



ISSN (E): 2277- 7695

ISSN (P): 2349-8242

NAAS Rating: 5.03

TPI 2020; 9(6): 121-127

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www.thepharmajournal.com

Received: 16-04-2020

Accepted: 18-05-2020

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An epidemiological and ultrasonographic study of renal failure in canine

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DOI: <https://doi.org/10.22271/tpi.2020.v9.i6b.4737>

Abstract

Renal failure (RF) in canine is mainly identified as progressive and irreversible loss of functioning nephrons and thus kidney, may lead to considerable morbidity and mortality. To understand such changes, an experiment was conducted in Department of Veterinary Medicine targeting the incidence and ultrasonographic findings. A total of 2480 canine patients were screened, apparently showing symptoms of renal failure, during the study period from November 2015 to April 2016 at teaching veterinary clinical complex, Bihar Veterinary College, Patna. Level of Blood Urea Nitrogen (BUN) and creatinine were applied for preliminary screening and ultrasonographic changes in kidney in renal failure were appreciated. Out of 2480 patients selected for assessment of renal failure, 42 animals (1.69%) were found to be suffered from both acute and chronic renal failure. Retrospective study on canine cases presented in the year 2014 and 2015 suggest the incidence of renal problem as 1.19% and 2.39% in the year 2014 and 2015, respectively. On the basis of biochemical (serum creatinine and BUN) and clinical study, the suspected and confirmatory percentage of renal problem in canine in year 2014, 2015 and 2016 were (56.17% & 27.65%) (62.37% & 30.06%) and (60.91% & 24.27%) respectively. The average age for renal failure (both sexes) were found to be 7.95 years. Significant ultrasonographic findings were hydronephrosis (8.33%), hyperechoic cortex (33.3%), oval and small sized kidney (25%), loss of cortico-medullary junction (58.33%), renomegaly (12.5%) and renal calculi (4.16%).

Keywords: Epidemiology, canine, renal failure, ultrasonography

Introduction

Renal failure (RF), now becoming a serious threat to dogs as these remain undetectable for longer periods and if detected, a major portion of kidney especially nephrons become non-functional and undergone in irreversible state. Under such condition high number of morbidity as well as mortality may occur. Treatment in this condition becomes really challenging. To understand the incidence of renal failure in a particular climatic zone it becomes more important to study with respect to different factors like age, sex and breed susceptibility. Elucidation of several ultrasonographic changes happen during this period might be helpful in diagnosis of renal failure.

Keeping in mind the above mentioned problems, this article was aimed made to access the incidence of renal failure in dogs in Patna city and its vicinity and use of modern diagnostic ultrasonography to highlights and differentiate various disorders that affect kidney.

Materials and Methods

The present study was conducted in the Department of Veterinary Medicine and Veterinary Clinical Complex, Bihar Veterinary College, Patna. A total of 2480 dog patients were screened for the syndrome of renal failure during the study period from November 2015 to April 2016. Besides this retrospective study were also performed in 3262 and 4210 cases of canine presented to the Teaching Veterinary Clinical Complex, in the year 2014 and 2015, respectively. Screening of dogs for renal failure was based on patient's history, clinical signs, laboratory urine analysis, hemato-biochemical estimation, Ultrasonography as per method described by Dominique and Marc (2008) [5].

Results and Discussions

A total of 2480 general clinical cases in the year 2016 of dogs brought to the clinical complex of Bihar Veterinary College, were screened. Out of 2480 cases, 173 were suspected for renal

failure and suggested for assessing serum creatinine. Of these 42 cases (prevalence 1.69%) were having serum creatinine level >1.69 (mg/dL) and diagnosed as renal failure. As per Delmer, 1995^[4] elevated level of serum creatinine above 1.69mg/dL is an established indication of renal dysfunction. Among these 42 dogs, 24 dogs having serum creatinine >1.69 mg/dL and BUN >60 mg/dL were selected for the present study. Retrospective study on canine cases presented in the year 2014 and 2015 suggest the prevalence of renal problem of 1.19% and 2.39% in the year 2014 and 2015, respectively in and around Patna city. Present finding is in accordance to the report of Tufani *et al.*, (2015)^[22] who reported 2.58% renal failure in dogs. The study (table 1) revealed the suspected and confirmatory percentage of renal problem in canine in year 2014, 2015 and 2016 were (56.17% & 27.65%) (62.37% & 30.06%) and (60.91% & 24.27%) respectively. The serum creatinine, blood urea nitrogen levels and ultrasonographic changes in kidney, all the three parameters were used for confirmatory diagnosis of renal failure cases in the present study (table 3). As per Delmer, 1995^[4] rise in serum creatinine is sure indication of kidney dysfunction. Scott *et al.*, (1985)^[19] and Shiva Kumar (2001)^[20] has taken serum creatinine greater than 2 mg/dL as azotemia. Thrall *et al.*, (1984)^[21] have considered the dogs to have renal failure if they had a BUN concentration more than 30mg/dL only. Out of 24 cases subjected for study, 15 were male and 9 were female dogs. The average age for renal failure (both sexes) were found to be 7.95 years, except in Labrador Retriever breed in which the average age of renal failure was found to be 3.75 year only. Higher risk of renal failure in Labrador could be due to the fact that this breed is more sensitive for pyometra, leptospirosis, systemic causes and other mixed conditions. The present finding of more risk in Labrador was in accordance with the finding of Ahmed (2011)^[1]. The sex wise prevalence for renal disorder was in accordance with the findings of Tufani *et al.*, (2015)^[22] and Ahmed (2011)^[1]. Higher prevalence of renal disorder in male than female dogs could be due to more risk associated urolithiasis and anatomical structure in male (Bjorling, 2003)^[3] and prevalence of higher creatinine values in male than in female (Jergens *et al.*, 1987)^[9]. The age wise prevalence of renal disorder was closely related to Mallela *et al.*, (2006)^[16], who reported that risk associated with renal disorders were more in dogs of older age (6-8 years). However, Kralova *et al.*, (2010)^[12], Ahmed (2011)^[1] and Kavitha, *et al.* (2013) opined that renal disorders are more common in older dogs of above 8 years of age. Polzin, *et al.*, (1992)^[17] mentioned that 15% dogs of above 10 years of age were affected with renal impairment. Higher risk of renal failure associated with aged dogs could be due to loss of nephron with the advancement of age.

Pyometra

In the present study seven out of nine cases of renal failure in female were also suffering from pyometra. Present study revealed pyometra as one of the main cause of renal failure in old bitches. A potentially higher percentage (77.77) of renal failure cases in female were found to have an association with pyometra. In female having cystitis and pyometra revealed highest incidence of end stage kidneys disorders (Houston, *et al.*, 2003 and Kumar, *et al.*, 2009)^[8, 13]. The reason for higher incidence might be due to endotoxins produced by pathogenic bacteria in the uterus reaches to kidney via systemic circulation and may cause interstitial inflammation and renal

insufficiency if untreated (Sato *et al.*, 2002 and Heiene *et al.*, 2007)^[18, 7].



Fig 1: Two dimensional ultrasonogram of a bitch revealing distended uterine horn

Hydronephrosis: Hydronephrosis in the present study were mainly found in dogs suffering from retention of urine. In the present study 8.33% of dogs were found to be suffering from this problem. It was diagnosed on the basis of enlarged anechoic core due to fluid filled renal pelvis. There was atrophy of renal medulla. Konde (1985)^[11] found loss of corticomedullary demarcation in case of severe hydronephrosis. Marked renal pelvic dilatation with central anechoic space (Fig 2) presence of ureteral calculi (Fig 4) also confirmed the cause of hydronephrosis. Hydronephrosis generally develop when there is obstruction in flow of urine or in case of back flow of urine. When animal put pressure for voiding of urine dilatation of renal pelvis occurs. These findings are in accordance with the findings of Lamb, (1995)^[15].



Fig 2: Two dimensional ultrasonogram of left kidney of a female dog revealing renal pelvis dilatation and atrophy of renal medulla.

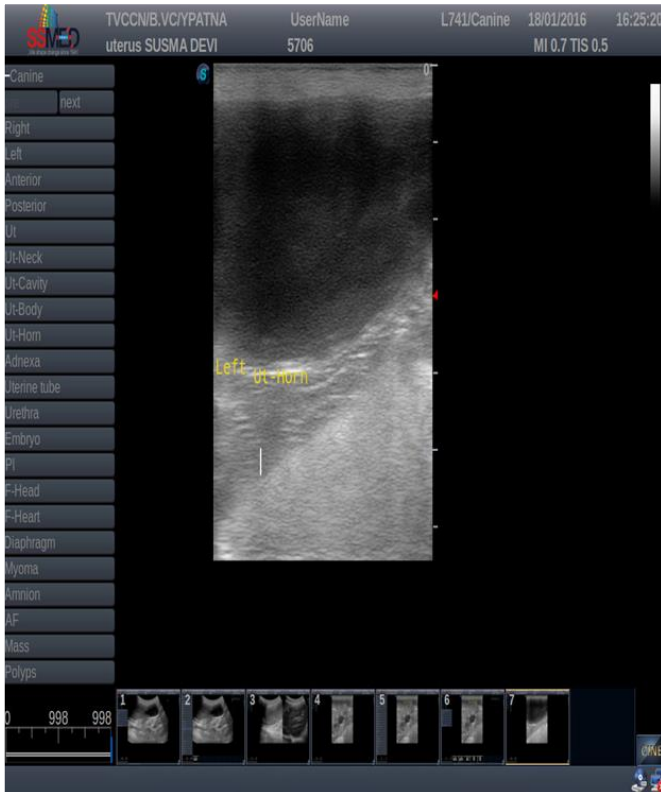


Fig 3: Ultrasonographic appearance of uterine (2D) distended by fluid. The echogenicity of far field is higher indicating setting of cells or particles in depended portion.



Fig 4: Two dimensional ultrasonogram of a bitch suffering from ureterolithiasis with shadowing.

End Stage Kidney: End stage kidney disease were found in dogs having creatinine levels above 10mg/dL. All dogs suffering end stage renal disorders had small and shrunken kidney (Fig 5-8). There is loss of demarcation of cortex and medulla and difficulty in differentiation from surrounding tissues. Additionally, medullary rim was found (Fig 8) indicating tubular necrosis, congestion or haemorrhage. Walter *et al.* (1987) [23] suggested that presence of hyperechoic medullary rim in sonographic findings reveals

nephropathy. Oval and small size kidney (25%), loss of cortico-medullary junction (58.33%) were found in present study. This finding is in corroboration with findings of Kumar *et al.*, (2011) [14] who reported end stage kidney disease in 10 dogs under study. Further, Bhadesiya *et al.*, (2017) [2] after conduction of ultrasonography in dogs suffering from renal failure found significant structural and morphological changes in kidney as indistinct cortico-medullary junction, hyperechoic renal cortex and medullary rim sign. In the present study of end stage kidney disease loss of demarcation of kidney from surrounding tissue, loss of cortico-medullary demarcation and small size kidney were observed. This might be due to loss of nephrons and interstitial nephritis (Felaki, *et al.*, 1992) [6].

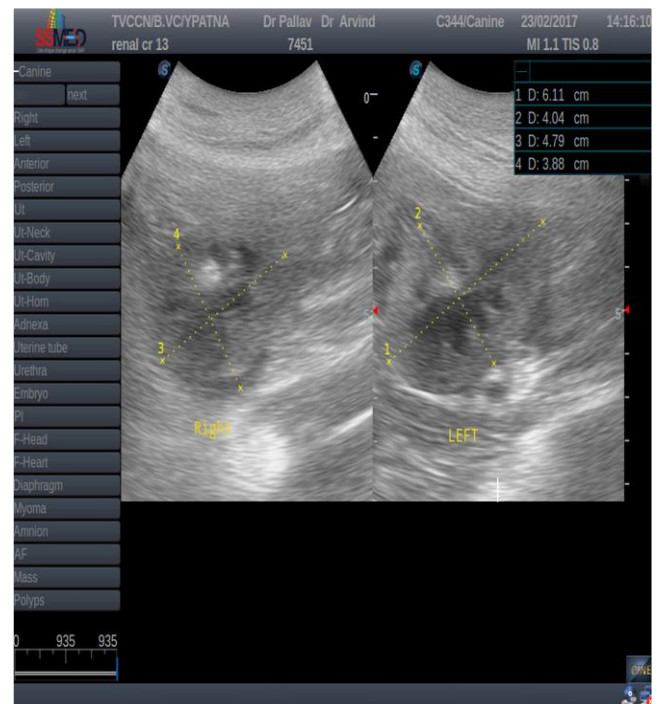


Fig 5: Ultrasonographic appearance of left and right kidneys shows loss of cortico medullary demarcation, and differentiation from surrounding tissue

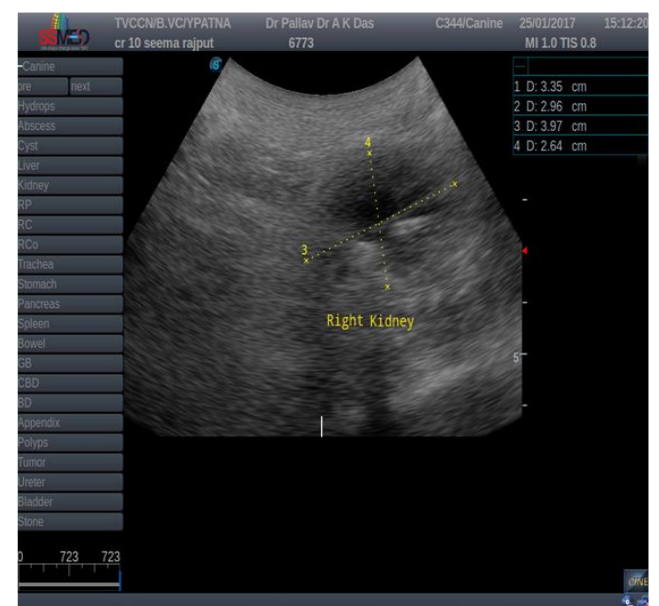


Fig 6: Ultrasonographic appearance of right kidney shows 3.35cm diameter and loss of cortex and medulla diameter



Fig 7: Ultrasonography of longitudinal section of kidney shows 3.76cm diameter.



Fig 8: Medullary Rim Sign visible in longitudinal ultrasonography of right kidney

Nephrolithiasis: In the present study nephrolithiasis and nephrocalcinosis of variable size and shape were found in 4.16% cases of renal failure. These calculi were seen by hyperechoic structure and deep acoustic shadowing. Similar findings were reported by Kumar *et al.*, (2011) ^[14].



Fig 9: Ultrasound indicating presence of single renal calculi



Fig 10: Ultrasound indicating 4.22cm nephrolith in kidney



Fig 11: Ultrasound indicating multiple diffuse, small hyperechoic calculi

Renomegaly: Sonography in the present investigation of renal failure revealed 12.5% cases suffering from renomegaly. Kidney diameter of 6.16 to 7.31 cm were found. Increased

overall echogenicity, and increased thickness of renal cortex were principal findings (Fig 12 & 14).

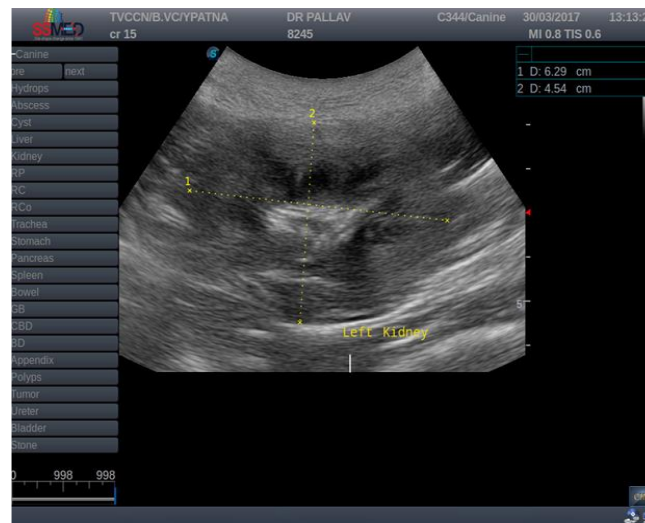


Fig 12: Ultrasound of enlarged Right kidney with diameter 6.29 x 4.54 cm and hyperechoic cortex

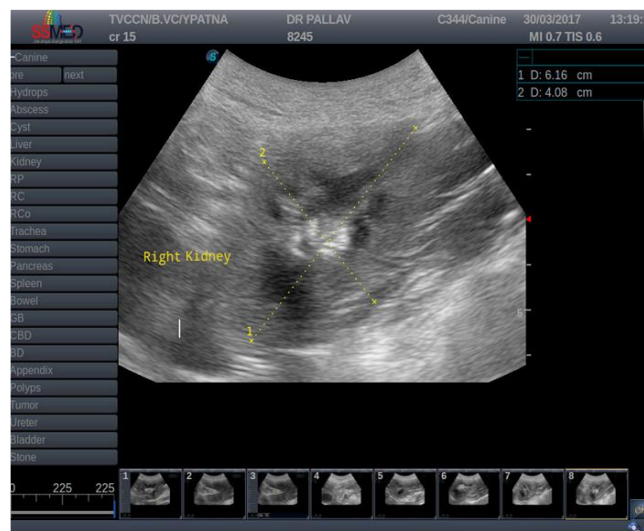


Fig 13: Ultrasound of left kidney with diameter 6.16 x 4.08cm and hyperechoic cortex

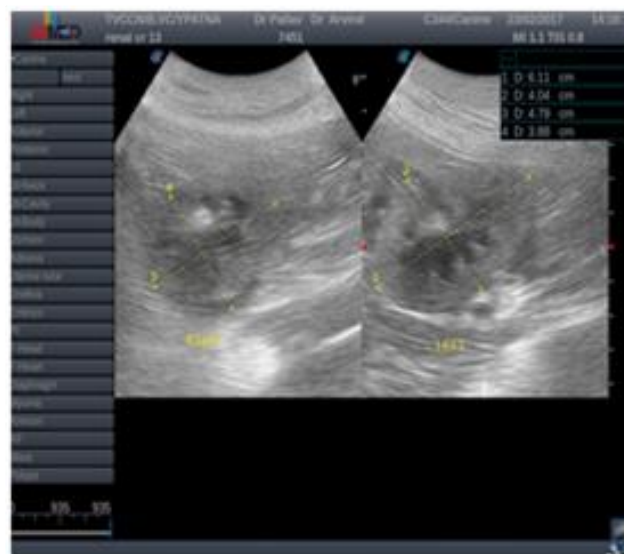


Fig 14: Ultrasound of left and right kidney showing increased overall echogenicity

Conclusion

Renal failure in canine in recent years is gaining attention due to un noticed and variable symptoms. Large number of cases are referred to Veterinary Clinical Complex, Bihar veterinary college, Patna at fourth stage (creatinine above 10mg/dL) of renal disorders with irreversible damage to the kidney. In the present study, it is confirmed on the basis of preliminary biochemical tests like BUN and serum creatinine that nearly 50% of suspected renal failure cases get confirmed by the tests (27.68/56.17(2014), 30.06/62.329 (2015) & 24. 27/60.91 (2015)). Also, the overall prevalence of renal failure cases in

dogs varies from 1.19 to 2.39 percent in Patna city. Pyometra (77.77%), Hydronephrosis (8.33%), End stage renal disorder (Oval and small sized kidney, 25% & loss of cortico-medullary junction, 58.33%), Nephrolithiasis (4.16%) and Renomegaly (12.5%) were the important ultrasonographic findings in dogs suffering from renal failure. Thus it is suggested from this article that regular screening of dogs by biochemical and ultrasonography tests, for evaluation of developing renal disorders may help in diagnosing the cases earlier.

Table 1: Epidemiological study of renal failure cases in canine on the basis of creatinine level

Sl. No.	Year	Total No. of Canine Cases	No. of cases for biochemical analysis	No. of sample for creatinine test	Suspected Prevalence (%)	Critical creatinine level (> 1.69mg/dl)	Actual Prevalence (%)	Confirmatory Percentage of Renal Problem
1	2014	3262	215	141	141/215 (56.17%)	39/3262 (39)	1.19%	39/141 (27.65%)
2	2015	4210	505	315	315/505 (62.37%)	101/4210 (101)	2.39%	101/315 (30.06%)
3	2016 (Half year)	2480	284	173	173/284 (60.91%)	42/2480 (42)	1.69%	42/173 (24.27%)

Table 2: Clinical study of renal failure cases in different breeds, sex and age.

Breed	Total no. of cases	Sex (M/F)	Average age (yr)	Chief complain
Great Dane	1	1/0	7	Anorexia, Melina from 1 month, pale mucous membrane
German Shepherd	5	4/1	7.3	Anorexia, vomiting, Melina, pale mucous membrane
Pomeranian	9	5/4	8.3	Uterine discharge, vomiting, Melina, recumbency
Labrador Retriever	4	3/1	3.75	Red urine, vomiting, sunken eye wall, pale mucous membrane, oligouria
Saint Bernard	2	1/1	5.25	Vomiting, Melina, uterine discharge
Rottweiler	1	0/1	13	Uterine discharge, vomiting
Golden Retriever	1	1/0	7	Red urine, excessive salivation
Lahasa Apso	1	0/1	9	Uterine discharge, Melina
Total	24	15/9	7.95	

Table 3: Level of Serum Creatinine (mg/dL) and Blood Urea Nitrogen (mg/dL) in 24 renal failure cases of dogs.

Diagnostic parameters	Group 1 (N=6)	Group 2 (N=6)	Group 3 (N=6)	Group 4 (N=6)
Creatinine	3.76 ^a ± .70	13.31 ^b ± .98	5.14 ^a ± .73	4.48 ^a ± .99
BUN	88.56 ^{ab} ± 11.15	102.62 ^b ± 9.79	90.09 ^{ab} ± 9.39	65.37 ^a ± 12.02

Mean values (row wise –a,b,c) with different superscript differed significantly ($P<0.05$)

Acknowledgment

The authors are highly thankful to ICAR, New Delhi and Dean, Bihar Veterinary College for providing necessary facilities.

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