

## Vertebral Scale System to Measure Heart Size in Thoracic Radiographs of Turkish Shepherd (Kangal) Dogs

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**Abstract:** In veterinary medicine determination of heart size is important in evaluating patients with heart disease. In this study heart sizes were compared with thoracic vertebrae in 120 clinically normal Turkish shepherd dogs (42 female) without thoracic radiographic abnormalities. It was aimed to determine the heart sizes of Turkish shepherd dogs according to the vertebral heart size (VHS). Lateral radiographs were obtained. Lengths of the long and short axis were determined with a ruler in millimeters. The dimensions were scaled against the length of the vertebrae beginning with the fourth thoracic vertebra. Mean  $\pm$  standard deviation (SD) vertebral heart sizes were  $9.7 \pm 0.67$  vertebrae, mean  $\pm$  SD long axis dimensions were  $5.24 \pm 0.39$  vertebrae and mean  $\pm$  SD short axis dimensions  $4.46 \pm 0.38$  vertebrae. The vertebral heart size method is easy to use and objective for clinical practice.

**Key Words:** Vertebral heart size, Turkish shepherd dog, Kangal, canine.

### Türk Çoban (Kangal) Köpeklerinin Thorakal Radyografilerinde Vertebral Skala Sistemi ile Kalp Büyüklüğünün Ölçülmesi

**Özet:** Veteriner hekimlikte kalbin büyüklüğünün tespiti kalp hastalarının değerlendirilmesinde önemlidir. Klinik olarak sağlıklı olan ve thoraks radyografilerinde bir anormallik bulunmayan 120 (42 Dişi) Türk Çoban köpeğinde radyografik olarak kalp büyüklüğü ile thorakal vertebrae karşılaştırıldı. Böylelikle Türk Çoban köpeklerinde Vertebral Skala Sistemine (VSS) göre kalp büyüklüğünün tespit edilmesi amaçlandı. Thoraks radyografileri lateral pozisyonda çekildi. Bu radyografilerde kalbin uzun eksen ve kısa eksen milimetre olarak cetvelle ölçüldü. Daha sonra bu ölçümler dördüncü thorakal vertebradan kaudale doğru karşılaştırıldı. Bu karşılaştırmada uzun ve kısa eksenlerin kaç adet thorakal vertebraya denk geldiği belirlendi. Her iki eksenin thorakal vertebra sayısı toplamı kalbin VSS ile büyüklüğünü oluşturdu. Ortalama değer ve standart sapma ile vertebral kalp büyüklüğü (VKB)  $9,7 \pm 0,67$  kısa eksen  $4,46 \pm 0,38$ ; uzun eksen ise  $5,24 \pm 0,39$  vertebra olarak saptandı. Klinik pratikte VKB kullanımı kolay ve objektif bir yöntemdir.

**Anahtar Sözcükler:** Vertebral kalp büyüklüğü, Türk çoban köpeği, Kangal, köpek.

### Introduction

Determination of heart size is important for evaluating patients with heart disease in veterinary medicine. Heart failure is most often seen in middle aged or older dogs and cats. The risk of developing a particular

type of heart disease varies with breed. Small breed dogs seem to have an increased risk of developing chronic degenerative valvular disease, patent ductus arteriosus, and pulmonic stenosis. Giant breed dogs often develop dilated cardiomyopathy. Pericardial effusion, aortic

stenosis, and endocarditis seem to be seen more frequently in large breed dogs. Although congenital heart disease in dogs and cats only represents 0.2%-1.0% of all university hospital admissions, it can result in significant morbidity and mortality for the patient. Accurate identification is important especially for owners of new animals to the household as well as genetic counseling for breeding programs (1,2).

Thoracic radiographs are very helpful in the diagnosis of heart disease and provide information available with any other modalities. Differences in conformation of the thorax among dog breeds have limited the use of measurement to ascertain cardiac enlargement. Studies using planimetry and various cardiothoracic ratios have been reported, but these methods have not been proved suitable for general clinical use. A guideline of 2.5 to 3.5 intercostal spaces for dogs was introduced in 1968 and is still used in veterinary medicine. Limitations of this method include variations of the heart size and shape, conformation of the thorax, phase of respiration, superimposition of ribs, and imprecise measurement points (1,3,4).

Buchanan and Bucheler (3) have described a method for measuring the canine cardiac silhouette that involves measuring its long and short axes in a lateral radiograph and comparing the sum of these measurements to the midthoracic vertebral bodies, to produce a unitless index called the vertebral heart score (VHS). According to the same researchers (3), most normal dogs have a VHS of 8.7-10.7; however, recent studies at the Royal Veterinary College have shown that there are differences between breeds that must be taken into account when interpreting VHS. When evaluating the heart, it may be better to compare the patient's radiographs with those of a normal dog from the same breed; however, the search for suitable comparative radiographs can be time-consuming and inconvenient (1-6).

VHS was reported  $9.7 \pm 0.5$  in dogs and  $7.5 \pm 0.3$  in cats. No significant differences were found between wide- and deep-chested dogs, males and females, and right or left lateral recumbency (1,3,5).

The correlations between VHS with echocardiographic and electrocardiographic parameters were determined by Nakayama et al. (7).

The objectives of the study reported here were to determine absolute and relative heart size in clinically

normal Turkish shepherd (Kangal) dogs by correlating heart size and midthoracic vertebral bodies.

## Materials and Methods

In 120 selected dogs with no radiological and clinical signs of cardiovascular or pulmonary disease, heart size was measured with VHS. Dogs were of various ages between 20 days and 14 years, and of various sizes between 1 kg to 55 kg body weight. There were 42 females and 78 males. Anesthesia was not used for radiography and all dogs were positioned in left lateral recumbency. Radiographs were taken during inspiration.

On lateral radiographic views, the long axis of the heart was measured from the ventral border of the left main stem bronchus (cranioventral border of the carina) to the cardiac apex (the most distant point on the ventral contour of the cardiac radiographic image). This dimension reflects the combined size of the left atrium and the left ventricle. The short axis was measured at the widest point of the cardiac image on a line perpendicular to the long axis at the level of the caudal vena cava (Figure 1). The measurements were made using a metric ruler. Measurements were recorded in millimeters for statistical analyses. The two measurements (long and short axis) were then compared to the vertebrae starting at the cranial edge of thoracic 4 (T4), and a result, expressed in units of vertebral lengths, was obtained for each axis. The sum of the measurements on both axes constituted the VHS and data are expressed as mean  $\pm$  SD. The obtained data were evaluated by t-test and ANOVA, using the computer software GraphPAD Prism (GraphPad Software Version 4) and GraphPAD InStat (GraphPad Software Version 3). Differences were considered significant at  $P < 0.05$ .

## Results

The sum of the long and short axes of the heart (VHS) in clinically normal Kangal dogs was  $9.7 \pm 0.67$  vertebrae. Distribution of VHS range was 8.4 to 10.9 vertebrae (Figure 2). The mean  $\pm$  SD of short axes were  $4.46 \pm 0.38$  vertebrae and the mean  $\pm$  SD of long axes were  $5.24 \pm 0.39$  vertebrae. VHS in females was  $9.8 \pm 0.12$  and in males was  $9.6 \pm 0.09$ . No significant difference was found between males and females. Also no significant changes were observed according to age.

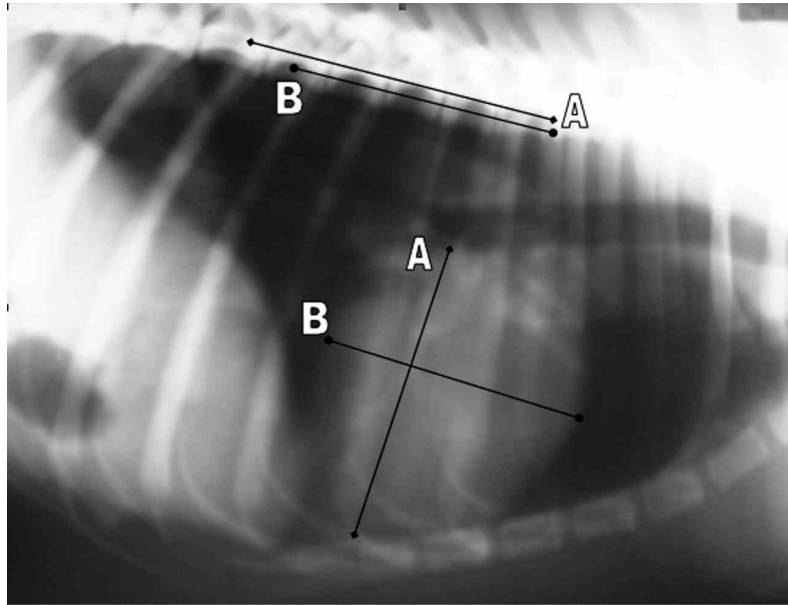


Figure 1. Method for determining the VHS measurement on a lateral thoracic radiograph. The long axis measurement of the cardiac silhouette (A) encompasses 5.2 thoracic vertebrae; the short axis measurement (B) encompasses 4.7 thoracic vertebrae.  $VHS = A+B = 5.2 + 4.7 = 9.9v$

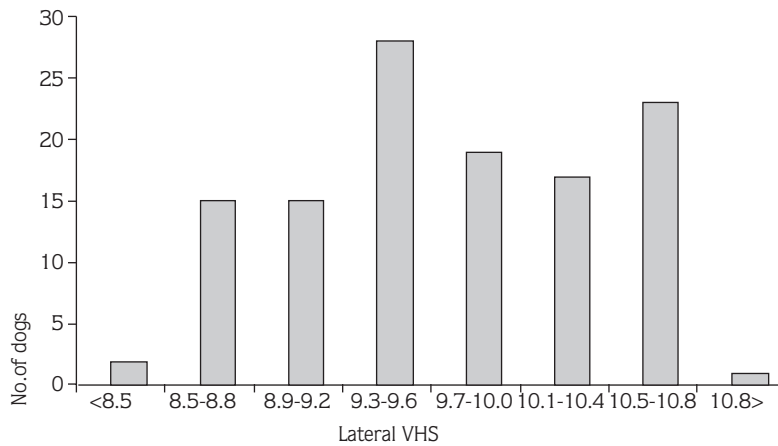


Figure 2. Distribution of VHS in lateral radiographs of 120 Turkish shepherd dogs.

## Discussion

Cardiomegaly is a reliable sign of heart disease and it is seen in cases of hypertrophic or dilated cardiomyopathy (1,2,4). It has been reported that in general dilated cardiomyopathy is progressing whereas pericardial effusion, aortic stenosis and endocarditis are seen very often in large breeds like Kangal dogs (2). Cardiomegaly can be easily determined in thorax radiographies and can be objectively measured with VHS application.

In other studies (1,3,5) related to VHS different dog breeds have been used. Because of this, many researchers have recommended comparing the radiographs of ill dogs with the radiograph of a completely healthy dog of the exact same breed and size. However, it has been emphasized that it is not always possible in practice to find a healthy dog of the exact same breed and size.

In the previous VHS studies lateral and ventrodorsal (VD) radiographic views have been used. No difference

has been found between lateral and VD views for VHS (1,3,5,6). Also we think that in clinical practice the lateral radiographic position may be preferred to the VD position, because the lateral radiographic position is more comfortable and causes less stress for the patients with suspected cardiac disease. Again in the studies of VHS, magnification was found in VD views caused by increased distance between heart and the X-ray cassette (5). In addition to magnification the increased length may also reflect the fact that the VD or dorsoventral long axis extends through the right atrium and left ventricle, whereas it only includes the left atrium and left ventricle in lateral projections (3). Because of these reasons, only the left lateral radiographies have been evaluated in this study.

If X-ray beams and thorax are not precisely vertical on each other, in some cases, changes of occur VHS will be changed during lateral radiography. These kinds of radiographs have been eliminated or taken once more. We think that this fact should be taken into consideration in practice.

We recognized that there is a parallelity of results among our study and some other ones in terms of VHS

grades. Also, there are no differences concerning age and sex of the patients in our study and in some others (1,3,5,6). The reason for this is that this study has been done on patients always with their body sizes. In general, the sizes of vertebrae and the sizes of internal organs show a parallel development. For example, even the VHS's of four Kangal puppies (twenty days old) have been determined as 9.6 in our study.

In other studies (7), electrocardiographic and echocardiographic parameters have shown equal results like VHS for heart size. Therefore, it could be concluded that cardiac illnesses causing cardiomegaly can be diagnosed using lateral thorax radiography and VHS in cases with insufficient diagnostic tools. On the other hand, normal heart size does not always mean that there is no heart disease. Because of this, only determination of VHS is not sufficient for patients having heart disease symptoms.

We conclude that VHS is easy to apply and objective for clinical practice in determining the heart size. Our study can be a guide in clinical practice for evaluating heart diseases in Kangal dogs.

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