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**Research Article**

# Ultrasonographic evaluation of abdominal aorta and kidney in adult Chippiparai dogs[#]

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## Abstract

**The present study was conducted to develop baseline data for the ultrasound evaluation of the abdominal aorta and kidney in adult Chippiparai dogs. The study was conducted in 20 apparently healthy adults Chippiparai dogs; among these male and female dogs were 10 in each group. In this study, the mean, maximum and minimum values of ultrasonographic measurement of the kidney and aorta were recorded. The measured ultrasonographic kidney and aorta parameters were left kidney sagittal length (mm), left kidney transverse width (mm), right kidney sagittal length (mm), right kidney transverse width (mm), and aorta diameter (mm). There was no significant difference observed between male and female dogs' kidney and aorta parameters. A high degree of positive correlation was observed between age and ultrasonographic kidney and aorta parameters. Similarly, body weight was directly proportional to the increased size of the kidney. The overall calculated kidney : aorta ratio and kidney : body weight ratios were 6.47±0.20 and 2.74±0.12, respectively. Ultrasonographic measurements of the abdominal aorta and kidney in healthy adult Chippiparai dogs were recorded and documented.**

**Keywords:** Aorta ratio, Chippiparai dog, Kidney, Sight-hound dogs

## Highlights

- Chippiparai is one of the popular sight-hound dog breeds of Tamil Nadu.
- Ultrasound examination of healthy adult Chippiparai dog's kidney data is still lacking.
- It's a baseline data of ultrasonographic evaluation of the abdominal aorta and kidney in adult Chippiparai dogs.

## INTRODUCTION

Chippiparai is one of the popular dog breeds of Tamil Nadu, and it is a sight-hound type breed (Ravimurugan *et al.*, 2014; Karthickeyan *et al.*, 2015). Chippiparai is traditionally used for hunting. It possesses the most intelligent and biddable nature. The breed has successfully been trained as police dogs (Bruce, 2009; David, 2012). Since these dogs were primarily used for hunting purposes, which increases muscular activity and elevated creatine kinase levels could trigger kidney injury. Renal disorders are major causes of morbidity and mortality in dogs, and it could be confirmed by biochemical analysis of serum, radiography, and ultrasonography.

Two-dimensional abdominal ultrasonography was one of the most useful diagnostic tools for evaluating kidney morphology (Moorthy and Venugopal, 2011). Its easy availability, non-invasiveness, cost-effectiveness, and safety without any radiation problem make the ultrasound application an important diagnostic tool for studying kidney morphology in both human and animal examinations (Barella *et al.*, 2012; Jabbari *et al.*, 2016). Evaluation of kidney size was a clinically important tool for screening, diagnosis and follow-up of renal diseases, as the basis of clinical decisions. Serial measurements are helpful in determining disease progression or stability (Cheong *et al.*, 2007). Reduction in kidney size usually indicates a chronic renal parenchymal change, while increasing kidney size suggests an acute change and other structural abnormalities similarly correlate to different pathology (Ozmen *et al.*, 2010).

Renal morphology has been reported to be correlated to body indices, such as age, sex, body height, body weight and body mass index in humans (Jabbari *et al.*, 2016), whereas in dogs, it is commonly correlated with age and body weight. The correlation between renal structure and body measurements enables a rapid assessment of renal health conditions and facilitates the identification of individuals beyond mere external recognition (Yadav *et al.*, 2017). In routine clinical practice, serum creatinine concentration has been a

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widely used parameter to evaluate kidney function and further, serum creatinine was considered as the replacement marker for glomerular filtration rate (GFR). However, it has several limitations and can be affected by non-renal factors (Finch, 2014). Drost *et al.* (2000) reported that ultrasound examination has been widely used for the initial evaluation of renal structure in patients with chronic kidney disease. It could be used to facilitate the diagnosis of potentially reversible causes, to evaluate the risk and necessity of ultrasound-guided renal biopsy, and to measure renal dimensions as prognostic factors.

To our knowledge, there has been no comprehensive study on ultrasonographic renal reference values for Chippiparai dogs. Hence, the present study aimed to establish a reference range for normal renal dimensions parameters by ultrasound examination in healthy adult Chippiparai dogs with the objective of ultrasonographic evaluation of abdominal aorta and kidney in adult Chippiparai dogs.

## MATERIALS AND METHODS

**Location of the study:** The present study was conducted at the Veterinary Clinical Complex (VCC), Veterinary College and Research Institute (VCRI), Orathanadu, Thanjavur, TANUVAS Chennai, India. The latitude and latitude of the study area was 10.6286° N, 79.2531° E. Chippiparai dogs brought for routine health check-ups and vaccination were taken for this study with consent from pet owners for examination. Twenty dogs with age of one year and above were selected (10 male and 10 female dogs), and body weight was measured on selected dogs in kilogram (kg). Patient preparation and positioning were performed as per the standard operating procedure by Nyland *et al.* (2015), and no sedative or anaesthetic drugs were given. Colour Doppler Ultrasound (Esaote Mylab Six™) with a Convex 3.5-10 MHz probe was used in this study. Two-dimensional B mode abdominal ultrasound examination was performed by standard operating procedure described by D'Anjou and Penninck (2015) and Nyland *et al.* (2015). The right and left kidneys were scanned from cranial to caudal and lateral to medial, in both sagittal and transverse planes, and measurements were taken (Fig. 1, 2 and 3).

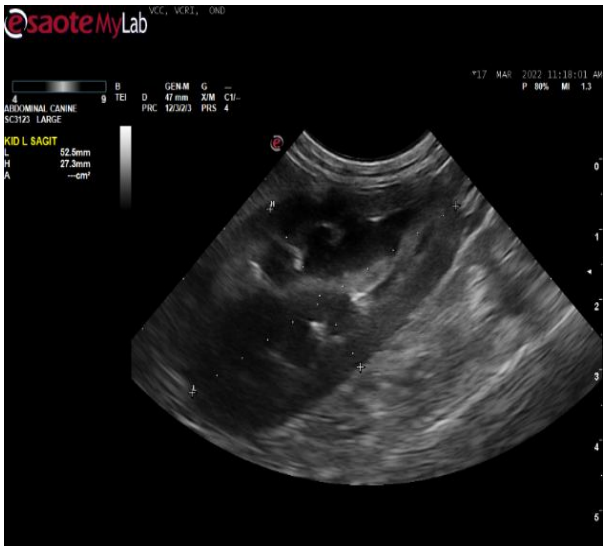


**Fig. 1. USG: Left kidney - Sagittal plane - length - distance between the cranial and caudal borders of the kidney**

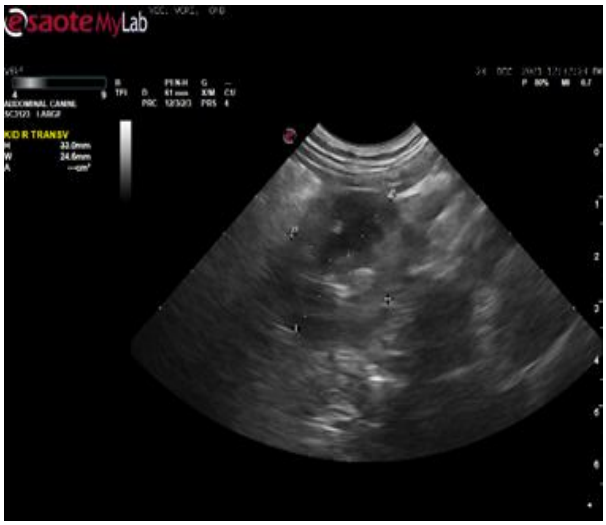


**Fig. 2. USG: Right kidney - Transverse plane - width - distance between the medial and lateral borders of the kidney at the level of the renal pelvis**


**Fig. 3. USG: Aorta - Maximum luminal diameter of the aorta**

USG measurements of the right and left kidney in a) Sagittal plane- length of the kidney were measured at a maximum distance (mm) between the cranial and caudal borders of the kidney. b) Transverse plane- width of the kidney was measured at a maximum distance (mm) between the medial and lateral borders of the kidney at the level of the renal pelvis. Aortic diameters were visualized in the caudo-dorsal abdomen, just to the left of midline, parallel to the caudal vena cava (on the right) from the level of L3 to L6. The aortic diameter was measured at the maximum luminal diameter of the aorta (mm), i.e., aorta on a straight line, anechoic tube without any mineralization within its wall. From the measured values, kidney length and aorta ratio (KL : Ao) were calculated as the mean of right and left kidney lengths divided by the aorta diameter. Similarly, kidney length and body weight ratio (KL : BWt) were calculated as the mean of right and left kidney length divided by body weight in kilograms.

**Statistical analysis:** Mean, standard error (SE), minimum and maximum levels were calculated. Independent t-test was performed to study the significance between the male and female dogs. Ultrasonographic kidney parameters, values of $P<0.05$ were considered significant. Pearson's correlation coefficient was performed between age, body weight and ultrasonographic kidney parameters.

## RESULTS

In the present study, 20 Chippiparai dogs were selected; among these dogs, male and female were 10 in each. The mean±SE of age of Chippiparai dogs was 2.93±0.3 years, and the minimum and maximum age of the dogs were 1 year and 5 years, respectively. Similarly, the mean±SE of the body weight of Chippiparai dogs was 21.58±1.26 kg, and the minimum and maximum body weights were 12.50 kg and 31 kg, respectively (Table 1). Mean and independent t-tests of age and body weight of male and female Chippiparai dogs are presented in Table 2. There was no significant difference between male and female dogs with respect to age and body weight of adult Chippiparai dogs.

**Table 1. Overall mean, minimum and maximum levels of ultrasonographic kidney parameters of Chippiparai dogs (n=20)**

| Sl. No. | Parameters | Dogs (n=20) | Minimum level | Maximum level |
|---|---|---|---|---|
| 1 | Age (Year) | 2.93±0.30 | 1.00 | 5.00 |
| 2 | B. wt. (kg) | 21.58±1.26 | 12.50 | 31.00 |
| 3 | Left kidney sagittal length (mm) | 56.79±1.46 | 42.50 | 65.50 |
| 4 | Left kidney transverse width (mm) | 28.67±0.68 | 21.90 | 32.90 |
| 5 | Right kidney sagittal length (mm) | 56.16±1.42 | 44.30 | 66.30 |
| 6 | Right kidney sagittal Height (mm) | 32.68±1.04 | 21.50 | 39.20 |
| 7 | Aorta diameter (mm) | 8.90±0.36 | 6.00 | 11.10 |
| 8 | Mean K length (mm) | 56.47±1.40 | 43.40 | 64.80 |
| 9 | K : Ao ratio | 6.47±0.20 | 5.43 | 8.75 |
| 10 | K : B. wt. ratio | 2.74±0.12 | 2.05 | 3.81 |

**Table 2. Mean and t-test of ultrasonographic kidney parameters of male and female Chippiparai dogs**

| Sl. No. | Parameters | Male dog (n=10) | Female dog (n=10) | t-test |
|---|---|---|---|---|
| 1 | Age (Year) | 2.15±0.24 | 3.7±0.20 | |
| 2 | B. wt. (kg) | 21.4±1.93 | 21.7±51.72 | $0.894^{ns}$ |
| 3 | Left kidney sagittal length (mm) | 56.17±2.41 | 57.41±1.77 | $0.684^{ns}$ |
| 4 | Left kidney transverse width (mm) | 28.32±1.16 | 29.02±0.75 | $0.618^{ns}$ |
| 5 | Right kidney sagittal length (mm) | 55.92±2.37 | 56.39±1.72 | $0.874^{ns}$ |
| 6 | Right kidney transverse width (mm) | 27.96±1.19 | 28.2±0.86 | $0.872^{ns}$ |
| 7 | Aorta diameter (mm) | 9.11±0.49 | 8.69±0.55 | $0.575^{ns}$ |
| 8 | Mean K length (mm) | 56.05±2.31 | 56.9±1.71 | $0.770^{ns}$ |
| 9 | K : Ao ratio | 6.21±0.16 | 6.72±0.35 | $0.204^{ns}$ |
| 10 | K : B. wt. ratio | 2.74±0.17 | 2.73±0.18 | $0.955^{ns}$ |

**Ultrasonographic measured values of kidney and aorta:** There was no significant difference between male and female dog's kidney parameters ultrasonographically in adult Chippiparai dogs (Table 2). The correlation of age and body weight with ultrasonographic kidney parameters of Chippiparai dogs (n=20) is presented in Table 3. In the present study, age of the dog had a high degree of positive correlation with left kidney sagittal length (0.619), left kidney transverse width (0.601), right kidney sagittal length (0.860), right kidney transverse width (0.594) and aorta diameter (0.791). Similarly, the body weight of the dog had a high degree of positive correlation with left kidney sagittal length (0.477), left kidney transverse width (0.991), right kidney sagittal length (0.873), right kidney transverse width (0.991) and aorta diameter (0.827). Based on Pearson's correlation coefficient analysis, the age and body weight of the adult Chippiparai dogs showed a high degree of correlation with ultrasound kidney parameters, which indicates increasing age and body weight are directly proportional to the size of the kidney.

**Table 3. Correlation of age, body weight with ultrasonographic kidney parameters of Chippiparai dogs (n=20)**

| Sl. No. | Parameters (year) | Age | Body weight (kg) |
|---|---|---|---|
| 1 | Left kidney sagittal length (mm) | 0.619 | 0.477 |
| 2 | Left kidney Transverse width (mm) | 0.601 | 0.991 |
| 3 | Right kidney sagittal length (mm) | 0.860 | 0.873 |
| 4 | Right kidney Transverse width (mm) | 0.594 | 0.991 |
| 5 | Aorta diameter (mm) | 0.791 | 0.827 |

**Ultrasonographic calculated values of kidney and aorta:** The overall calculated kidney : aorta ratio is 6.47±0.20, and kidney : body weight ratio was 2.74±0.12. There was no significant difference in estimated kidney parameters between male and female Chippiparai dogs. The mean±SE of kidney length to aortic diameter ratio was 6.47±0.20 in healthy adult Chippiparai dogs (Table 2).

## DISCUSSION

Ultrasonographic measurement of kidneys plays a pivotal role in the diagnosis of renal disease in dogs and cats (Kawalilak *et al.*, 2019). Kerry (2005) and Satish *et al.* (2012) reported that ultrasonography allows more consistent visualization of the kidneys, and ultrasonographic renal volume measurements have been helpful in the diagnosis of kidney diseases in dogs. Similarly, our study on ultrasonographic kidney parameters will be helpful to assess kidney diseases of Chippiparai dogs. The correlation between renal morphology and body indices allows for the evaluation of renal health conditions by quick estimation, and it allows for the identification of individuals beyond exterior recognition (Yadav *et al.*, 2017). The mean values of the kidney length-to-aortic diameter ratio in measurements of healthy adult Chippiparai dogs were found to be similar to the observation of Mareschal *et al.* (2007), who reported that the kidney length-aorta ratio of healthy dogs was in the range of 5.5 to 9.1.

This study concluded that ultrasonographic measurement of the abdominal aorta and kidney in adult healthy Chippiparai dogs could be the first study; further, this study will provide scope to use them as one of the indices in the diagnosis of kidney diseases in adult Chippiparai dogs.

**Conflict of interest:** The authors disclose no conflict of interest.

**Author's contribution:** MS: Selection and examination of dogs, and USG examination of dogs; CJ: Guided for this study, selection of study objective and proofreading; KJ: Technical support for the ultrasound examination; PP: Assisted for study and data collection; SSK: Data compilation and proofreading; KK: Data compilation and analysis.

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