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RESEARCH ARTICLE

SONOGRAPHIC EVALUATION OF KIDNEYS IN DOGS WITH ACUTE AND CHRONIC KIDNEY DISEASE

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Abstract

The objective of the present study is to sonographically assess size and architecture of kidneys in dogs with acute and chronic kidney disease. The study was conducted in a total of 24 clinical cases of dogs which had either acute or chronic kidney disease and 20 normal healthy dogs which were taken as the control group. In the present study, the dogs with chronic kidney disease of 25-35kg body weight group had a significant decrease in width and a highly significant decrease in volume of left kidney when compared to normal dogs. Irregular contour, indistinct corticomedullary junction, increased cortical echogenecity, increased medullary echogenecity, abnormal internal architecture and medullary rim sign were recorded in dogs with chronic kidney disease. The dogs with acute kidney disease of 25 – 35kg body weight group had a highly significant increase in depth of both the kidneys and a highly significant increase in volume of right kidney when compared with normal dogs. Increased cortical echogenecity was the major finding followed by increased medullary echogenecity and medullary rim sign in dogs with acute kidney injury. In the present study among the body weight range 5-15kg, there was no significant difference in any renal dimensions between control, acute kidney disease and chronic kidney disease group. It is concluded that ultrasound is a reliable aid in differentiating acute and chronic kidney disease when combined with other diagnostic modalities.

INTRODUCTION

Ultrasonography is a very important non-invasive safe imaging technique for the study of renal disease. It is very useful method to evaluate kidney size, shape and internal structure and this evaluation is not affected by kidney function. Ultrasonography is superior to conventional radiography in many cases but there are also limitations. These include inability to visualize the kidney in some large or obese dogs and those with excessive bubble gas. Excretory urography is superior for qualitative assessment of renal function and localization of site of urine leakage in case of trauma(Nyland *et al*., 1995). Renal disease in dogs may be associated with changes in renal size for example chronic interstitial nephritis often results in decrease in kidney size while acute pyelonephritis, polycystic kidney disease and hydronephrosis may leads to kidney enlargement. Therefore estimation of kidney size in dog may provide useful clinical information. Diffuse renal disease may cause increased cortical echogenecity with enhanced corticomedullary distinction or result in decreased definition between cortex and medulla as a result of diseases affecting both of these regions (Mattoon, 2008).

Materials and Methods:

The Study was carried out at Small animal Out Patient unit of Madras Veterinary College Teaching Hospital, Tamil Nadu Veterinary Animal Sciences University (TANUVAS) comprised of healthy dogs and dogs with acute and chronic kidney disease. Twenty apparently healthy adult dogs of different breeds, sexes, and age groups attending the outpatient unit for general health check up and vaccination were selected for study. They were grouped in to two groups as follows: Control I - body weight range of 5-15kg (10 Dogs) and Control II - body weight 25-35kg (10 Dogs). Dogs with acute and chronic renal disease were selected based on history, clinical signs, physical examination findings, hematology, serum biochemistry, urinalysis and radiographic findings. They were randomly allotted to the following groups : Group I - body weight 5-15 kg, Group Ia -. acute kidney disease (6 Dogs), Group Ib - chronic kidney disease (6 Dogs) , Group II. body weight 25-35 kg, Group IIa - acute kidney disease (6 Dogs) and Group IIb - chronic kidney disease (6 Dogs). The selected dogs were subjected to thorough ultrasound examination of both right and left kidneys.

Ultrasonographic examination:

The dogs selected for the study were subjected to ultrasonigraphic examination using ALOKA Prosound SSD 3500SV with convex probe of frequency 3.8-10MHz. The abdomen was prepared by clipping the hairs and applying acoustic coupling gel on the skin. Two standard plane of section was imaged in each kidney to measure renal parameters(Barr, 1990). Coronal section was taken along the long axis of kidney. Maximum bipolar length (L) and the width at the pelvis (W) were measured. (Figure -1a). Head of transducer was rotated through 90 degree to achieve a transverse section. Adjustments were made until the section was as round or oval as possible and renal pelvis could be clearly seen. The depth was measured. The approximate renal volume was calculated from these measurements by using the formula of ellipsoid V= (L×W×D) 0.523 (Figure -1b). The following qualitative parameters like renal contour, corticomedullary junction, medullary rim sign, cortical echogenicity and medullary echogenecity were also obsereved.

Results and discussion:

Study comprised of healthy dogs as control group divided in two groups based on their body weight i.e. 5-15kg and 25-35kg with 10 dogs each. The diseased dogs comprised of acute and chronic kidney disease with 12 numbers in each group. They were further allotted to two body weight groups as mentioned above.

TABLE-1

THE MEAN±S.E VALUES OF ULTRASOUND MEASUREMENTS OF KIDNEY SIZE IN NORMAL, ACUTE KIDNEY DISEASE AND CHRONIC KIDNEY DISEASE DOGS (Body weight 5-15kg)

Parameters	Length		Width		Depth		Volume	
	Left	Right	Left	Right	Left	Right	Left	Right
Control	4.7±0.30	4.7±0.36	2.5±0.16	2.5±0.12	2.6±0.14	2.6±0.16	17.4±3.18	17.15±3.3
AKD	4.5±0.32	4.4±0.35	2.5±0.15	2.5±0.13	2.6±0.12	2.7±0.16	14.5±3.56	16.48±2.47
CKD	3.9±0.26	4.05±0.27	2.3±0.13	2.2±0.12	2.4±0.12	2.3±0.11	10.9±1.21	11.3±1.3
F-value	1.595 ^{NS}	0.912 ^{NS}	O.621 ^{NS}	1.290 ^{NS}	0.621 ^{NS}	1.065 ^{NS}	1.130 ^{NS}	1.002 ^{NS}

^{NS} = Non Significant, *****= Significant (P≤ 0.05) ******= Highly Significant (P≤O.01) Means bearing different superscript in a column differ significantly

TABLE- 2

THE MEAN±S.E VALUES OF ULTRASOUND MEASUREMENTS OF KIDNEY SIZE IN NORMAL, ACUTE KIDNEY DISEASE AND CHRONIC KIDNEY DISEASE DOGS (Body weight 25-35kg)

Parameters	Length		Width		Depth		Volume	
	Left	Right	Left	Right	Left	Right	Left	Right
Control	7.0±0.13	6.9±0.17	3.8±0.08a	3.4±0.39	3.7±0.12a	3.6±0.12a	52.7±3.39a	50.5±3.6ab
ARF	7.0±0.25	6.9±0.22	3.8±0.10a	4.0±0.19	4.1±0.09b	4.2±0.06b	60.5±4.67a	61.8±4.9b
CRF	6.4±0.21	6.7±0.22	3.4±0.11b	3.4±0.13	3.4±0.13a	3.5±0.17a	40.1±3.58b	43.9±4.34a
F-value	2.588^{NS}	0.535^{NS}	4.985*	0.785^{NS}	7.092**	6.522**	5.868**	3.783*

^{NS} = Non Significant, *****= Significant (P≤ 0.05) **= Highly Significant (P≤O.01) Means bearing different superscript in a column differ significantly

TABLE - 3

RENAL APPEARANCE AND ARCHITECTURE IN ACUTE AND CHRONIC KIDNEY DISEASE

Renal Parameters	Acute Kidney Disease n=12		Chronic Kidney Disease n=12	
Contour	Regular	Irregular	Regular	Irregular
	12/12	0/12	5/12	7/12
Corticomedullary junction	Distinct	Indistinct	Distinct	Indistinct
	12/12	0/12	8/12	4/12
Medullary rim	Present	Absent	Present	Absent

Sign	2/12	10/12		2/12	10/12	
Cortical echogenecity	Normal	Increased	Decreased	Normal	Increased	Decreased
	2/12	8/12	2/12	0/12	12/12/	0/12
Medullary echogenecity	Normal	Increased	decreased	Normal	Increased	Decreased
	10/12	2/12	0/12	8/12	4/12	0/12
Internal architecture	Normal	Abnormal		Normal	Abnormal	
	12/12	0/12		8/12	4/12	

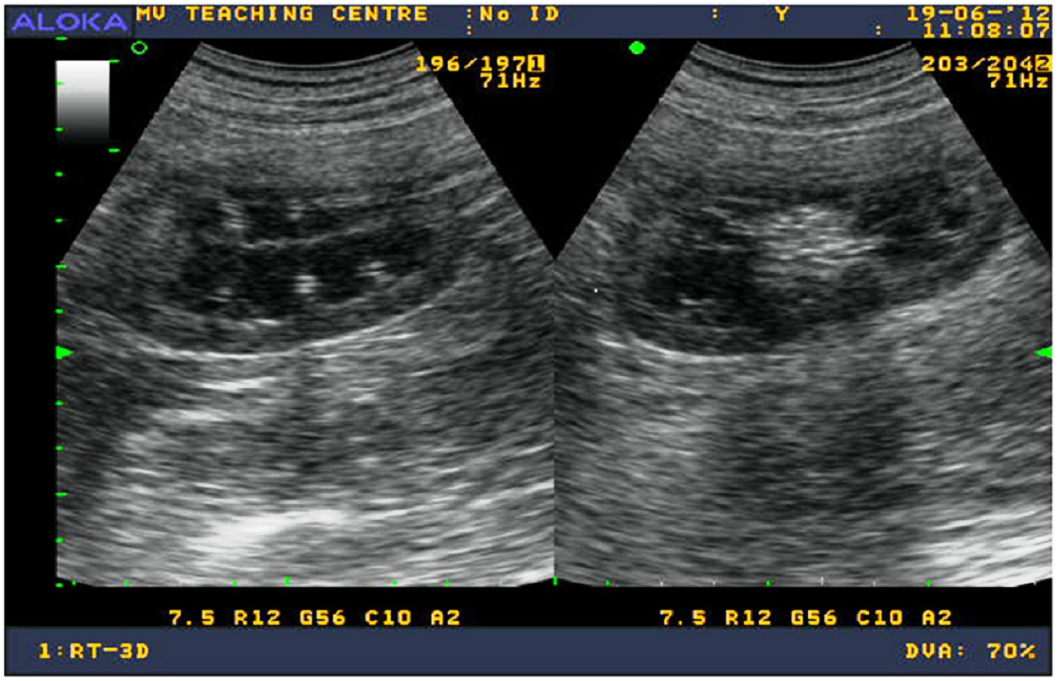

Figure 1a Normal renal appearence and architecture in mid sagital section and at renal pelvis

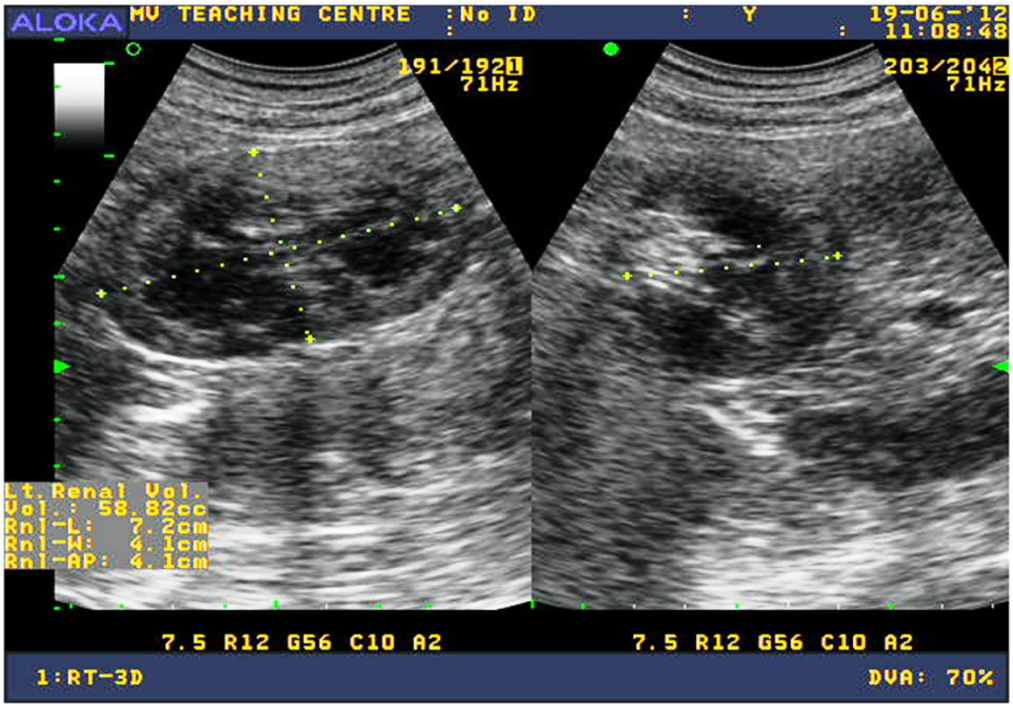

Figure 1 b: Renal measurements in coronal and transverse Section

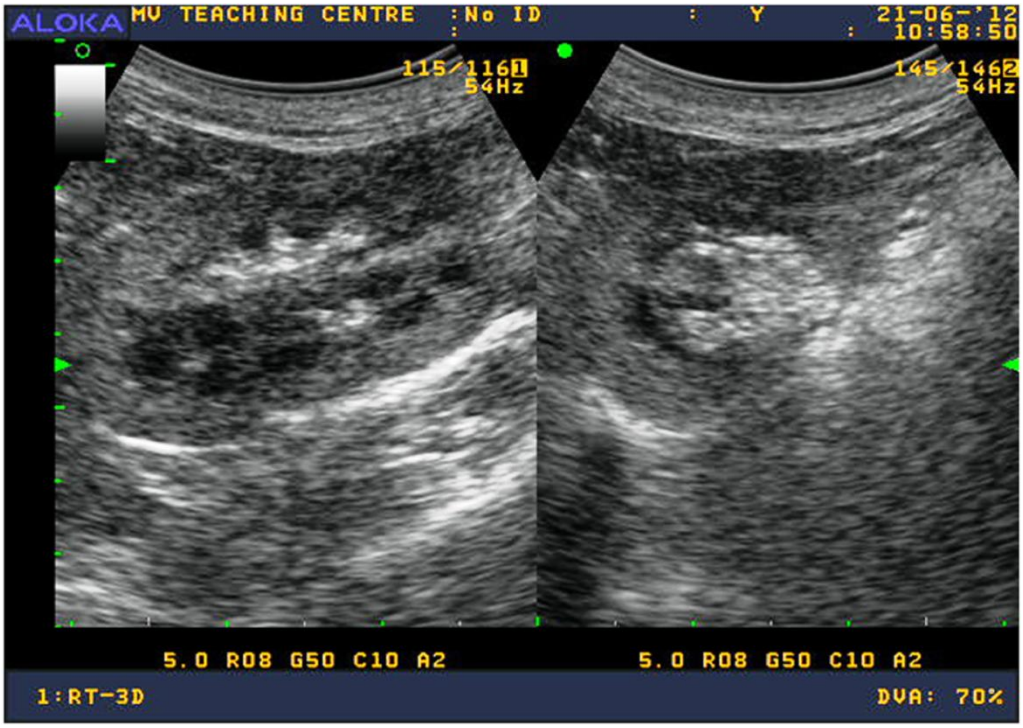

Figure 2a: Increased echogenicity in Acute Kidney Disease

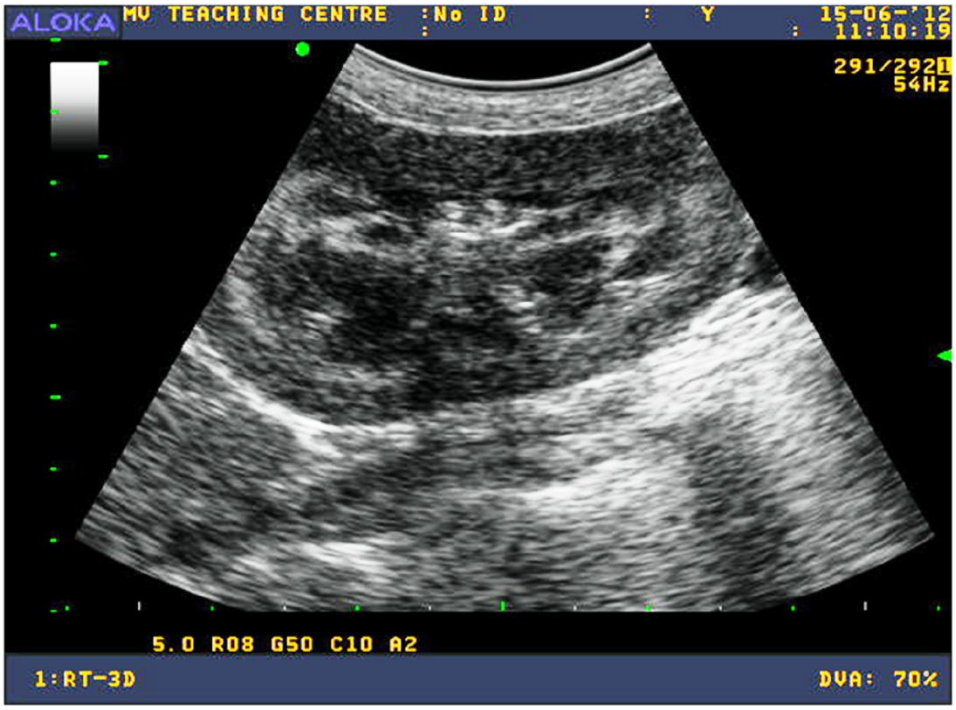

Figure 2 b: Medullary rim sign in Acute Kidney Disease

Figure 3a: Increased echogenicity in Chronic Kidney Disease

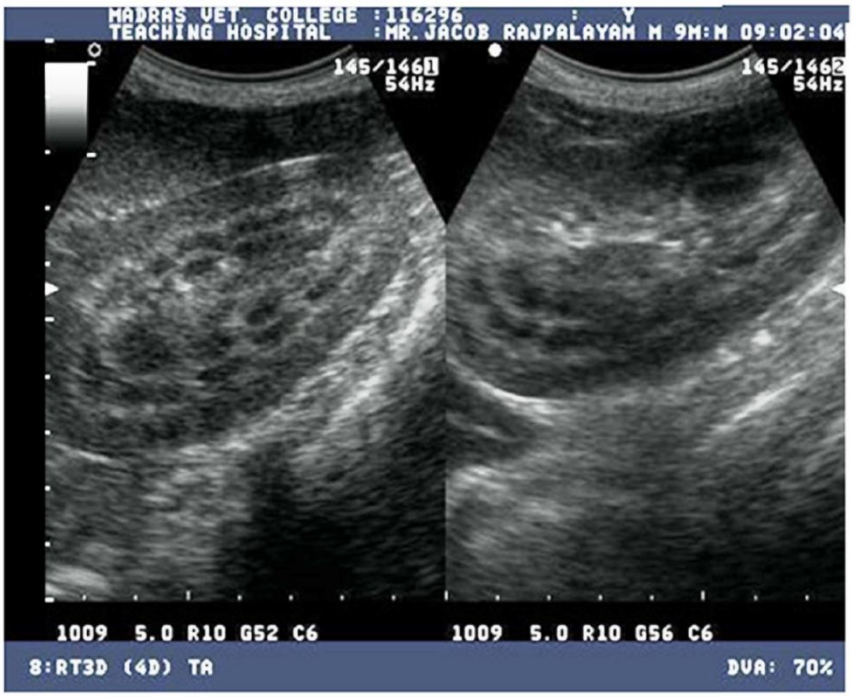

Figure 3b: Medullary rim sign in in Chronic Kidney Disease

Figure 4a: Thickened cortex and altered renal architecture in Chronic Kidney Disease

Figure 4b: Irregular contour and increased cortical echogenicity in Chronic Kidney Disease

Figure IVc: Contracted kidney in Chronic Kidney Disease

Renal Measurements for both body weight groups:

The Mean ± S.E values of length, width, depth and volume of kidneys for 5-15kg body weight group dogs with acute kidney disease and chronic kidney disease are given in Table 1., There was no significant difference in any renal dimension between control, acute kidney disease and chronic kidney disease group. Myott and Langston (2011), stated that in chronic kidney disease kidney appears small and asymmetrical frequently, whereas in acute kidney disease, the kidney appears normal or enlarged. The findings in present study is not in agreement with the findings of above authors whereas it is in partial agreement with Hecht and Henry(2011) , who opined that diagnosis of enlarged or small kidney was often subjective. In the present study the renal volume for healthy dogs measured by using ellipsoid formula was in agreement with Barr *et al*.(1990) and Barrera *et al*.(2009). There is no significant difference in any renal measurements between control group, acute and chronic kidney disease group. This may due to variations in body weight, stage of renal disease and the subjective assessment of the sonographer. This requires further elaborate study with large sample size.

The Mean ± S.E values of length, width, depth and volume of kidneys for 25-35 kg body weight group dogs with acute kidney disease and chronic kidney disease are given in Table 2. There was no significant difference in the length between control, acute kidney disease and chronic kidney disease groups. A significant difference between control group and chronic kidney disease group were observed in the width of the left kidney whereas no significant difference were observed in the width of the right kidney between control, acute and chronic kidney disease. A highly significant increase was observed in the depth of both the kidneys in acute kidney disease group compared to control group, Whereas no significant difference were observed in the depth of left and right kidney in chronic kidney disease group compared to control group. A highly significant decrease in the volume of left kidney was observed in the chronic kidney disease group compared to control group whereas a significant increase was observed in the volume of right kidney of acute kidney disease group compared to control group. A non significant decrease in renal volume of right kidney was observed in chronic kidney disease group compared to control group.

Highly significant and significant changes were observed in renal measurement such as width, depth and volume in the present study among the large dogs (25-35kgs). These findings are in agreement with Hecht and Henry (2011), they observed small sized kidney in chronic kidney disease and diffuse increase in renal size in acute inflammatory disease.

In present study 12 dogs in acute kidney disease and 12 dogs in chronic kidney disease were assessed for appearance and architecture with ultrasound. The qualitative parameter includes kidney contour, appearance of corticomedullary junction, presence or absence of medullary rim sign, cortical echogenecity, medullary echogenecity and the internal architecture (Table 3) (Figure 2 a&b). In acute kidney disease 12/12 dogs had regular contour, distinct corticomedullary junction and normal internal architecture. Increased cortical echogenecity in 8/12 dogs, medullary rim sign in 2/12 dogs, , decreased cortical echogenecity in 2/12 dogs and increase medullary echogenecity in 2/12 dogs were the other findings, (Figure 3 a&b). In chronic kidney disease increased cortical echogenecit were present in 12/12 dogs, followed by irregular contour in 7/12 dogs, indistinct corticomedullary junction in 4/12 dogs, increased medullary echogenecity in 4/12 dogs, abnormal internal architecture in 4/12 dogs and medullary rim sign in 2/12 dogs were recorded. (Figure 4 a, b & c). Increased cortical echogenecity was observed in most of the dogs affected with acute as well as chronic kidney disease. This is in agreement with Nyland *et al*. (1995), Forrest *et al*. (1998) , Anderson(1989), Myott and Langston (2011) and Hecht and Henry(2011). Nyland *et al*.,(1995) and Anderson *et al.* (1989) observed increase cortical echogenecity in glomerular interstitial nephritis, acute tubular necrosis, and the increased cortical echogenecity may be attributed to acute and chronic inflammatory process in the cortex. Medullary rim sign were observed in few cases in the study which is in agreement with Biller *et al*. (1992) who reported medullary rim sign in wide variety of renal lesions which include acute tubular necrosis, chronic interstitial nephritis and renal calcification secondary to hypercalcaemia.

In chronic kidney diseases irregular contour, indistinct corticomedullary junction, and abnormal internal architecture were the prominent findings. This is in agreement with Myott and Langston(2011) , who reported hyperechoic cortices, decreased corticomedullary distinction, renal mineralization and small irregular kidney in chronic cases.

Conclusion:

From the above study it was observed that in small sized dogs there were no significant alterations in renal measurements in the both acute and chronic kidney disease whereas significant changes are seen in large sized dogs. In dogs with acute kidney disease, renal appearance and architecture remains preserved except for texture changes whereas in chronic kidney disease, changes in contour, texture and architecture were very well appreciated. Therefore, it is concluded that reliability of renal measurements and appearance is more subjective and ultrasound is a reliable aid in differentiating acute and chronic kidney disease when combined with other diagnostic modalities.

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