RESEARCH ARTICLE

Canine Leptospirosis: Clinical and Ultrasonographic Assessment in South Gujarat

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Abstract

Leptospirosis is a severe spirochetes infection in dogs that can cause significant damage to vital organs, particularly the liver and kidneys and may lead to life-threatening complications. This study was aimed to assess occurrence of leptospirosis in dogs along with associated haemato-biochemical and ultrasonographic changes. Over a period of two years, 195 cases (3.50%) were suspected out of total 5566 dogs registered for medical treatment. Among confirmed 30 cases (15.38%), majority of affected dogs (60%) were between 1-6 years old and males (70%). On ultrasonographic evaluation of confirmed cases of canine leptospirosis, more than 80% cases exhibited kidney to aorta ratio greater than 9. Pyelectasia (80%), medullary rim sign in the kidney (70%) and hypoechoic liver parenchyma (60%) were also observed during ultrasonography. Haematological analysis revealed elevated mean total leukocyte counts (26790 cells/µL) along with neutrophilia (80.4±10.04%) and mild anaemia (11.33±3.19 g/dL). Serum biochemical analysis showed elevated mean serum AST (71.28±47.37 IU/L) and ALT (86.28 ±53.26 IU/L) along with hypoalbuminaemia (<2.5 g/dL) suggesting impaired liver function. Elevated serum creatinine and BUN levels were found in 23.33% and 43.33% dogs, respectively, indicating renal involvement. Findings indicated the multisystem impact of canine leptospirosis which underscores the importance of its early detection based on USG and haemato-biochemical findings.

Key words: Canine, Leptospirosis, Medullary rim sign, Pyelectasia, Ultrasonography.

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Introduction

Leptospirosis is a widespread zoonotic infection caused by pathogenic spirochetes of the genus *Leptospira*, affecting virtually all mammals and has a broad range of effects, from mild, asymptomatic infections to multiple-organ failure and death. The disease is especially prevalent in tropical and subtropical regions and where environmental factors such as frequent rainfall, warm temperatures and poor sanitation create ideal conditions for the survival and dissemination of *Leptospira* organisms (Levett, 2001). Dogs have a distinct role in the transmission cycle of Leptospira, acting as both a host and a vector, due to their frequent interactions with humans, other animals, and the natural environment (Gay *et al.,* 2014). Dogs contract *Leptospira* infection by direct contact with infected urine or contaminated water sources, through bite wounds or otherwise damaged skin, by eating infected tissue or exposure during birth. Once in the body, leptospires spread rapidly via the lymph system to the bloodstream and then to all tissues. If the animal mounts an immune response and survives, leptospires will be cleared from most organs and the bloodstream. However, the infection persists in sites hidden from the immune system; the most common hidden sites are the kidneys and reproductive tract. Persistence in these organs results in a carrier state; the infected animal may shed leptospires in the urine and genital secretions for months to years. Global sero-prevalence of canine leptospirosis was recently estimated at 18.5% (Ricardo *et al*., 2020). However, the true prevalence is likely higher as estimates are primarily based on studies using owned dogs, excluding the burden in un-owned dogs where animal access and data are limited. Stray dogs also have a higher *Leptospira* prevalence when compared to owned dog populations, possibly due to a lack of veterinary care, increased environmental exposures *etc.* (Costa *et al.,* 2022).

In canine patients, the disease presents considerable diagnostic and therapeutic challenges due to its non-specific and variable clinical signs which frequently involve

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renal and hepatic impairment (Goldstein, 2010; Sykes *et al*., 2011). Therefore, early and precise diagnosis is crucial for effective management of the disease (Levett, 2001). Abdominal ultrasonography has become an essential, non-invasive diagnostic tool for assessing organ involvement in suspected cases of leptospirosis. It is particularly effective in identifying structural changes in the kidneys and liver such as pyelectasia, altered echogenicity, and the medullary rim sign which are commonly observed in infected animals (Thrall *et al*., 2013; Maxie, 2016). Epidemiological studies indicate that leptospirosis affects dogs of all age groups with a higher incidence observed in young to middle-aged male dogs. This may be attributed to behavioural and hormonal factors that increase their risk of exposure. Biochemical and haematological abnormalities such as elevated liver enzymes (AST, ALT), increased blood urea nitrogen and creatinine levels, along with reduced serum albumin and altered protein profiles are common markers of organ dysfunction and systemic inflammation in affected animals (Goldstein, 2010). Considering the facts, the present study was aimed to assess the clinical signs, ultrasonographic finding, haematological and biochemical alterations in dogs diagnosed with leptospirosis in the South Gujarat region. The detailed clinical evaluation supported by ultrasonography and haemato-biochemical analysis provides a comprehensive analysis of disease presentation and diagnostic indicators. Further, it seeks to improve the understanding of demographic patterns, organ-specific involvement and laboratory correlations associated with leptospirosis in canines from this geographic area.

Materials and Methods

Dogs (n=5566) presented with complaints of general systemic illness at the Veterinary Clinical Complex, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Navsari, Gujarat (India) were initially screened. Based on history, clinical findings (Fig.1, 2) and urine examination 195 cases were suspected of leptospirosis. Out of these, total 30 cases were confirmed based on urine examination under dark field microscopy (DFM) for the presence of motile leptospires and subsequently on microscopic agglutination test (MAT) (Fig. 3, 4) as per standard techniques. All suspected cases were evaluated using ultrasonographic assessment of affected organs according to the standard procedure described by Nyland and Mattoon (2002) utilizing a Sonosite M-Turbo colour Doppler machine equipped with 2-5 MHz convex, 5-8 MHz microconvex and 7-12 MHz linear probes. Whole blood and serum samples were also collected from confirmed cases (n=30) for complete blood count and serum biochemistry analysis. Blood parameters were estimated in fully automatic laser based haematology analyser (MEK-6420P, Nihon Kohden India) and serum biochemical parameters were estimated in semi auto clinical chemistry analyser (Microlab-300, Q-line Biotech, India) using commercially available diagnostic kits.

The demographic parameters like age, sex and USG findings of affected dogs were considered for percent prevalence and severity of leptospitosis. The data on haemato-biochemical parameters were analysed and expressed as mean ± SE, and compared with the reference standard values.

Results and Discussion

Out of the 30 leptospirosis-positive dogs identified, the majority (60%) were in the age group of 1-6 years, followed by 30% in the 6-10 years range and 10% below 1 year of age. No cases were reported in dogs above 10 years (Table 1). These findings indicate higher susceptibility in younger and middle-aged animals likely due to increased exposure to contaminated environments and heightened exploratory behaviour (Bharti *et al*., 2003). During the present study, male dogs accounted for 70% of the affected cases, a finding consistent with earlier reports attributing the predisposition to increased roaming behaviour and hormonal factors (Levett, 2001).

Table 1: Clinico-epidemiological and ultrasonographic findings in confirmed cases of canine leptospirosis (n=30)

Parameter	Category	No. of animals	Percent
Age (years)	0-1	3	10.00
	1-6	18	60.00
	6-10	9	30.00
	>10	0	0.00
Sex	Male	21	70.00
	Female	9	30.00
Kidney: Aorta ratio (left)	<5.5	0	0.00
	5.5-9.0	6	20.00
	>9	24	80.00
Kidney: Aorta ratio (right)	<5.5	0	0.00
	5.5-9.0	5	16.66
	>9	25	83.33
Ultrasonographic liver findings	Hypoechoic parenchyma	18	60.00
	Hyperechoic parenchyma	9	30.00
	Loss of vasculature	6	20.00
	Nodular changes	3	10.00
	Cirrhosis	3	10.00
	Hemangiosarcoma	3	10.00
Renal ultrasound findings	Medullary rim sign	21	70.00
	Pyelectasia	24	80.00

Ultrasonographic examination revealed renal enlargement in the majority of dogs as indicated by a kidney-to-aorta length ratio exceeding 9 in 80% of left kidneys and

Fig. 1: Sign of jaundice with congested sclera in *Leptospira* infected dog

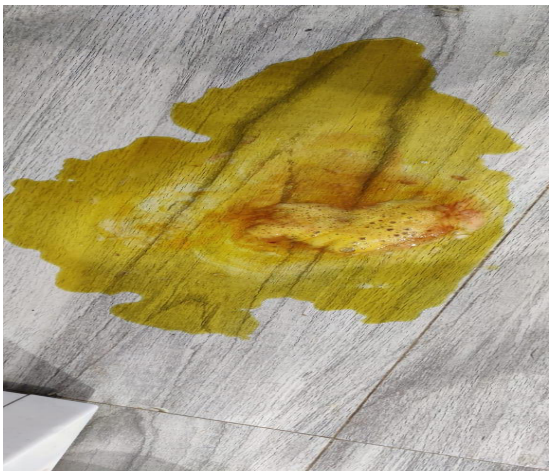

Fig. 2: Blood tinged vomitus mixed with bile in *Leptospira* infected dog

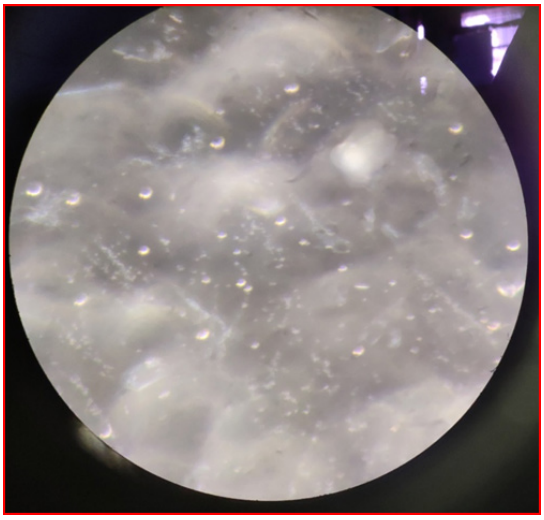

Fig. 3: *Leptospira* like organism under dark field microscopy

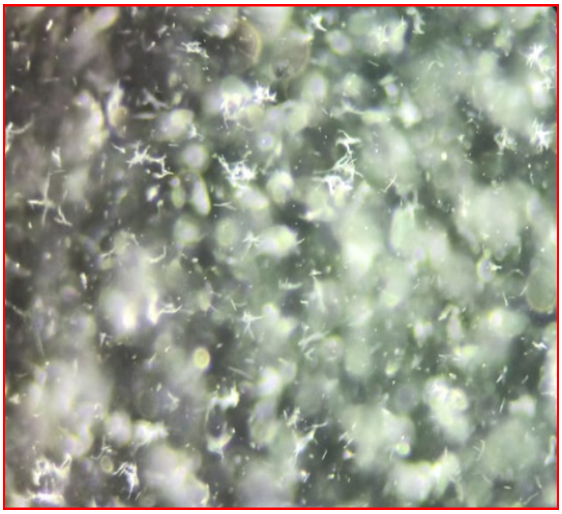

Fig. 4: Photos of Microscopic Agglutination Test (MAT)

83.33% of right kidneys (Fig. 5). Renal abnormalities such as pyelectasia (80%) (Fig. 6) and medullary rim sign (70%) (Fig. 7) were frequently observed ultrasonographic findings in canine leptospirosis cases. These results aligned with interstitial nephritis and tubular changes associated with leptospiral nephropathy (Goldstein *et al*., 2006). Liver changes were prominent with 60% of dogs showing hypoechoic parenchyma (Fig. 8), 30% showing hyperechoic changes and 20% displaying reduced vascularity (Table 1). Nodular liver changes (10%) and suspected cirrhosis or haemangiosarcoma (10% each) were also observed indicating chronic hepatic pathology (Miller *et al*., 2011).

Haematologically, the *Leptospira* infected dogs exhibited mild to moderate anaemia with an average haemoglobin concentration of 11.33 ± 3.19 g/dL. Leukocytosis was evident with a mean total leukocyte count of 26,790 ± 12,508 cells/µL. The differential leukocyte count showed neutrophilia (80.4 ± 10.04%) and lymphopenia (14.7 ± 8.77%) reflecting an acute inflammatory response to bacterial infection (Table 2). In earlier report of Chandrasekaran *et al.* (2011), they observed decreased RBC count, PCV and Hb concentrations characterized by a normocytic, normochromic anaemia associated with signs of haemorrhage and blood loss in leptospirosis infected dogs. They also found that *Leptospira* infected dogs exhibited a profound leukocytosis with a prominent neutrophilia and lymphopenia. Our results are in agreement with reports in which leucocytosis, normocytic and normochromic anaemia as well as base line value of thrombocytes in *Leptospira* infected dogs were observed (Aswathanarayanappa *et al*., 2019; Wagh, 2024). Leukocytosis and neutrophilia might be due to stimulation of neutrophil adherence and activation which may be involved in inflammatory and coagulatory abnormalities (Greene *et al*., 1998). Anaemia is usually either mild and non-regenerative or regenerative and caused by

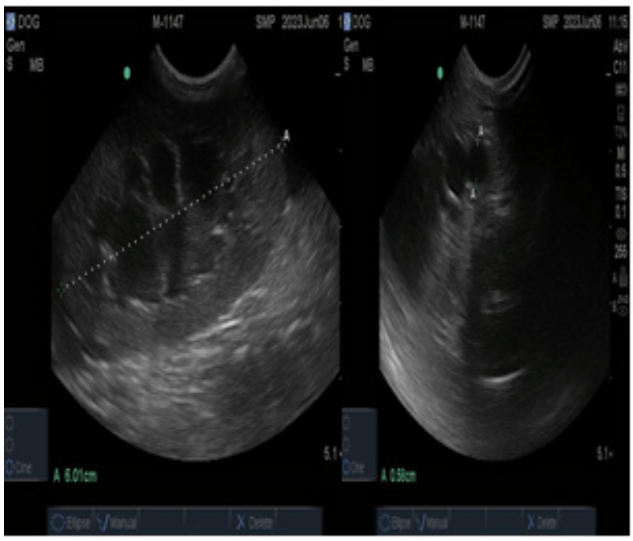

Fig. 5: Increased kidney/aorta ratio in *Leptospira* infected dog

Fig. 6: Pyelectasia in *Leptospira* infected dog

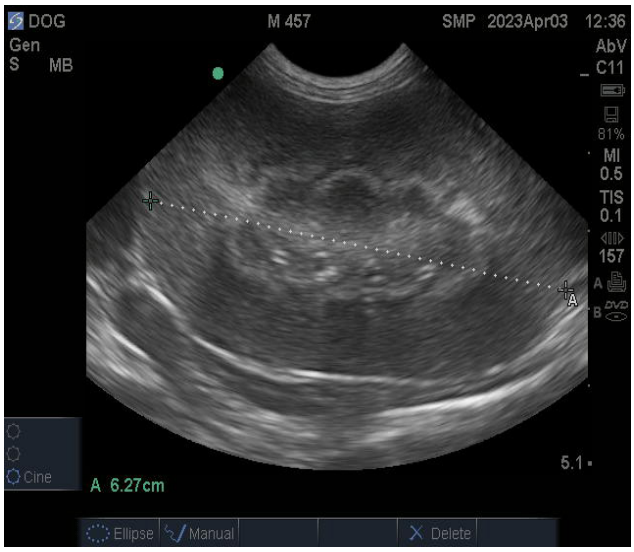

Fig. 7: Medullary rim sign in *Leptospira* infected dog

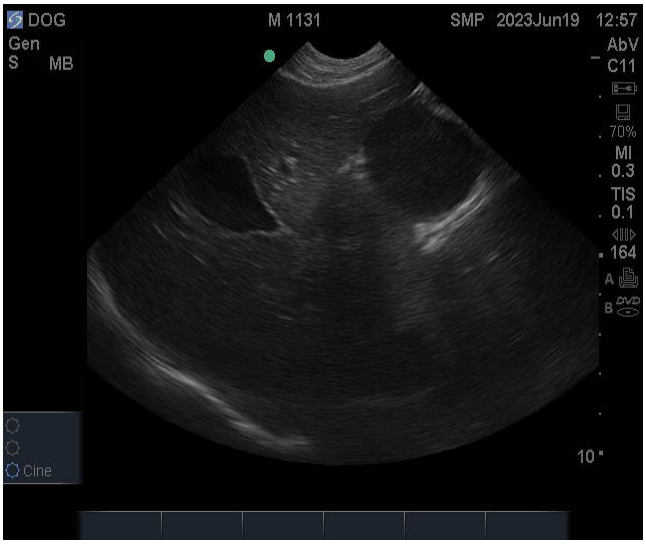

Fig. 8: Hypoechoic liver parenchyma in *Leptospira* infected dog

blood loss via the gastrointestinal, urinary or respiratory tracts due to coagulopathy or vasculitis, whereas, increased leukocyte count observed because of *Leptospira* bacterial infection (Picardeau, 2017). Reduction of platelet counts or thrombocytopenia might be because of vascular injury due to Leptospiral toxins (Athanazio *et al*., 2008).

During the study, serum biochemical analysis revealed hepatocellular damage, as evidenced by elevated liver enzymes AST (71.28 ± 47.37 IU/L) and ALT (86.28 ± 53.26 IU/L) (Table 2). Among all, 40% and 30% of dogs showed these values above 100 IU/L. Renal impairment was reflected by increased creatinine levels (>1.5 mg/dL) in 23.33% of dogs and elevated blood urea nitrogen (BUN >30 mg/dL) in 60% of dogs (Table 3). These findings are in agreement with observations of Chandrasekaran *et al.* (2011) who also found significantly elevated mean values of BUN, Creatinine, ALT, ALP, GGT, total bilirubin and direct bilirubin in leptospirosis affected dogs. Marginal increase in BUN and creatinine in *Leptospira* infected dogs were also observed by Aswathanarayanappa *et al.* (2019) and Wagh (2024). Increased BUN and creatinine level in renal failure might be due to marked reduction in glomerular filtration rate (GFR), diminished renal excretion, enhanced tubular absorption of urea and impaired ability of kidneys to excrete proteinaceous catabolites (McDonough, 2001). Protein abnormalities were also common with 83.33% of dogs exhibiting hypoalbuminaemia (<2.5 g/dL) and 13.33% showed hypoproteinaemia suggestive of hepatic dysfunction or protein-losing nephropathy (Table 3) (Ellis, 2015).

Table 2: Haemato-biochemical findings in confirmed cases of canine leptospirosis (n=30)

Parameters	Mean ±SE	Reference values*
Haemoglobin (g/dL)	11.33 ±3.19	12-18
TLC counts (cells/µL)	26790±12508	5000-14000
Neutrophils (%)	80.4 ±10.04	58-85
Lymphocytes (%)	14.7 ±8.77	8-21
Platelets ($\times 10^3$/ µL)	2.3 ±1.44	2.1-6.2
AST (IU/L)	71.28 ±47.37	23-66
ALT (IU/L)	86.28 ±53.26	21-102
Creatinine (mg/dL)	1.31±1.17	0.2-1.5
BUN (mg/dL)	65.61±73.10	29.9-59.9
Total protein (g/dL)	5.99±1.12	5.4-7.1
Albumin (g/dL)	1.85±0.67	2.6-3.3

(* Kaneko *et al.,* 2008)

Table 3: Distribution of hepato-renal markers among confirmed cases of canine leptospirosis

Parameters	Category	No. of dogs	%
AST (IU/L)	0-50	15	50.00
	50-100	3	10.00
	>100	12	40.00
ALT (IU/L)	0-50	12	40.00
	50-100	9	30.00
	>100	9	30.00
Creatinine (mg/dL)	0-1	20	66.67
	1-1.5	3	10.00
	>1.5	7	23.33
BUN (mg/dL)	10-30	12	40.00
	30-100	13	43.33
	>100	5	16.67
Total protein (g/dL)	5.5-7.5	21	70.00
	4.5-5.5	5	16.67
	<4.5	4	13.33
Albumin (g/dL)	2.5-3.5	5	16.67
	1.5-2.5	13	43.33
	<1.5	12	40.00

Conclusions

This study underscores the widespread impact of leptospirosis in dogs particularly its effects on the liver and kidneys. Ultrasonographic imaging plays a key role in diagnosing and tracking organ-specific changes in infected dogs revealing important abnormalities like renal enlargement, pyelectasia and hypoechoic liver parenchyma. Haematological and biochemical changes such as neutrophilia, elevated liver enzymes and altered renal markers further confirm the diagnosis and emphasize the need for early and precise diagnostic approaches in managing leptospirosis. Given that leptospirosis is a zoonotic disease prompt detection and treatment in dogs are crucial to prevent severe complications and reduce the risk of transmission to humans. To enhance understanding of the disease larger-scale studies in various geographic regions are necessary to provide a more comprehensive view of its clinical and diagnostic characteristics.

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