

Ultrasonographic Investigation on the Occurrence Pattern of Various Renal Diseases in Dogs

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Abstract

Renal diseases are one of the most common conditions seen among various age groups of dogs that cause multiple electrolyte and metabolic abnormalities, thereby leading to mortality in affected dogs. A total of 551 out of 3085 dogs (overall occurrence 17.86 per cent) with a mean age of 8.12 ± 0.41 years identified with various renal diseases upon abdominal ultrasonography during the two-year study period. Highest occurrence of renal diseases was recorded amongst the Labrador, Spitz, Pug and Non-Descriptive breeds of dogs. Male dogs were represented more frequently (60.44%) than females. Ultrasonography of kidneys revealed chronic renal changes (435/551, 78.94%), acute kidney injury (46/551, 8.34%), nephrolithiasis (29/551, 5.26%), renal mineralization (25/551, 4.53%), renal cysts (11/551, 1.99%) and renal mass lesions (5/551, 0.90%) as various renal diseases in dogs.

Keywords: Chronic Kidney Disease, Interstitial Nephritis, Nephrolith, Renal Mineralization, Ultrasonography



Introduction

Kidneys are the most valuable vital organs in the body as they perform a number of functions like excretion of metabolic waste substances, regulation of fluid, electrolyte and acid-base balances in-addition to secreting renin and erythropoietin hormones which maintain the blood pressure and red blood cell production in the body, respectively. Any insult which causes renal parenchymal damage and nephron loss results in gradual or sudden decline in glomerular filtration rate which subsequently leads to accumulation of metabolic waste substances in the body ending in a state of azotemia and uremia (Cowgill and Francey, 2005). Those patients will exhibit non-specific clinical signs such as inappetance, lethargic, polyuria or oliguria, weight loss, oral ulcerative lesions, limb edema and occasional seizure.

Multi-etiological and complexity involved in renal diseases makes tough to treat especially when the patients are presented in later stages of the disease. Hence, early and precise diagnosis is always desirable in renal diseases to improve the quality of life and survival time. This can be achieved by the combination of diagnostic imaging techniques, serum biochemistry, evaluation of renal biomarkers and renal biopsy studies. Among the available diagnostic methods, ultrasonography is a simple, non-invasive, economical and highly sensitive imaging diagnostic technique to assess the various pathological conditions affects the kidneys. With this background, this study was focused on ultrasonographic investigation of the occurrence pattern of various renal diseases in dogs.

Material and Methods

The present study was conducted with the objectives of sonographic assessment of various renal diseases in dogs. A total of 3085 cases referred to the Ultrasound Unit, Department of Veterinary Clinical Medicine, Madras Veterinary College, TANUVAS, Chennai, during the period from February 2017 to January 2019 were considered for this study. Cases were also investigated for the presence of co-organ involvement and subsequently compared with the clinical and hemato-biochemical changes.

An Esaote MyLab 20@ ultrasound machine was used to perform ultrasound examinations in dogs suspected for renal diseases by following proper patient preparation, positioning and application of ultrasound gel to facilitate the conductivity. Out of 3085 cases, 551 dogs showed various structural changes in one or both the kidneys, which were categorized as nephroliths (focal hyperechoic areas in the renal parenchyma with shadowing), renal mineralization (multifocal hyperechoic areas in the kidneys), acute kidney injury (renomegaly or medullary rim sign associates with hyperechoic or hypoechoic cortex), renal neoplasia (focal echogenic areas within the renal parenchyma with excessive blood supply), chronic kidney disease (CKD) (thick and hyperechoic renal cortex, indistinct cortico-medullary junctions with an irregular renal capsule) and renal cysts (one or multiple anechoic areas in the renal parenchyma) based on the respective ultrasonographic findings.

Results and Discussion

Out of 3085 cases, 551 dogs a mean \pm S.E. age of 8.12 ± 0.41 years (range 0.8-14) revealed pathological lesions in one or both kidneys upon abdominal ultrasonography with an incidence of 17.86 per cent. Labrador, Spitz, Pug and Non-Descriptive breeds of dogs were represented more than the other dog breeds. Male dogs were represented more frequently (60.44%) than females. Among the various renal diseases identified by ultrasonography, chronic kidney disease, acute kidney injury, nephrolithiasis, renal mineralization, renal cysts and renal tumors were recorded with a prevalence of 78.49 per cent, 8.34 per cent, 5.26 per cent, 4.53 per cent, 1.99 per cent and 0.90 per cent respectively.

Nephroliths and renal mineralization were observed with a higher frequency in small-sized dog breeds (Spitz and Pug together contributed to 50.00 per cent, than Labrador and Non-descriptive dogs that contributed to 29.62 per cent. On the contrary, acute and chronic kidney diseases were reported higher in large breeds (Labrador and Non-descript together 44.59 per cent) than small sized dogs (Spitz and Pug together 13.51 per cent). Mean ages recorded for the occurrence of nephroliths, renal mineralization, acute and chronic kidney diseases were 8.72, 10.0, 6.0 and 8.12 years respectively. Among 25 dogs diagnosed with renal mineralization, also concurrently had cystic or prostatic urethral calculi (n=5), bladder tumors, hepatomegaly and hepatic tumors (2 cases each) as associated lesions. Besides, chronic structural changes were also observed in all the cases suffering from renal mineralization. Retrospective analysis of clinical and hemato-biochemical findings revealed variable degrees of azotemia and characteristic signs of renal disease among affected cases. Similarly, out of 29 dogs suffering from nephroliths

(Fig.1) (unilateral-44.82 per cent and bilateral-55.17 per cent), CKD (n=10), cystic calculi (n=7), hydronephrosis (n=6) (Fig.4), splenomegaly (n=3), splenic tumor (n=1) and both hepato-splenic involvement (n=2) were observed as associated findings upon ultrasonography.

Formation of uroliths might involve multiple physiological and pathological processes (Osborne *et al.*, 1996). Geddes *et al.* (2013) explained the mechanisms responsible for hyperphosphatemia and renal mineralization, increased plasma concentration stimulates increased parathyroid hormone (PTH) secretion and alteration in the formation of calcitriol in the kidneys which favours towards hyperphosphatemia. Chronic elevation of PTH leads to demineralization of bone, additionally deposition in soft tissues results in mineralization of kidneys and other viscera, causing successive progression of the disease. Ulrich *et al.* (1996) also described the nephroliths as an aggregation of crystalline and matrix materials that form either in one or more locations within the kidneys and urinary tract, due to abnormal mineral metabolism which may contain a plethora mineral composition; such as various combinations of phosphate, calcium, oxalate, urate, cystine, carbonate and silica (White 1996). Snyder *et al.* (2005) reported that the sensitivity of the ultrasonography in diagnosis of urinary calculi was found to be 100 per cent than radiography (80 per cent sensitivity), whereas combination of both ultrasonography and radiography was showed to be more effective. Among 46 dogs found with acute and interstitial nephritis, medullary rim sign with hyperechoic cortex (Fig. 2) (n=8), renomegaly associated with uterine involvement could be due to onset of systemic inflammatory response (n=2), splenomegaly (n=11), splenic tumor and hepatomegaly (1 case each), urinary bladder sediments (n=5), pyelonephritis (n=2), and both hepato-splenic involvement (n=2) were observed as co-organ lesions.



Figure 1: Large hyperechoic area with shadowing in the renal parenchyma (arrow head) suggestive of nephrolith



Figure 2: Kidney showing medullary rim sign pattern suggestive of AKI associated with Leptospirosis

Only three dogs out of five consisting of renal tumors, showed characteristic distribution of mass lesions in the spleen, liver and lymphnodes, subsequently which were confirmed as a multicentric lymphoma. The CKD was recorded as the most common disease condition among dogs particularly in geriatric patients. This study revealed that out of 3085 dogs examined 435 cases (78.94%) showed chronic structural changes in kidneys (Fig. 3).



Figure 3: Kidneys showing hyperechoic, thick renal cortex and loss of internal architecture suggestive of chronic kidney disease



Figure 4: Left Kidney hydronephrosis with dilated ureters

Of which, cystic calculi (20 cases), bladder tumors (4 cases), splenomegaly (24 cases), splenic tumors (3 cases), hepatic changes (16 cases) and hepatic tumors (11 cases) were identified as concurrent findings in the abdominal viscera. All these dogs correlated with clinical and laboratory data, which had signs of weight loss, lethargic, polyuria, oral lesions, limb edema, anemia and variable levels of hypertension and azotemia. Brown (2007) has estimated that CKD is a major cause for morbidity and mortality, especially in older dogs with overall incidence of 0.5 to 1.5 per cent. Nephron damage associated with CKD is usually irreversible and can be progressive in nature which may takes one to three months to become clinically ill (Grauer, 2017). Dehmiwal *et al.* (2015) reported that ultrasonography is an excellent diagnostic technique to differentiate various conditions of the urinary bladder and kidneys such as cystitis, cystoliths, urethroliths, ureteroliths, nephroliths, renal and urinary bladder neoplasia. Remechi *et al.* (2014) also emphasized the importance of ultrasonography in the detection, characterization and management of affections involving the kidney without any deleterious effects on healthy tissue.

Conclusion

The present study revealed that, chronic kidney disease is the most common renal disease in dogs. Spitz and Pug breeds showed higher affinity to develop nephroliths and mineralization of kidneys than larger dog breeds. In conclusion, ultrasonography was found to be effective in diagnosing various structural changes in the kidneys and urinary tract.

Conflict of Interests

There is no conflict of interest.

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