلی گزارش شده بود قرار داشت. لحاظ کردن داده‌های اختصاصی نژاد در ارزیابی اندازه قلب در رادیوگرافی اهمیت دارد.

**کلمات کلیدی-** رادیوگرافی، VHS، سگ‌های محلی، استان خراسان، ایران.