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Prevalence of canine renal insufficiency: A decade-long retrospective study in and around Patna, Bihar

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Renal insufficiency is a widespread and debilitating condition with a considerable impact on health and well-being. The clinical symptoms of kidney disease in dogs include weight loss, pale mucous membranes, vomiting, oral ulcers, polyuria, polydipsia, anorexia, and neurological problems (Bronson 1982, Lund *et al*. 1999). Renal insufficiency is among the most common and frequently diagnosed diseases in dogs, particularly in aging individuals. Owing to advancements in diagnostic tools and increased awareness among pet owners, the early recognition of this condition has become possible. Many predisposing factors that may contribute to renal disease are age, sex, season, and obesity. Renal failure can occur in dogs of any age and sex. Patients typically range in age from 11 months to 15 years, with an average age of 6.9 years. The management of renal insufficiency remains a clinical challenge despite numerous advancements in biomedical research (Karunanithy M *et al*. 2019). Renal insufficiency cannot be cured completely; early diagnosis using haematology and biochemical findings which can help in symptomatic and supportive therapy to reduce the consequences of renal dysfunction. However, there is a lack of comprehensive data on the prevalence of renal failure in canines across different regions of India, particularly Bihar. Considering these facts, a clinical survey aimed to provide insight into the prevalence of renal failure in dogs in Patna, Bihar, India was conducted. A preliminary study was carried out to define the incidence of renal disorder in dogs in and around Patna, Bihar, and to study the effect of season, age, and sex on the prevalence rate of renal insufficiency in dogs. The study of haematological and biochemical changes associated with renal insufficiency in dogs should also be considered.

This retrospective study was conducted at the Veterinary Clinical Complex (VCC), Bihar Veterinary College (BVC), Patna, between May 2012 and March 2022. The study focussed on the clinical cases of dogs reported between the study period at the Veterinary Clinical Complex. The study was piloted ethically, responsibly, and in full compliance with all relevant codes of experimentation and legislation.

In total, 5,700 cases of dogs with various illnesses were screened. To determine the epidemiological characteristics for propensity, such as age, season of incidence, breed, and sex, cases of renal problems were further analyzed. The following formula was used to calculate the prevalence rate (%):

$$\text{Prevalence rate (\%)} = \frac{\text{Total number of renal failure cases presented}}{\text{Total population at risk of development of disease}} \quad (\times 100)$$

Clinical examination: The dogs underwent a thorough clinical examination, and a history of vomiting, anuria, oliguria, polyuria, anorexia, limb oedema, diarrhoea, weight loss, and any recent medications such as aminoglycosides and non-steroidal anti-inflammatory drugs (NSAIDs) were noted on the investigation sheet.

Laboratory examination: Blood samples sent for routine laboratory examination were collected in two vials [One plasma vial contained K_3-EDTA (with anticoagulant) and a serum vial (without any anticoagulant)]. Serum was separated by centrifugation at 3000 rpm for 15 min and stored at –20°C for further analysis. Renal insufficiency cases were screened based on serum biochemistry test, namely serum creatinine. Samples with creatinine levels >5 mg/dL were included in this study for further serum examinations, including total protein (TP), albumin (ALB), sodium (Na), potassium (K), calcium (Ca), and phosphorus (P). These values were estimated using commercially available kits. Haematological tests, including complete blood counts (CBC) such as haemoglobin (Hb), total leukocyte count (TLC), differential leukocyte count (DLC), and total platelet count, were estimated using an automated analyser.

Ultrasonography: Ultrasonographic examination was performed on sick and healthy dogs using SonoScape® with a 2.5-5 MHz kidney transducer.

Statistical analysis: The Statistical Package for Social

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Sciences (SPSS; version 23 software) was used for statistical analysis. An independent sample t-test was used to determine significance at 1% and 5% levels.

After biochemical and haematological examinations, reports were sent to clinics, and data were stored to segregate renal insufficiency cases; a total of 5,700 cases of dogs with various illnesses were screened during this duration, out of which 317 were identified with renal insufficiency with serum creatinine levels >5 mg/dL, and 25 healthy dogs were included in this retrospective study. Out of the 317 dogs that underwent screening, 142 (45%) had serum creatinine levels between 5 and 10 mg/dL and 175 (55%) dogs had levels exceeding 10 mg/dL for renal disorders.

Incidence rate

Age-wise prevalence rate: Out of the 317 dogs that underwent screening, the highest incidence rate of kidney diseases was recorded in the 8-10 years (29.97%) age group, followed by 6–8 years (24.24%), 4-6 years (20.51%), >10 years (12.62%), 2-4 years (9.46%) and the lowest in the 0-2 (2.21%) years age group, respectively.

Sex-wise prevalence rate: Out of 317 dogs, 61% of males and 39% of females were confirmed to have kidney insufficiency, indicating a higher incidence rate of kidney disease in males than females, with female: male sex ratio of 0.639 (Table 1).

Table 1. Sex-wise distribution of renal disorders in dogs

Sex	No. of cases with kidney failure	% Incidence rate	Female: male ratio
Female	124/317	39%	0.639
Male	193/317	61%	

Breed-wise distribution rate: The highest occurrence of kidney diseases in different breeds of dogs was recorded in Pomeranian (32.18%), followed by Labrador (25.55%), German Shepherd (20.82%), Mongrel (10.09%), Crossbreed (3.79%), Beagle (1.26%), Lhasa apso (1.89%), Rottweiler (1.26%), Pug (1.89%) and St. Bernard (1.26%).

Season-wise prevalence rate: The incidence rate of renal disorders was found to be highest in the month of November, while the incidence rate being lowest in month of April. The seasonal incidence rate was reported to be highest in the post-monsoon (37.85%), i.e. September-November and lowest in the winter (18.61%) and summer (18.61%) seasons.

Laboratory investigation

Complete blood count (CBC): The average CBC values for dogs with kidney disorders are presented in Table 2. Renal insufficient dogs had significantly (P<0.01) lower levels of haemoglobin (Hb), total erythrocyte count (TEC), and packed cell volume (PCV) than healthy dogs. In contrast, significantly (P<0.01) increased total leukocyte counts were found in dogs with renal insufficiency.

Biochemical parameters: Biochemical alterations in dogs with renal insufficiency are shown in Table 3.

Table 2. Haematological changes in dogs with renal insufficiency

Parameter	Healthy dogs	Dogs with renal insufficiency
PCV (%)	44.42±0.56**	35.42±0.82
Hb (g/dl)	12.68±0.32**	9.38±0.62
TEC (X 10^6/µl)	7.19±0.72**	4.45±0.61
TLC (X 10^3/µl)	10.48±0.79**	16.42±0.91

**, Significant at P≤0.01.

Table 3. Biochemical changes in dogs with renal insufficiency

Parameter	Healthy dogs	Dogs with renal insufficiency
Creatinine (mg/dl)	1.019±0.05**	16.69±1.50
BUN (mg/dl)	26.06±1.25**	176.6±2.48
Total protein (g/dl)	6.90±0.27**	4.36±0.28
Albumin(g/dl)	2.96±0.21**	1.88±0.11
Sodium (mEq/ L)	139.61±0.91*	133.56±1.16
Potassium (mEq/ L)	4.32±.89*	5.14±1.26
Chloride (mEq/ L)	101.76±.1.58	94.56±.1.88
Calcium(mg/dl)	9.43±.0.75	8.42±.1.12
Phosphorus (mg/dl)	4.21±.0.46*	6.37±.1.01

**, P<0.01; *, P<0.05.

Compared with healthy dogs, serum levels of BUN (P<0.01), creatinine (P<0.01), potassium, and phosphorus (P<0.05) were found to be significantly higher. However, changes in serum total protein, albumin (P<0.01), and sodium (P<0.05) levels decreased significantly in dogs with renal insufficiency. However, there were no significant changes in serum chloride and calcium levels in healthy dogs or dogs with renal insufficiency.

Ultrasonographic findings: When dogs with renal insufficiency underwent ultrasonography, their internal cortical-medullary junction was not differentiated, as evidenced by decreased renal size and increased echogenicity (Fig. 1).

Renal failure is often accompanied by symptoms such as anorexia, vomiting, diarrhoea, pyometra and melena. These symptoms may be caused by gastrointestinal ulceration resulting from uremia, which is a common occurrence in cases of renal failure (Forrester and Troy 1999). Vomiting is a prevalent sign of uremia in animals with acute kidney injury. Gastrinemia, which occurs in animals with decreased renal function, may contribute to increased gastric acidity and associated inflammation (Grauer 2005). Anorexia may occur as a consequence of dehydration or hypokalemia associated with polyuric renal failure, metabolic acidosis, or may be a side effect of medications used to treat renal failure. Diarrhoea was observed in dogs and may be due to the degradation of urea to ammonia by bacterial urease, resulting in manifestation such as haemorrhagic gastroenteritis (Schulman and Krawiec 2000, Polzin 2010). Polyuria and polydipsia occur as a result of glomerular hyperfiltration and systemic hypertension, as reported by Bartges (2012). Limb edema has been reported to occur due to hypoalbuminemia or vasculitis leading to interstitial fluid accumulation despite

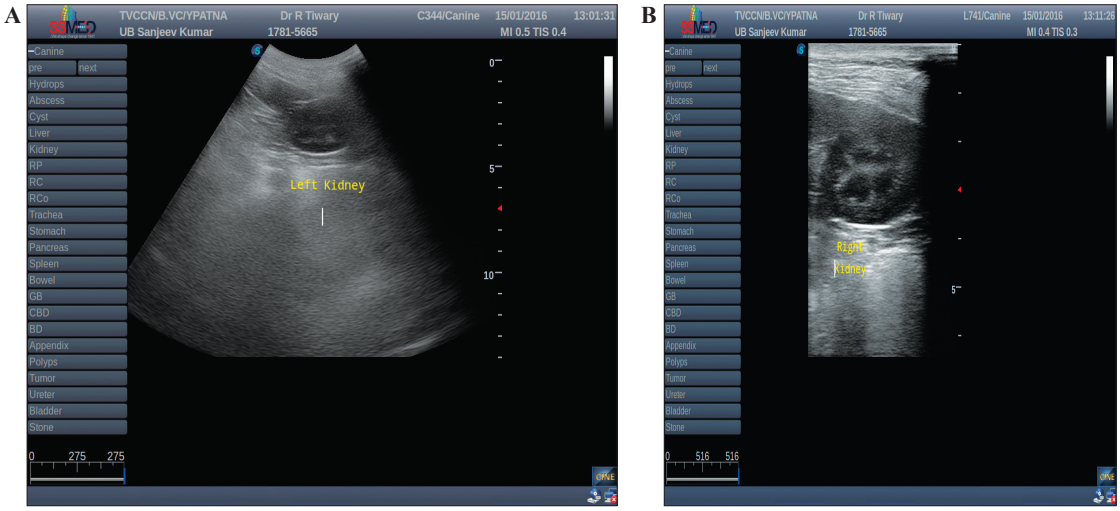

Fig. 1. Sonogram of dog showing (A) left and (B) right kidney losing the integrity of cortex and medullary region.

an intravascular volume deficit (Vaden 2004).

In this study, the overall incidence rate of kidney disease in dogs was found to be 5.56%. Similar epidemiological studies have been conducted in various regions of India, including those by the Indian Veterinary Research Institute (IVRI) in Bareilly and the Govind Ballabh Pant University of Agriculture and Technology in Pantnagar. The findings of these studies are consistent with the results of this research (Tufani *et al.* 2015 and Karunanithy M *et al*. 2019).

The sex-wise prevalence rate of renal disorders was more in males as compared to females. This finding is in accordance with the findings of Behrend *et al.* (1996) and Ahmed (2011) who also reported that the incidence rate of renal failure was greater in the male when compared to female dogs. This could also be attributed to endocrine factors, as well as the increased risk associated with urolithiasis in males compared to females (Bjorling 2003). Additionally, anatomical differences between male and female kidneys, in terms of size and volume, as well as variations in the urinary tract, play a significant role in disease progression. The preference of dog owners for male dogs as pets could further contribute to the higher prevalence of renal disorders observed in males (Oburai *et al*. 2015, Tufani *et al*. 2015, Katoch *et al*. 2017, Thade *et al*. 2019). Contrary to the present study many studies reported higher prevalence in females than males (Kandula and Karlapudi 2014, Bouillon *et al*. 2018, Nabi *et al*. 2018).

The prevalence rate of renal failure in dogs, stratified by breed, aligns with findings by Mallela (2006), Ahmed (2011) and Tufani *et al.* (2015) who identified the highest incidence of renal disorders in Labrador Retrievers and German Shepherds. The elevated prevalence in Labrador might be attributed to their heightened sensitivity to conditions such as pyometra, leptospirosis, systemic causes, and other mixed conditions. German Shepherds and Pomeranians exhibit greater susceptibility to urethritis, urolithiasis, cystitis, and other systemic conditions (Tufani et al. 2015). These breed-specific differences in renal disorders may be influenced by geographical distribution and management practices. Additionally, highest breed wise incidence rate of kidney diseases was reported in Pomeranian and lowest but equally in Beagle, Rotweiler, and St. Bernard (Karunanithy M *et al*. 2019), but many previous workers reported that there is no age, breed or sex predilection for acute renal failure (Mary 1992, Tilley and Smith 2007).

The incidence rate of kidney diseases was observed to be highest in the 8-10 years age group, followed sequentially by the 6-8 years, 4-6 years, and >10 years age groups. This is likely due to the fact that as animals age, blood flow to the kidneys decreases and so does the resorption process in the remaining nephrons. This decrease in blood flow and resorption can be attributed to the loss of nephrons that occurs with age (Grauer and Lane 1995). The lowest incidence rate was noted in animals within the young (0-2 year) age group that could due to various factors, including trauma, any parasitic infection, neoplasms, genetic anomalies like renal dysplasia, and exposure to toxins (de Morais *et al.* 1996). Higher age wise incidence rate of kidney failure has also been reported in earlier studies (Polzin 2010, Tufani *et al.* 2015). The post-monsoon season was determined to have the highest occurrence rate of renal insufficiency in dogs because of the ingestion of contaminated water and the proliferation of various infectious diseases after monsoon (Graner 2007, Karunanithy M *et al*. 2019,).

The kidney is the primary organ for the production of erythropoietin, which helps in the production of haemoglobin in an animal body. Studies have shown that dogs with renal disease tend to have lower packed cell volume, haemoglobin, and total erythrocyte count. These lower levels might be due to reduced production of erythropoietin hormone, red blood cells in the kidneys, decreased lifespan of red blood cells, bleeding in the intestines, or nutritional deficiencies in dogs with renal insufficiency (Devauk *et al*. 1996, Kralova *et al*. 2009, Srikanth and Karlapudi 2015). Evaluation of both creatinine and BUN in serum is regularly used to monitor renal

function since they are the two endogenous metabolic end products that the kidneys remove in urine, and elevation in serum levels of these two are primarily found in dogs with renal insufficiency (Jeong *et al*. 2006, Zygner *et al*. 2007). Significantly elevated serum phosphorus levels in dogs with renal insufficiency may be due to decreased excretion from the kidney and increased absorption from the intestinal wall. Previous researchers have also reported elevated values of blood urea nitrogen, creatinine and phosphorus indicating renal failure (Chand *et al*. 2009, Karunanithy M *et al*. 2019). Elevated potassium and decreased sodium levels in the serum of dogs with renal insufficiency may be the result of impaired water regulation, which causes electrolyte imbalances in the kidneys (Karunanithy M *et al*. 2019).

In conclusion, renal insufficiency is commonly associated with an increase in serum BUN and creatinine levels, and their initial recognition and regular monitoring in dogs will help in early diagnosis and reduce the occurrence rate of this condition. The peak incidence of renal insufficiency was observed in November and post-monsoon season. Older animals are more likely to be affected, with male animals being more likely to be affected. The present retrospective study gives an overview of renal failure epidemiology, and diagnostic modalities which may help in reducing the renal failure incidence rate through early detection and monitoring of dogs for renal failure.

SUMMARY

This retrospective study investigates the prevalence and epidemiological factors associated with renal insufficiency in dogs within Patna, Bihar, India. Out of 5,700 dogs with various illnesses, 317 were diagnosed with renal insufficiency, identified by serum creatinine levels exceeding 5 mg/dL. The study assessed the incidence of renal insufficiency across different demographics, including age, sex, breed, and season. The highest incidence was observed in dogs aged 8-10 years, with males showing a higher prevalence than females. Pomeranians (32.18%), Labrador Retrievers (25.55%), and German Shepherds (20.82%) were the most affected breeds. Seasonally, the post-monsoon period (September-November) exhibited the highest incidence (37.85%) of renal disorders. Laboratory investigations revealed significant haematological and biochemical alterations in affected dogs, including lower haemoglobin, total erythrocyte count, and packed cell volume, alongside elevated serum levels of blood urea nitrogen (BUN), creatinine, potassium, and phosphorus. Ultrasonography indicated decreased renal size and increased echogenicity in dogs with renal insufficiency. The study concludes that renal insufficiency in dogs is most prevalent in older males and certain breeds, particularly during the post-monsoon season. Regular monitoring of serum BUN and creatinine levels is recommended for early diagnosis and management of this condition.

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