Diagnostic evaluation of renal failure in canine with special reference to urinalysis

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Abstract
The present investigation was conducted in the Department of Veterinary Medicine, GBPUA&T, Pantnagar during January 2011 to December 2013 with the objective of early diagnosis of renal failure in canine by simple laboratory procedure of urinalysis. Microscopic examination of urine showed a significant increase in cellular component, urinary casts and crystals. The predominant crystals in the urine samples were triple struvite- 47.83% (11/23), followed by calcium oxalates- 26.09% (6/23), ammonium biurate- 13.04% (3/23), amorphous- 8.70% (2/23) and lowest was bilirubin- 4.35% (1/23). Urolith was present in 23% cases of dogs commonly in male- 86.96% (20/23) under 8 years of age- 78.26% (18/23). The chemical analysis of stones revealed phosphate, oxalate and ammonia suggested struvite, calcium oxalate and urate. Topography of urinary calculi under scanning electron microscopy was columnar shaped aggregation of crystallites, suggesting calcium oxalates. Approximately 70% of dogs with struvite urolithiasis were associated urinary tract infection with urease producing bacteria. Out of 100 dogs with renal impairment, 63.00% were having urinary tract infections. The most prevalent bacteria isolated from urine specimens were Escherichia coli (38.10%), followed by Staphylococcus aureus (20.63%), Proteus spp. (17.46%) and Streptococcus spp. (6.35%). The most sensitive antibiotics were observed amoxiclav (85.71%), followed by gentamicin (76.19%) and ofloxacin (71.43%).

Keywords: Canine, culture and sensitivity, electron microscopy, urinalysis

Introduction
Like other species of animals, canines are also prone to suffer with many systemic diseases during their lifespan. Dogs are susceptible to various diseases, ailments and poisons, but renal failure is the most common and fatal condition in canine occurring in 2-5% of dogs \(^1\) and is the third leading cause of death in dogs. Vigorous efforts are required to identify the underlying cause. Diagnosis of renal failure usually based on a combination of compatible history, physical examination, laboratory facts and imaging studies, which play a crucial role in differentiating acute from chronic renal failure \(^2\). The diagnostic evaluation of renal diseases is expensive and time consuming.

Urinalysis, despite being an immensely useful tool, is perhaps the most underused test in veterinary practice. When performed properly a urinalysis the presence of cellular component, casts and crystals and bacteria in urine is the best way to detect renal diseases before the onset of renal failure. Therefore, urinalysis is a remarkable tool that can reveal many of the diseases that could go unnoticed and undiagnosed because they generally do not produce striking signs or symptoms of, various forms of glomerulonephritis and chronic urinary tract infections \(^3\). Keeping in view all these facts, the present study was carried out with the objective of simple laboratory procedure for early diagnosis of renal failure in canine with special reference to urinalysis.

Materials and Methods
1. Urine sample collection and storage
For routine urinalysis, urine samples were collected from 100 dogs affected with renal failure and 30 healthy dogs as the animal voided or by catheterization or by cystocentesis (Fig. 1 &2). About 10 ml of urine sample was collected in a clean glass tube for routine urological examination and about 2 ml of urine sample was also collected in a sterile glass test tube for microbial culture and antibiotic sensitivity.
2. Urological examination (urinalysis)
   a. Physical characteristics
   The physical characterization of urine included colour, turbidity and odour of urine (Fig. 3 & 4).

b. Microscopic examination of urine
   Deposit microscopy is a powerful tool in assessing urine. It was therefore performed, using 5 ml of plain urine sample which was centrifuged at 2,000 rpm for 5 minutes and discards the supernatant and re-suspends the deposit by flicking the tube. Pipette the deposit onto a clean grease free glass slide and was adding a cover slip. It was examined in the light microscope under both low-power (lpf, 10X) and high-power (hpf, 40X) objectives \cite{5}. Numbers of casts are recorded per lpf and numbers of RBCs, WBCs and epithelial cells are recorded per hpf. The components observed are- red blood cells, white blood cells, epithelial cells, crystals, casts, bacteria/yeasts, spermatozoa and amorphous debris \cite{5}.

c. Microbial culture of urine and antibiotic sensitivity test
   The microbiological examination of urine sample was done for all the dogs showing renal impairment. Collected urine samples were plated onto the nutrient agar, MacConkey agar and Eosin Methylene Blue agar (Hi-Media, Mumbai, India) and incubated aerobically at 37 °C for 24 hrs. The isolated colonies were again plated onto nutrient agar plates as pure culture and subjected to standard morphological, biochemical tests \cite{6} to ascertain their identity. In vitro antibiogram of urine samples were done as per the standard procedure \cite{7}.

Statistical analysis
   The statistical analysis of data obtained was performed by applying simple percentage \cite{8}.

Results and Discussion
   i. Examination of cellular components and casts
   Complete examination of urinary sediment requires proper identification of cells (RBCs, WBCs and epithelial cells), casts, organisms (bacterial, fungal), crystals, mucus and artifacts or contaminants. The presence or absence of crystals, urinary casts and lipid droplets were noticed. Positive findings were further characterized as few, moderate, or many and results from an average of 10 microscopic fields are depicted in Table 1 and Fig. 5-10.
   Significant increase in epithelial cell counts in the urine of dogs with renal impairment as compared to healthy dogs indicates disease process in kidney and inconclusive \cite{9}. Squamous epithelial cells observed in healthy as well as renal patient were large, polygonal cells with small round nuclei (Fig. 6). It also seen in voided or catheterized samples due to urethral or vaginal contamination. Small numbers can be a normal finding and increased numbers may be found in the urine sediment of females during estrus and hence, presence of squamous epithelial cells in urine sediment is usually having no diagnostic value. High numbers of transitional epithelial cells were usually seen in urine sediment of renal patient of variable-size that enters urine anywhere from the renal pelvis to the urethra. The size of transitional cells increases from the renal pelvis to urethra. Small transitional cells usually originate from the kidney, but small transitional cells can originate from the ureter, bladder and urethra. Large transitional cells do not arise from the kidney. Increase number of transitional cells may present in the urine sediment with infection, mechanical trauma (urolithiasis), or neoplasia of the urinary tract \cite{12}. Moderate amount of renal cells were seen particularly in dogs with acute renal failure (ARF). These were small epithelial cells that originate from the renal pelvis or tubules. The presence of renal epithelial cells in urine is abnormal. They are observed mostly in patients with
ischemic, nephrototoxic, or degenerative renal disease, usually in acute renal failure [2]. Presence of significantly higher RBCs, WBCs and epithelial cells in the present investigation might be due to inflammation of urinary tract and presence of more number of these cells suggests renal affection [10]. Haematuria was common finding in dogs with lower urinary tract obstruction (urolith), bladder rupture, however lack of haematuria does not rule out the possibility of urolith [11]. Microscopic haematuria may be present with upper urinary tract obstruction, but gross haematuria is uncommon. Urinary cast present in most of the urine samples of dogs could be the result of solidification of protein in the lumen of the kidney tubules, specifically in nephron, indicated kidney disease rather than lower urinary tract disease.

Casts are cylindrical molds of the renal tubules composed of aggregated protein matrix with or without embedded cells. Casts form by precipitation of protein and any intact cells, intracellular organelles, brush border, or cellular debris that present in the tubular lumen. In the present study several types of cast were identified in the urine sediment of most dogs affected with renal failure. Significantly higher count of urinary casts in renal affected dogs could be due to active pathologic process at loop of henle, distal tubule and collecting tubule. The absence of cast does not rule out the disease and number is not a reliable index of severity, duration and reversibility or irreversibility of disease [12].

RBC casts (Fig. 9) in the present investigation indicated glomerular disease, whereas WBC casts were indicative of tubular disease, especially infection and acute pyelonephritis. Epithelial casts (Fig. 6) are serious pathologic finding and associated with acute tubular necrosis were also observed. Granular casts (Fig. 7) in the present investigation suggests stasis in the nephron, which was primarily associated with tubule-interstitial disease. Presence of waxy casts in many cases suggested renal stasis or nephron obstruction and represented serious disease and referred to as renal failure casts (Fig. 5) [13, 14]. Granular casts in the urinary sediment is about 30% and 10% in case of acute and chronic renal failure, respectively observed by many authors [15-17]. However, 8.1% dogs affected with chronic kidney disease reported by others [18]. Moreover, some unclassified casts (Fig. 10) were also observed in severely renal affected dogs.

Many renal epithelial cell casts were observed in renal patient during this study. It is most commonly occurs in patients with acute tubular necrosis or pyelonephritis with severe tubular injuries. They are often associated with nephrototoxic or ischemic renal injury and may be seen with renal infarction, acute interstitial nephritis (e.g. leptospirosis) and pyelonephritis [2]. Mixed casts contain more than one identifiable cell type (e.g. WBCs, RBCs, epithelial cells) were also observed in many patients.

Hyaline casts are pure protein precipitates and seen few to many numbers in healthy and renal patient, respectively. It was commonly seen in glomerular diseases associated with marked proteinuria and in renal tubular diseases that decrease reabsorption of proteins or add inflammatory proteins to urine. WBC casts (pus casts) present in dogs associated renal failure were suggestive of pyelonephritis. However, acute to sub-acute interstitial nephritis, nephrosis and exudative glomerulonephritis (rare) may also be considered. A few numbers of RBC casts were observed in urine sediment of some renal affected dogs. RBC casts are the most fragile of the cellular casts and are rarely observed in the urine of dogs and cats. They may be seen in acute glomerulonephritis, after renal trauma (e.g. renal biopsy) or after strenuous exercise.

Excessive numbers of granular casts suggested accelerated tubular degeneration, but may be seen in patients with glomerular disease when large amounts of filtered plasma protein precipitated in urine. Few waxy casts presented in some cases with chronic renal failure represent final stage of degeneration of granular casts and were suggestive of substantial chronic intra-renal stasis, because these casts take considerable time to form. They are associated with advanced chronic renal disease and their presence is considered an ominous finding [2]. Presence of cellular, coarse granular and waxy casts is always pathologic. The presence of casts of all types indicated renal involvement.

### Table 1: Microscopic examination of urine in healthy and renal failure dogs

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameters</th>
<th>Healthy dogs (n=30)</th>
<th>Renal failure dogs (N=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Before Treatment (n=56)</td>
<td>After Treatment (n=31)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Cellular component:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Red blood cells (RBCs)</td>
<td>Few (0-8)</td>
<td>High</td>
</tr>
<tr>
<td>ii.</td>
<td>White blood cells (WBCs)</td>
<td>Few (&lt;10)</td>
<td>High</td>
</tr>
<tr>
<td>iii.</td>
<td>Epithelial Cells:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Squamous epithelial cells</td>
<td>Few</td>
<td>Moderate</td>
</tr>
<tr>
<td>b.</td>
<td>Transitional epithelial cells</td>
<td>Few</td>
<td>Moderate (smaller to larger size)</td>
</tr>
<tr>
<td>c.</td>
<td>Renal epithelial cells</td>
<td>None</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Cellular cast:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Epithelial casts (per lpf)</td>
<td>Few</td>
<td>Many</td>
</tr>
<tr>
<td>ii.</td>
<td>WBC cast (per lpf)</td>
<td>None</td>
<td>Few</td>
</tr>
<tr>
<td>iii.</td>
<td>RBC cast (per lpf)</td>
<td>None</td>
<td>Few</td>
</tr>
<tr>
<td>iv.</td>
<td>Mixed cast (per lpf)</td>
<td>None</td>
<td>Few</td>
</tr>
<tr>
<td>v.</td>
<td>Granular cast (per lpf)</td>
<td>Few (0-1)</td>
<td>Many</td>
</tr>
<tr>
<td>vi.</td>
<td>Hyaline cast (per lpf)</td>
<td>Few (0-2)</td>
<td>Many</td>
</tr>
<tr>
<td>vii.</td>
<td>Waxy cast (per lpf)</td>
<td>None</td>
<td>Few</td>
</tr>
</tbody>
</table>

lfp: Low power field (10X objective) Figures: Microscopic examination of urine sediment
Fig 5: Microphotograph of urine sediment of 4 years old female Pug affected with renal impairment showing broad casts "renal failure casts" (10x).

Fig 6: Microphotograph of urinary sediment of a renal failure affected dog showing large, flat and irregular shape with large cytoplasm and small nuclei squamous epithelial cast (40x).

Fig 7: Microphotograph of urinary sediment of a 9 years old male German shepherd dog affected with chronic renal failure showing granular cast (40x).

Fig 8: Microphotograph of urine sediment of a 9 years old chronic renal failure affected male German shepherd dog showing different types of urinary casts and calcium oxalate crystals.

Fig 9: Microphotograph of urine sediment of an 8 years old Spitz male dog affected with urolithiasis showing RBCs/haematuria (10x).

Fig 10: Electron Microscopic Scanning (SEM) of urine sediment showing several unclassified casts (10x).

ii. Examination of urinary crystals

Microscopic examination of urine revealing various types of crystals in urine are presented in Table 2 and Fig. 11-16. The predominant crystals in the urine samples were triple phosphate (magnesium ammonium phosphate) or struvite crystals- 47.83% (11/23), followed by calcium oxalates crystals- 26.09% (6/23), ammonium biurate- 13.04% (3/23), amorphous crystals- 8.70% (2/23) and lowest were bilirubin crystals 4.35% (1/23). These crystals were identified on the basis of their characteristic morphology or shape. Struvite crystals usually appeared as colourless, 3-dimensional, prism-like crystals "coffin lids". Calcium oxalates dehydrate crystals were typically colourless squares whose corners were connected by intersecting lines (resembling an envelope). Calcium oxalate monohydrate crystals varied in size and may have a spindle, oval, or dumbbell shape or "hemp seed". Ammonium urate (or biurate) crystals generally appeared as brown or yellow-brown spherical bodies with irregular protrusions "thorn-apples". "Amorphous" crystals appeared as aggregates of finely granular material without any defining shape. Bilirubin crystals form from conjugated bilirubin (water-soluble) and were needle-like to granular crystals those are yellow in colour.

In the present study, urolithiasis was present in 23% cases of uremic dogs commonly in male- 86.96% (20/23) under 8 years of age- 78.26% (18/23) and it was more common in lower urinary tract. The most common location of urinary calculi was the urinary bladder, urethra and both concurrently in bladder and urethra of male dogs and in urinary bladder of female dogs. These calculi were of various shape, size, colour and texture that were recovered after cystotomy or urethrotomy and were subjected for chemical analysis and scanning electron microscopy for further study.

The chemical analysis of different stones revealed phosphate,
oxalate and ammonia suggested struvite, calcium oxalate and urate stones, respectively. The major mineral component of urinary bladder calculi was triple phosphate (struvite) and in urethra and multiple locations, it was calcium oxalate. Topographic feature of urinary calculi under scanning electron microscopy (SEM) was characterized by columnar shaped aggregation of crystallites (Fig. 17-22), suggested calcium oxalates, and it was further confirmed by chemical analysis.

Urolithiasis in dogs associated in the present study was also responsible for the development of secondary renal azotemia due to post renal obstruction. Approximately 70% of dogs with struvite urolithiasis had associated with urinary tract infection with urease producing bacteria, such as Staphyloccci and Proteus spp. Hydrolysis of urea by the enzyme urease ultimately resulted in the formation of ammonia and carbonate, which creates an increasingly alkaline environment in the urine. These conditions were ideal for the development of struvite uroliths, but they also favoured the formation of a number of other uroliths, including calcium carbonate and apatite [20]. High uric acid levels in blood resulted in the formation of biurate crystals and bladder stones in Dalmatian dogs is a genetic defect in protein metabolism [21]. Although common, renal stones are painful (hunched back), can cause nausea, difficulty in passing urine, and may progress to kidney disease, if there is a blockage. Urinary calcium, the main constituent of renal stones, is increased by a high salt diet and this increases the risk of stones forming. A number of studies have successfully shown that a reduction in salt consumption can reduce calcium excretion and reduce reoccurrence of renal stones [21]. Hypercalciuria and high blood pressure are more likely to develop renal stones [22]. A diet designed to reduce hypertension markedly reduced kidney stone [23]. However, crystalalluria is not a sensitive marker of ureteral calculi because only 6.5% of cats with calcium oxalate ureteroliths present calcium oxalate crystalluria [24]. Both dihydrate and monohydrate calcium oxalate crystals may be observed in ethylene glycol cases or lily poisoning, although both can be seen in normal animals [25]. The presence of crystals in urine can be of no clinical significance in health, but in animals with history of urolithiasis or relevant clinical signs they may be significant [20]. In pets, urolithiasis has been attributed to changes in diet and fluid intake as well as environmental factors, such as activity and stress [27, 28]. A change also takes place with time in the composition of stones passed by domestic pets. In dogs the proportion of calcium oxalate stones has increased from 6-27% within past 10 years and the proportion of magnesium ammonium phosphate stones has fallen concomitantly and usually occurs due to urinary tract infection [29]. Purely vegetarian diet fed to the pets is more likely leading to alkaline urine than a diet containing significant amount of animal proteins. This may be a contributing factor for the formation of stones containing magnesium ammonium phosphate and calcium carbonates as observed in the present study. If crystalalluria become persistent, the probability of an abnormally large particle forming and becoming trapped at some narrow section of the urinary tract increases. Alternatively, blocking of the lumen may occur by a “log jamming” mechanism in a urinary system which is over loaded with crystals. This is the “free particle” model of stone formation [30]. In the present study, ammonium biurate, calcium oxalates dehydrate and monohydrate and triple phosphate were the common crystals recorded [26].

Obstruction of the lower urinary tract is a common urologic emergency that results in significant azotemia in cats more often than in dogs that can usually be diagnosed based on the history and palpation of a turgid, painful urinary bladder during physical examination [31]. Urethral obstruction by uroliths is more common in male dogs than in female dogs and most often lodge at the ischial arch or just proximal to the os penis because of several anatomic characteristics [32]. Calcium oxalate and ammonium urate stones are most frequently implicated in urethral obstruction due to their relatively smaller size and tendency to occur as multiple stones, along with the increased incidence of oxalates and urates in male dogs, likely factor into this predilection [31]. The most common component of upper urinary tract stones in dogs and cats is calcium oxalate [33, 34, 35] and its incidence has increased, dramatically in the past 10 years [33, 34, 36]. Calcium oxalates stones are formed in the parenchyma of the kidneys and may remain there or pass into the ureters and bladder. The formation of calcium oxalates stones were influenced by many factors, including the degree of urine saturation with calciologic minerals, urinary inhibitors of crystallization and crystal aggregation and growth, and urinary promoters of crystal aggregation and growth [34, 37]. Some patients that present with acute, severe post-renal azotemia due to upper urinary tract obstruction have simultaneous, acute bilateral obstruction, however many present with acute obstruction of a single functional kidney. These animals usually have permanent partial or complete dysfunction of one kidney. In these patients, the compensatory hypertrophy of the contra lateral kidney for the functional decrement and obstruction of this single functional kidney has resulted in acute azotemia. Physical examination of these patients revealed renal asymmetry, the smaller kidney was firm, atrophied and nonpainful and the larger kidney was resilient, obstructed and often painful. Some astute owners detect subtle behavioural signs accompanying initial unilateral upper urinary tract obstruction, including antisocial behaviour, flank licking and back or abdominal pain, leading to earlier diagnosis of nephrolithiasis or ureterolithiasis [31]. Diet influences the urine composition and hence, dietary change is often incorporated into the medical management of uroliths [19].

Table 2: Microscopic examination of urine for crystals

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Urine crystals</th>
<th>Healthy dogs (n=30)</th>
<th>Renal failure dogs (n=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Struvite/triple phosphates/Magnesium ammonium phosphate (MgNH₄PO₄·6H₂O)</td>
<td>Nil</td>
<td>11/23 (47.83%)</td>
</tr>
<tr>
<td>2.</td>
<td>Calcium oxalates</td>
<td>2/30 (6.67%)</td>
<td>6/23 (26.09%)</td>
</tr>
<tr>
<td>3.</td>
<td>Ammonium biurets or uric acid crystals</td>
<td>Nil</td>
<td>3/23 (13.04%)</td>
</tr>
<tr>
<td>4.</td>
<td>Amorphous crystals</td>
<td>Nil</td>
<td>2/23 (8.70%)</td>
</tr>
<tr>
<td>5.</td>
<td>Bilirubin crystals</td>
<td>Nil</td>
<td>1/23 (4.35%)</td>
</tr>
</tbody>
</table>
Fig 11: Microphotograph of urinary sediment of a 4 years old Bhutia male dog showing triple phosphate crystals or “struvite” in a (10x).

Fig 12: Microphotograph of urinary sediment of a 4 years old Pug male dog showing triple phosphate or “struvite” crystals resembles prism “coffin lids” (40x).

Fig 13: Microphotograph of urinary sediment of a 9 years old German shepherd male dog affected with renal failure, showing calcium oxalates crystals (40x).

Fig 14: Microphotograph of urine sediment of an 8 years old Dalmatian male dog suffering with renal failure and showing golden brown colour and “thorn apple” shape ammonium urates crystals (40x).

Fig 15: Microphotograph of urinary sediment of 5 years old male German shepherd dog affected with renal failure showing amorphous phosphates fine colourless granules (40x).

Fig 16: Microphotograph of urine sediment of an 11 years old renal failure affected dog showing bilirubin crystals appearing “needle-like to granular” in shape and yellow in colour (40x).

Fig 17: Small, dark-brownish, smooth calculi (ammonium urates) received from urinary bladder and urethra of an 8 years old male Spitz dog suffering from renal failure.

Fig 18: Calcium oxalates stones (yellowish-brownish colour) of various sizes recovered from urinary bladder of a 3 years old male Spitz dog affected with renal disorder.
iii. Microbial culture of urine and antibiotic sensitivity test
Quantitative urine culture before initiation of antimicrobial therapy is considered to be the gold standard for diagnosis of bacterial urinary tract infections (UTIs). In addition to facilitating differentiation of harmless bacterial contaminants from bacterial pathogens, accurate identification of specific bacterial species aids in selection of antimicrobial drugs. It also facilitates differentiation of recurrent UTIs caused by relapses from recurrent UTIs caused by reinfections [38]. In the present investigation, various microorganisms were involved in the urinary tract of renal inefficiency dogs. Out of 100 dogs, 63 (63.00%) were having urinary tract infections and negative bacteriological cultures were obtained from 37 (37.00%) of the cases. The most prevalent bacteria isolated from urine specimens were *Escherichia coli* (38.10%, 24), followed by *Staphylococcus aureus* (20.63%, 13), *Proteus* spp. (17.46%, 11) and *Streptococcus* spp. (6.35%, 4). Smaller numbers of *Enterobacter* spp. (4.76%, 3), *Klebsiella* spp. (4.76%, 3), *Pseudomonas aeruginosa* (3.17%, 2), *Staphylococcus epidermidis* (3.17%, 2), and *Corynebacterium* spp. (1.59%, 1) were also isolated (Table 3 and Fig. 23-28). No anaerobic bacteria were isolated from the urine specimens [39, 40]. Bacterial urinary tract infections are reported in 2 to 3% of dogs and in <1% of cats [41, 42].

Out of the 63 strains examined, 54 (85.71%) were sensitive to amoxiclav, 48 (76.19%) to gentamicin, 45 (71.43%) to ofloxacin, 44 (69.84%) to enrofloxacin, 39 (61.90%) to ceftriaxone sulbactam, 34 (53.97%) to oxytetracycline, 28 (44.44%) to cefepime tazobactam, 14 (17.46%) to amoxicillin, 11 (17.46%) to cefuroxime, and 5 (7.94%) to penicillin G (Table 3) [43]. Presence of different types of microorganism (bacteria) in urine culture were indicative of urinary tract infection, referred to a bacterial invasion to any or all parts of the urinary tract, but most commonly the urinary bladder, called bacterial cystitis [44] was common finding in the present study.
Fig 25: Urine bacterial culture of a renal failure affected dog, showing yellow colonies of *Staphylococcus aureus* in mannitol salt agar.

Fig 26: Bacterial culture of a renal failure affected dog’s urine with small red to pink colonies of *Staphylococcus epidermidis* in mannitol salt agar.

Fig 27: Urine bacterial culture of a renal failure affected dog, showing “fish-eye” type colony of *Klebsiella* sp on EMB agar.

Fig 28: Antibiotic sensitivity pattern of urine culture in renal failure affected dogs (sensitive for Ofloxacin and Enrofloxacin).
### Table 3: FOD of common bacteria isolated in dogs (n=63) affected with renal failure and *in vitro* antimicrobial sensitivity patterns

<table>
<thead>
<tr>
<th>Bacterial isolates</th>
<th>FOD</th>
<th>AMC</th>
<th>AM</th>
<th>P</th>
<th>CIS</th>
<th>CPT</th>
<th>CU</th>
<th>EX</th>
<th>OF</th>
<th>G</th>
<th>OT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>S%</td>
<td>R%</td>
<td>S%</td>
<td>R%</td>
<td>S%</td>
<td>R%</td>
<td>S%</td>
<td>R%</td>
<td>S%</td>
<td>R%</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>13</td>
<td>(20.63%)</td>
<td>84.62</td>
<td>15.38</td>
<td>53.85</td>
<td>46.15</td>
<td>23.08</td>
<td>78.92</td>
<td>61.54</td>
<td>38.46</td>
<td>46.15</td>
</tr>
<tr>
<td><em>Staphylococcus epidermidis</em></td>
<td>2</td>
<td>(3.17%)</td>
<td>100</td>
<td>0</td>
<td>50</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td><em>Streptococcus spp.</em></td>
<td>4</td>
<td>(6.35%)</td>
<td>75</td>
<td>25</td>
<td>25</td>
<td>75</td>
<td>25</td>
<td>75</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>24</td>
<td>(38.10%)</td>
<td>91.67</td>
<td>8.33</td>
<td>12.50</td>
<td>87.50</td>
<td>0.00</td>
<td>100</td>
<td>75.00</td>
<td>25.00</td>
<td>37.50</td>
</tr>
<tr>
<td><em>Proteus spp.</em></td>
<td>11</td>
<td>(17.46%)</td>
<td>81.82</td>
<td>18.18</td>
<td>27.27</td>
<td>72.73</td>
<td>0.00</td>
<td>100</td>
<td>45.45</td>
<td>54.55</td>
<td>36.36</td>
</tr>
<tr>
<td><em>Klebsiella spp.</em></td>
<td>3</td>
<td>(4.76%)</td>
<td>66.67</td>
<td>33.33</td>
<td>0.00</td>
<td>100</td>
<td>0.00</td>
<td>100</td>
<td>66.67</td>
<td>33.33</td>
<td>66.67</td>
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<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>2</td>
<td>(3.17%)</td>
<td>50</td>
<td>50</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>50</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td><em>Enterobacter spp.</em></td>
<td>3</td>
<td>(4.76%)</td>
<td>66.67</td>
<td>33.33</td>
<td>0.00</td>
<td>100</td>
<td>0.00</td>
<td>100</td>
<td>66.67</td>
<td>33.33</td>
<td>66.67</td>
</tr>
<tr>
<td><em>Corynebacterium spp.</em></td>
<td>1</td>
<td>(1.59%)</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>63</td>
<td></td>
<td>85.71</td>
<td>14.29</td>
<td>17.46</td>
<td>83.54</td>
<td>7.94</td>
<td>92.06</td>
<td>61.90</td>
<td>38.10</td>
<td>44.44</td>
</tr>
</tbody>
</table>

Conclusion
Urinalysis is a safe, non-invasive method. Simple study of urine which requires only urination on the part of the subject, creates no discomfort, poses no health-related risks, has no direct side effects, and indicates no adverse reactions. Urinalysis is a simple but time-consuming procedure that normally requires significant amounts of labour. However, parameters obtained from urinalysis are still extensively used to guide empirical treatment of urinary tract infections. Urinalysis when performed properly is a highly reliable index of renal disease. This is especially true for minor changes in renal pathology which are not usually accompanied by abnormal blood biochemical values as well as imaging techniques, as in cases of early renal diseases. Thus, urinalysis including physical examination, microscopic examination, chemical examination and culture and sensitivity of freshly collected urine is the most effective tool for early diagnosis of renal impairment in canine. Besides, scanning electron microscopy (SEM) also helps to identify the types of urinary crystals or calculi evolved in urolithiasis in canine patients. Therefore, it was concluded that urinalysis is of great importance for early diagnosis of renal impairment and enables us to provide early treatment and thereby increases the recovery rate of renal patients.

Acknowledgement
Authors are highly thankful to Dean, College of Veterinary Sciences, GBPUSA&T, Pantnagar for providing research facilities to carry out this investigation. We are also thankful to Head Department of Veterinary Anatomy and Mr. M.P. Singh, Technician to facilitate us for Scanning Electron Microscopy (SEM).

References
Journal of Entomology and Zoology Studies


