

## Detection of Normal Renal and Liver Resistive and Pulsative Index Measurements in Kangal Dogs

Lora KOENHEMSİ\*, Remzi GÖNÜL<sup>1</sup>, Alper BAYRAKAL<sup>1</sup>, Sinem ÜLGEN SAKA<sup>1</sup>,  
Mehmet Erman OR<sup>1</sup>

<sup>1</sup>Istanbul University-Cerrahpaşa, Faculty of Veterinary Medicine, Department of Internal Medicine, 34000, Istanbul - Turkey

### ABSTRACT

Doppler ultrasonography is one of the tools that started to use recently in human and veterinary medicine for this purpose. Currently, there are many studies to investigate methods of earlier diagnosis of prognosis of renal and hepatic diseases. However there is stil no consensus among researchers about the normal values. To our knowledge no systematical research exits revealing the normal values of Kangal breed dogs. Our purpose in this research is to determine the normal renal and hepatic doppler values of Kangal breed. For this purpose, 30 Turkish Kangal dogs and 20 healty dogs from several breeds were included to the study. The mean value of renal resistive index (RI) and pulsative index (PI) were  $0,65 \pm 0,04$  and  $1.13 \pm 0,05$  for Turkish Kangal dogs;  $0,64 \pm 0,08$  and  $1.12 \pm 0,05$  for different breed dogs. For the hepatic RI and PI values  $0,65 \pm 0,04$  and  $1.16 \pm 0,03$  for Turkish Kangal dogs;  $0.63 \pm 0,04$  and  $1.15 \pm 0.04$  for different breed dogs respectively. The hepatic and renal PI and RI values of Kangal dogs were found to be compatible with other breeds.

**Keywords:** hepatic doppler, renal doppler, Kangal Dogs

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### Kangal Köpeklerinde Normal İntrarenal ve İntrahepatik Doppler Parametrelerinin Tespiti

#### ÖZ

Doppler ultrasonografi son zamanlarda insan hekimliği ve veteriner hekimlikte bu amaçla kullanılmaya başlanan araçlardan biridir. Halen, böbrek ve karaciğer hastalıklarının prognozunun erken teşhisi yöntemlerini araştıran birçok çalışma vardır. Ancak, araştırmacılar arasında normal değerler hakkında hala bir fikir birliği yoktur. Bildiğimiz kadarıyla Kangal cinsi köpeklerin normal değerlerini ortaya koyan hiçbir sistematik araştırma yapılmamıştır. Bu araştırmadaki amacımız Kangal ırkının normal böbrek ve karaciğer doppler değerlerini belirlemektir. Bu amaçla 30 Türk Kangal köpeği ve çeşitli ırklardan 20 sağlıklı köpek çalışmaya dahil edildi. Türk Kangal köpekleri için renal RI (rezistif indeks) ve PI (pulzatif indeks) ortalama değeri  $0,65 \pm 0,04$  ve  $1,13 \pm 0,05$ ; farklı cins köpekler için ise  $0,64 \pm 0,08$  ve  $1,12 \pm 0,05$  olarak belirlendi. Karaciğer için RI ve PI değerleri Türk kangal köpeklerinde  $0,65 \pm 0,04$  ve  $1.16 \pm 0,03$  olarak belirlenirken diğer köpeklerde ;  $0.63 \pm 0,04$  ve  $1.15 \pm 0.04$  olarak saptandı. Kangal köpeklerinin hepatic ve renal PI ve RI değerleri diğer ırklarla uyumlu bulundu.

**Anahtar Kelimeler:** hepatic doppler, renal doppler, Kangal Köpekleri

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ORCID ID; LR: 0000-0002-4979-170X, RG: 0000-0001-9425-0964, AB: 0000-0003-4002-435X,

SÜS: 0000-0002-2198-6396, MEO: 0000-0002-8764-1956

\*Corresponding author e-mail: lomekh@istanbul.edu.tr

## INTRODUCTION

Hepatic and renal diseases are one of the important causes of death in small animals. Early detection of renal or hepatic disease has an important role in the prognosis and treatment. There were too many diagnostic tools including function tests, serum electrolyte concentrations and acid-base status, urinalysis, and imaging studies used for this reason. Eventhough these tools were the hints of the disease may be present, they do not necessarily confirm the presence of the diseases (Brown et al. 1997, Polzin 2011).

Grey-scale ultrasonography (US) is one of the sensitive method for non-invasive morphologic evaluation of organs, however in many cases differential diagnosis can't be done alone with US findings (Rivers et al. 1997, Tipisca et al. 2015). Duplex Doppler US is an ancillary diagnostic technique that adds determination of the blood flow to this evaluations. Disease alter the blood flow may detected via this method (Rivers et al. 1997).

A number of studies have demonstrated the use of Doppler US in kidney and hepatic diseases in animals recently. Resistive index (RI) and Pulsatility index (PI) values that estimate the vascular resistance within an artery were calculated by many researchers (Lamb et al. 1990, Novellas et al. 2007). The RI and PI have been used to evaluate changes in vascular resistance due to urinary obstruction, acute and chronic renal failure, congenital dysplasia and hepatic disease (Novellas et al. 2007, Tipisca et al.2015). Additionally renal doppler changes investigated in dogs with pyometra and hepatic disease (Koenhemi et al. 2016, Novellas et al. 2008). However sedation, anesthesia or hypertension may change this values (Novellas et al. 2007).

Knowledge of the normal values is important to recognize and diagnose alterations that may occur in renal and liver disease. Since sizes and weights are changing occurring to the different breeds in dogs, it is important to know whether these normal values differ between dogs according to weight (Sartor et al. 2010). Kangal dog is a special breed of shephard dogs originating from Sivas. They are one of the largest dogs weighting 50-63 kg. No studies could be found in literature with regard to normal values of renal and hepatic doppler measurements in Kangal dog breeds. The purpose of this study is to determine the normal values of intrarenal and intrahepatic doppler measurements in non-sedated clinically normal Kangal dogs.

## MATERIALS and METHODS

### Animals

30 Kangal dogs and 20 healthy dogs from several breeds were included to the study. Dogs aging under

1 yearold were excluded from the study. Dogs with conditions that may affect hemodynamic measurements, such as heart failure, hypertension, liver and renal disease were not included in the study. All animals were healthy according to physical examination, routine blood works , (including complete blood cell count, glucose, Alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALKP), total protein, albumin, blood urea nitrogen (BUN), and Creatinine) and urinalysis. All dogs were from different age and sex. Dogs were fasted before the examinations; water was present during this time.

### Doppler Ultrasonography

Dogs were not sedated for ultrasonography (US) examination. Doppler US was performed with a SIUI Apogee 3500V doppler ultrasound machine. Different transducers and frequencies (4-10 mHz) were used depending on animal weight. Hair was clipped and acoustic gel was applied to the skin. US performed with the dogs in dorsal or lateral recumbency. After color doppler was used to visualize the vasculature, skipped to Pulsed Doppler US. Doppler waveforms obtained in renal artery, interlobar or arcuate arteries for renal doppler measurements and right hepatic arterial intrahepatic branch for hepatic doppler measurements. The smallest scale that displayed the flow without overlap was selected. The sample gate was adjusted individually for insonation of the whole vessel. The angle between the Doppler beam and the blood flow was below 60°. The resistive index (RI) and pulsative index (PI) were calculated automatically by the software of the ultrasound machine. Three arterial waves were measured and the values averaged to produce the result for each dog. All US examinations were performed by the same person.

Results were compared using Students t test. A commercial software package (SPSS 10.0) was used to analyze data. Differences of  $p < 0.5$  were considered significant.

## RESULTS

The group of dogs from several breeds comprised 20 animals (12 males, eight females); seven Golden Retriever, five German Shepherd, five mixed breed, 2 Chow chow, 1 pekingese. The mean age of the healthy group was 7 years (range 1-16 years-old). The mean weight of the dogs were 20 kg. The group of Kangal Dogs comprised 30 dogs (24 males, 6 females). The mean age of Kangal Dogs was 6 years (range 1-13 years-old). The mean weight of the dogs were 52 kg.

All dogs were clinically normal and had normal routine blood work (RBCand urinalysis results. In

addition to this ultrasonographic examinations were normal.

Intrarenal and intrahepatic RI and PI values were obtained from all animals. The mean value of renal RI and PI were  $0,65\pm0,04$  and  $1.13\pm0,05$  for Kangal dogs;  $0,64\pm0,08$  and  $1.12\pm0,05$  for mixed-breed dogs.

For the hepatic RI and PI values  $0,65\pm0,04$  and  $1.16\pm0,03$  for Kangal dogs;  $0.63\pm0,04$  and  $1.15\pm0.04$  respectively. The results are summarized in Table 1-2. No significant differences were found between Kangal dogs and mixed breed dogs.

**Table 1.** Routine blood work of Kangal and Mixed breed dogs

	Kangal	Mixed Breed	Normal Values
RBC (X 10 <sup>6</sup> µL)	7,2	7	5,65-8,87
HGB (g/dl)	15,2	17,5	13,1-20,5
HCT (%)	34,2	38,9	37,3-61,7
WBC (X10 <sup>3</sup> µL)	11,45	13,2	5,05-16,76
PLT (X10 <sup>3</sup> µL)	252	320	148-484
MCV	65,3	66,2	61,6-73,5
MCH (pg)	24,2	22,2	21,2-25,9
MCHC (%)	34,2	35,2	32-37,9
ALT (IU/L)	45	39	10-125
AST (IU/L)	26	29	5-50
ALP (U/L)	107	98	23-212
BUN (mg/dl)	9	8,4	7-27
CREATİNİN (mg/dl)	1	0,9	0,5-1,8
GLUCOSE (mg/dl)	95	90	70-143

**Table 2.** Intrarenal and intrahepatic RI and PI values in Kangal and mixed breed dogs.

	Kangal Dogs (n=30)	Mixed-Breed Dogs (n=20)
Renal RI	$0,65\pm0,04$	$0,64\pm0,08$
Renal PI	$1.13\pm0,05$	$1.12\pm0,05$
Hepatic RI	$0,65\pm0,04$	$0.63\pm0,04$
Hepatic PI	$1.16\pm0,03$	$1.15\pm0.04$

## DISCUSSION

RI and PI are unitless ratio, but critical for accurate velocity measurements. There are a few studies related with the normal values of hepatic arteries of dogs. Proposed upper limits differ from 0.70 to 0.73 in previous studies for renal RI in dogs [Novellas et al. 2007, Rivers et al. 1997]. Novellas et al. (2007) concluded that baseline values for intrarenal PI was 1.52 in healthy dogs. Lamb et al. (1999) have been reported the normal values of RI within hepatic artery in fasted dogs and found 0.68 (range 0.62-0.74). However normal hepatic PI values did not calculated in this study (Lamb et al. 1999). The intrarenal RI and PI values obtained in this study are similar to those

obtained by Novellas et al. (Novellas et al. 2007). Furthermore hepatic RI values were within the normal range given by Lamb et al. (1999).

A study have been reported of 60 obese and 20 healthy adults, a statistically significant reduction in mean flow velocity, peak velocity, minimum velocity and pulsatility was found in the portal vein of the patients (Erdoğan et al. 2008). Erdoğan et al. (2008), concluded that this was due to reduction of vascular compliance as a result of fat infiltration into the liver. Similar results were concluded in another study made by Sartor et al. (2010). Right portal vein of the healthy dogs of different body weights were evaluated in this study and mean flow velocity,

volume, and congestion index were influenced by body weight. RI and PI from hepatic arteries were measured in our study and there was no association between body weight and this parameters.

Lubomirova et al. (2007), evaluated the patients with hypertension and obesity with renal doppler USG. RI levels was within the normal limits and there was no significant differences between groups (Lubomirova et al. 2007). Also Ostrowska et al. (2016), concluded that no statistically significant relationship between renal RI and body weight of the healthy dogs. In our study, we compared large breed Kangal dogs with several breeds, and no statistically significant difference was observed. Additionally, all renal and hepatic doppler measurements were within normal limits.

Although Lamb et al. (1999) concluded that hepatic arterial and portal blood flow occur normally in dogs after feeding, all dogs were fasted because hepatic RI increases markedly after feeding in human studies. The main reason is hepatic arterial vasoconstriction occurs to decrease portal flow that stimulated by feeding (Lamb et al. 1999). Furthermore hypertension, sedation/anesthesia and heart rate problems can change the RI results (Novellas et al. 2007). So that dogs with hypertension or heart rate problems were excluded from this study.

## CONCLUSIONS

Duplex Doppler ultrasonography is a quick and noninvasive method for examination of the liver and kidneys. In this study, normal values for intrarenal and intrahepatic RI and PI in non-sedated clinically healthy Kangal Dogs were determined. As a result, we determined that, they were in similar limits as previously described by other researchers. Further studies are warrant for better understanding the usage of these parameters in animals.

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