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Differential diagnosis of acute versus chronic renal failure in canines with special reference to clinical manifestations

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General Note

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ABSTRACT

Out of 9149 dogs screened for renal diseases, 100 (1.09%) canine patients were showing syndrome of renal failure. Various renal disorders were observed but, gastrointestinal abnormalities were the commonest clinical outcome of renal disease in dogs, which included chronic vomiting (84% cases), halitosis (68% cases), oral lesions/ulceration (54% cases) and loss of appetite (89% cases). Clinical signs observed related to urine abnormalities were polyuria/polydipsia (52.38% in CRF and 20.69% in ARF), oliguria/anuria (79.31% in ARF, 47.62% in CRF and 100% in obstructive urolithiasis) and haematuria (55.17% in ARF, 28.57% in CRF). However, haematuria was recorded highest in case of urolithiasis (78.26%). Except in dogs with pre-renal renal failure, dysuria, stranguria andpyuria were noticed in most dogs affected particularly with urolithiasis. Poor hair coat, abnormal posture (hunched posture), pedal edema, dyspnea and other systemic signs were frequently observed in ARF and advanced stage CRF affected dogs. Less frequently, as cites (30.95%) were also observed in CRF dogs. Anaemia was common manifestation of both acute (77.59%) and chronic (88.10%) renal failure. Similarly, dehydration was noticed in dogs affected with acute (94.83%) and chronic (83.33%) renal failure. Fewer cases of dogs with renal failure (18.97% acute and 7.14% chronic) were also showing the signs of uremic neuropathy (nervous signs). There are several modern techniques, but ultrasonographic scanning of kidneys, urinalysis and biochemical estimation are the most common and easiest methods to detect renal failure in dogs. Moreover, in field conditions clinical manifestations of the disease are also very important feature to diagnose renal affected dogs. There are several renal specific syndromes that can easily be identified by the clinician and can be further confirmed by advanced diagnostic tools and can manage the renal patients accordingly.

Keywords: Canine, Clinical manifestation, Diagnosis, Incidence and Renal failure

1. INTRODUCTION

Like other species of animals, canines are also prone to suffer with many systemic diseases during their lifespan. The use of xenobiotic in modern agriculture and livestock farming has been found as a major factor, responsible for degenerative changes in cardiovascular system, liver and kidneys and later on encountering a syndrome which is called renal failure, that pave the cascade of multi organ failure and ultimately death. Among various canine diseases, renal failure is the most common and fatal condition in canine occurring in 2-5% of dogs (Lund *et al*., 1999) and is the third leading cause of death in dogs. The mean age of diagnosing renal disorder in dogs is about 6.5 years with 45% of cases.

Kidneys serve as the principal organ in maintenance of homeostasis, elimination of metabolic waste products of the body, regulation of extra-cellular fluid volume, blood pressure and systemic pH. In addition, kidneys play integral role in metabolic processes as well as regulation of erythrocyte mass under influence erythropoietin hormone (Cortan and Kumar, 1999).

Renal failure in dogs can be classified as acute renal failure (ARF) and chronic renal failure (CRF) depending upon the nature or onset of disease. Acute renal failure is "a clinical syndrome characterized by the sudden onset of hemodynamic, filtration and excretory failure of the kidneys with subsequent accumulation of metabolic (uremic) toxins and dysregulation of fluid, electrolyte and acid-balance" (Cowgill and Elliott, 2000). There are numerous causes of acute kidney injury (AKI) in dogs. These can be grouped into a few major categories including renal ischemia (e.g. hypotension), nephrotoxicity (e.g. ethylene glycol, gentamicin) and infectious (e.g. leptospirosis, pyelonephritis). As the causes of ARF are multiple and since subsequent treatment of ARF depends on a clear delineation of the cause, prompt diagnostic evaluation of individual case of ARF is necessary.

However, chronic renal failure is a slow irreversible deterioration of kidney function, occurs without clinical or biological signs over a long period (months to years) and the development of clinical signs that reflect the kidneys' decreasing ability to perform normal regulatory and excretory functions. Renal disease can develop at any age, but chronic renal disease more frequently is diagnosed in aged pets (Polzin *et al*., 1995) and is a common cause of death. There are many potential causes for the initial kidney damage, which leads to chronic disease. These causes include trauma, infection, immunological disease, neoplasms, renal ischemia (decreased blood flow to the kidneys), genetic anomalies and exposure to toxins. In most cases, the initial underlying cause of renal damage is no longer present when the pet develops chronic renal failure. This is due to the ability of the kidney to compensate for large proportions of functional tissue loss. However, over the time these compensatory mechanisms may break down, leading to progressive loss of kidney function and development of signs of chronic disease.

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Vigorous efforts are required to identify the underlying cause of any active renal disease, which may contribute towards progression to chronic renal failure and thus for therapeutics of treatable causes. 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. It is therefore, the initial diagnostic worked up performed in acute renal failure patients is aimed also to identify the underlying cause, so the latter can be eliminated, and further kidney injury can be minimized to become a chronic. Keeping in view all these facts, the present study was carried at Teaching Veterinary Clinical Complex, Pantnagar, in 100 cases of dogs affected with renal failure showing different clinical conditions.

2. MATERIALS AND METHODS

Out of 9149 dogs screened for renal diseases, 100 (1.09%) canine patients were showing syndrome of renal failure during the study period from January 2012 to December 2013 at the Teaching Veterinary Clinical Complex, College of Veterinary & Animal Sciences, G.B. Pant University of Agriculture & Technology, Pantnagar, U.S. Nagar, Uttarakhand, India. Dogs affected with renal failure were thoroughly examined for various clinical syndromes. Urine was collected for 24 hrs.using Foley'scatheter in bitch and infant feeding tube in male dogs for urinalysis. Texture and size of kidneys size were evaluated by USG scanning. Radiography of lower urinary tract was done for uroliths. Dehydration was detected by skin fold tenting test. Anaemia was detected both by examine visible mucous membranes and analyzing haemogramme. Urine specific gravity, hematuria and proteinuria were measured by dipstick urinalysis. Urinary BUN/creatinine ratio and Urine/plasma creatine ratio were estimated by using biochemical kits. Urine and plasma osmolality (mOsm/kg) was calculated using following formula.

$$\text{Osmolality}_{mOsm/kg} = (2 \times (Na_{mmol/L} + K_{mmol/L})) + (BUN_{mg/dl} / 2.8) + (glucose_{mg/dl} / 18)$$

3. RESULTS AND DISCUSSION

The common clinical ministrations observed in various renal disorders were depicted in Table 1 and Fig. 1-12. The gastrointestinal abnormalities were the commonest clinical outcome of renal disease in dogs, which included chronic vomiting (84% cases), halitosis (68% cases), oral lesions/ulceration (54% cases) and loss of appetite (89% cases). Clinical signs observed related to urine abnormalities were polyuria/polydipsia (52.38% in CRF and 20.69% in ARF), oliguria/anuria (79.31% in ARF, 47.62% in CRF and 100% in obstructive urolithiasis) and haematuria (55.17% in ARF, 28.57% in CRF). However, haematuria was recorded highest in case of urolithiasis (78.26%). Except in dogs with pre-renal renal failure, dysuria, stranguria andpyuria were noticed in most dogs affected particularly with urolithiasis. Poor hair coat, abnormal posture (hunched posture), pedal edema, dyspnea and other systemic signs were frequently observed in ARF and advanced stage CRF affected dogs. Less frequently, ascites (30.95%) were also observed in CRF dogs. Anaemia was common manifestation of both acute (77.59%) and chronic (88.10%) renal failure. Similarly, dehydration was noticed in dogs affected with acute (94.83%) and chronic (83.33%) renal failure. Fewer cases of dogs with renal failure (18.97% acute and 7.14% chronic) were also showing the signs of uremic neuropathy (nervous signs).

Table 1 Frequency distributions of clinical syndrome associated with uraemia in dogs suffering with various conditions (N=100)

Clinical signs	ARF (n=58)	CRF (n=42)	Urolithiasis (n=23)	Pyometra (n=10)	Leptospirosis (n=20)	Idiopathic (n=48)
Dull, depress and lethargy	55 (94.83%)	35 (83.33%)	20 (86.96%)	9 (90.00%)	20 (100.00%)	40 (83.33%)
Poor hair coat	36 (62.07%)	23 (54.76%)	10 (43.48%)	4 (40.00%)	15 (75.00%)	30 (62.50%)
Pale/ anaemic mucosa	45 (77.59%)	37 (88.10%)	12 (52.17%)	7 (70.00%)	18 (90.00%)	45 (93.75%)
Weight loss/ emaciation	15 (25.86%)	35 (83.33%)	8 (34.78%)	4 (40.00%)	2 (10.00%)	36 (75.00%)
Dehydration	45 (77.59%)	35 (83.33%)	16 (69.57%)	8 (80.00%)	20 (100.00%)	36 (75.00%)

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Hunched posture/ reluctant to move	45 (77.59%)	5 (11.90%)	11 (47.83%)	3 (30.00%)	12 (60.00%)	24 (50.00%)
Pedal oedema	15 (25.86%)	5 (11.90%)	2 (8.70%)	-	3 (15.00%)	15 (31.25%)
Ascites	-	13 (30.95%)	-	-	-	13 (27.08%)
Inappetence/ Anorexia	58 (100.00%)	31 (73.81%)	23 (100.00%)	10 (100.00%)	20 (100.00%)	36 (75.00%)
Vomiting	50 (86.21%)	34 (80.95%)	20 (86.96%)	8 (80.00%)	16 (80.00%)	40 (83.33%)
Halitosis	42 (72.41%)	26 (61.90%)	5 (21.74%)	3 (30.00%)	15 ((75.00%)	45 (93.75%)
Stomatitis/oral ulceration/ Gingivitis	32 (55.17%)	22 (52.38%)	4 (17.39%)	2 (20.00%)	6 (30.00%)	42 (87.50%)
Dyspnoea	48 (82.76%)	24 (57.14%)	15 (65.22%)	8 (80.00%)	18 (90.00%)	31 (64.58%)
Uremic neuropathy	11 (18.97%)	3 (7.14%)	-	-	-	14 (29.17%)
Polydipsia	12 (20.69%)	22 (52.38%)	-	2 (20.00%)	4 (20.00%)	28 (58.33%)
Polyuria	12 (20.69%)	22 (52.38%)	-	2 (20.00%)	4 (20.00%)	28 (58.33%)
Oliguria/anuria	46 (79.31%)	20 (47.62%)	23 (100.00%)	-	-	43 (89.58%)
Pollakuria	32 (55.17%)	12 (28.57%)	18 (78.26%)	2 (20.00%)	12 (60.00%)	12 (25.00%)
Haematuria	55 (94.83%)	35 (83.33%)	20 (86.96%)	9 (90.00%)	20 (100.00%)	40 (83.33%)

ARF: Acute renal failure CRF: Chronic renal failure

Table 2 Differentiation between acute verses chronic renal failure in dogs

Parameters	**Acute renal failure (n=58)**	**Chronic renal failure (n=42)**
Body conditions	Good	Poor
Clinical signs	Acute onset, severely ill, vomiting, anorexic, lethargic/depressed, dehydrated	Chronic, gradually progressive signs, weight loss, decreased appetite, chronic vomiting, often not very ill for degree of azotemia
PU/PD	May be poly-, an-, or oliguric	+++ (an-, or oliguric in advance/end stages)
Kidney size	Often enlarged/ painful	Small, irregular
Azotemia	+	+
Proteinuria	Usually normal, may be high depending on cause	Normal to high
Anaemia	Not usually unless gastrointestinal ulceration and haemorrhage	Usually depending on severity of renal disease
USG	Usually high, may be low	Usually low

PU; Polyuria PD: Polydipsia USG: Urine specific gravity

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Table 3 Differentiation of pre-renal, intrinsic and post-renal failure in dogs

Parameters	Pre-renal renal failure	Intrinsic renal failure	Post-renal renal failure
Urine output	Oliguria (100%)	18% anuria*, 43% oliguria**, 25% have normal† urine output and 14% polyuria‡	Anuria/dribbling (100%)
Kidney	Normal-sized and nonpainful	Normal or enlarged and painful	Normal or enlarged
Lower urinary tract	Normal	-	Presence of urolith
Uremic signs	Less prominent	More prominent than pre-renal	Very high
Dehydration	Often present	Present due to vomition, diarrhoea, lack of food and water intake and polyuria in some patients	Normal to dehydrated
Urine specific gravity	USG ≥1.030	USG < 1.020	-
BUN/creatinine ratio	>20	<15	Variable
Urine/plasma creatine ratio	>40	<20	Variable
Urine osmolality (mOsm/kg)	>500	<400	-
Urine/plasma osmolality	>1.5	<1.1	-

*Anuria: no urine output, **Oliguria: urine output 0.1-1 ml/kg/hr, †Normal: urine output 1-2 ml/kg/hr, ‡Polyuria: urine output >2 ml/kg/hr

Figure 1 A 12 years old acute renal failure affected male dog showing signs of emaciation and hunched back posture (severe back pain).

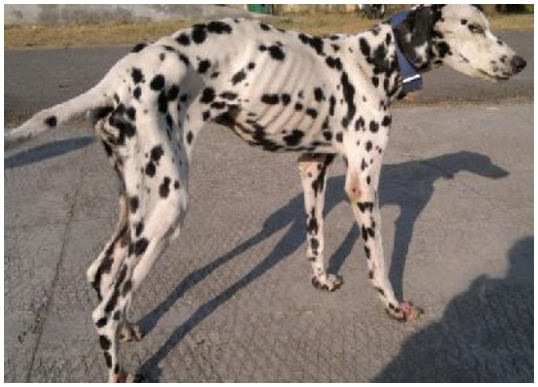

Figure 2 An 8 years old male Dalmatian dog affected with ARF (urolithiasis) and showing hunched back posture due to severe pain.

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Figure 3 An 8 years old male Spitz affected with ARF (urolithiasis) showing bitch like urination posture.

Figure 4 A 10 years old male Boxer showing praying posture due to concurrent severe gastritis in renal impairment.

Figure 5 Fluids and electrolytes therapy in a 13 years old Great Danemale dog affected with severe dehydration and cachexia due to chronic renal failure.

Figure 6 A 5.5 years old Labrador dog affected with acute renal failure and showing signs ofascites, dullness and depression.

Figure 7 A 9 years old mongrel dog suffering with renal impairment and showing sign of haematemesis due to haemorrhagic gastritis.

Figure 8 A 6.5 years old Labrador bitch affected with acute renal failure and passing black coloured pasty stool due to haemorrhagic gastroenteritis.

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Figure 9 Oral ulcer in a 7 years old Dalmatian male dog affected with renal disorder.

Figure 10 An11 years old renal failure affected Spitz male dog showing typical lesion of infectious gingivitis and dental tartar.

Figure 11 A 7 years old male Dalmatian dog affected with renal disorder showing decaying of teeth and dental tartar.

Figure 12 An 8 years old male Spitz passing fresh blood in the urine due to urolithiasis.

The signs observed in dogs affected with renal failure were in accordance with the observations of Kingma *et al.* (2006); Rusenov *et al.* (2009) and Kavitha *et al.* (2013). Decreased appetite, vomiting, lethargy, and weight loss associated with renal failure in dogs due to azotemia/uremia (Polzin, 2010). Gastrointestinal complications (inappetence, anorexia, vomiting, diarrhoea, weight loss) were very common and they are usually the first signs observed by the owners. Anorexia may be due to gastrointestinal disorder as reported by Mary (1992) and Krawiec (1996). Robinson *et al.* (1989) also reported anorexia in 80% of the cases. Uremic breath (halitosis) observed in uremic dogs reported by Cowgill and Francy (2005) due to bacterial degradation of urea to ammonia (Nascimento *et al.*, 2009). Chronic vomiting is the most common gastrointestinal signs observed in renal patients due to uremic gastritis (Peters *et al.*, 2005). The present finding is similar to the observations of Robinson *et al.* (1989), who reported vomiting in 67% cases of renal failure in dogs. Mary (1992) has reported the similar findings in clinical cases of renal failure. Reasons for vomiting in renal failure cases may be the direct effects of uremic toxins on D_2-dopaminergic receptors in the chemoreceptor trigger zone (Washabau and Elie, 1995).

Uremic stomatitis is the manifestation of uremic syndrome and comprises of stomatitis of oral cavity, ulceration in some cases and necrosis of the margins of the tongue. Robinson *et al.* (1989) have also reported oral ulceration in some cases of renal failure in

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dogs. Many factors may contribute to uremic gastropathy like, uremic alterations in mucus layer causing back diffusion of hydrochloric acid, gastrointestinal bleeding, platelet dysfunction and erosions or ulcers due to ammonia production from urea by bacteria in the gastrointestinal tract, excess gastrin stimulates acid secretion in the stomach (Goldstein *et al.*, 1998 and Chew *et al.*, 2011). Tarry coloured stool (melena)may be due to gastrointestinal ulcerations that leads to haemorrhages in renal failure cases (Mary, 1992 and Craig, 2003).

Robinson *et al.* (1989) reported progressive weight loss in 30% renal patients also due to anorexia, oral ulceration, gastritis and entities. Weight loss in renal patient particularly in CRF may be due to lack of adequate caloric intake or catabolic processes that are activated even when adequate calories are consumed. Moreover, excess glucagon may contribute to negative nitrogen balance and increased tissue catabolism and metabolic acidosis can activate protein catabolic pathways in muscle (Chew *et al.*, 2011). Lethargy, weakness and neurologic signs may be due to centrally mediated mental dullness in uremic patients, loss of lean muscle mass and uremic encephalopathy. Hypocalcaemia in dogs with renal failure causes increased excitability in neuromuscular system. Weakness in dogs may be associated with renal secondary hypothyroidism, which causes peripheral neuropathy and myopathy (Raylander, 2010).

Neurological signs (uremic seizures) could be due to high levels of uremic toxins, leading to uremic encephalopathy (Vanholder*et al.*, 2003). Uremic encephalopathy may occurs when GFR decreases to less than 10% of normal and it is more readily recognized when the onset of uremia is rapid (as in ARF) but it also can be severe in CRF when calcium influx in the brain mediated by high PTH.

Profound depression in the dogs affected with renal failure was similar to the finding of Robinson *et al.* (1989), who observed letharginess in 53% cases of renal failure. Dehydration was another important clinical manifestation observed in dogs affected with renal failure could be due to chronic vomiting, diarrhea, less water intake and excessive urination (Johnson, 1992 and Chew *et al.*, 2011). Robinson *et al.* (1989) reported dehydration in 40% of renal failure dogs. Extent of dehydration may be overestimated based on skin turgor when evaluating cachexic animals (Chew *et al.*, 2011).According to Kralova*et al.* (2009) the most common clinical signs in CRF dog were polyuria and polydipsia due to the loss of urine concentrating ability. Other possible causes for polydipsia are vomiting, diarrhoea and chronic interstitial nephritis. Haller (2002) reported that polyuria and polydipsia is the first clinical sign of renal disease in dogs as observed in 67% cases by Robinson *et al.* (1989).

Most animals with urinary tract infection present with clinical signs of lower urinary tract distress (i.e. symptomatic bacteriuria) are haematuria, pollakiuria, stranguria or dysuria, urination in inappropriate locations, incontinence, decreased volume of urine voided also may occur in animals with partial obstruction of the urethra (e.g. granulomatous urethritis). Oliguria was one of the most striking clinical finding observed in end stage renal disease might be due to decreased renal blood flow, which accompanied by decreased GFR and subsequently decreased urine output (Guyton and Hall, 2006). Clement *et al.* (1993) also reported similar findings in uremic patients. Moreover, animals with urinary tract infection may have no clinical signs (i.e. asymptomatic bacteriuria) in 80% of dogs, as many as 10% of hospitalized dogs with a variety of illnesses have urinary tract infection without clinical signs (Chew *et al.*, 2011).

Anaemia and pallor of mucous membrane was in accordance with the observations of Osborne *et al.* (1972), might be due to depressed REF (Renal Erythropoietin Factor) production from impaired kidneys, blood loss in the form of hematemesis or melena, and decreased RBC survival time as an upshot of uremic intoxication. Hematemesis in renal patients was accordance to Krawiec (1996), possibly due to gastric ulceration, which is associated with hypergastrinemia due to increased secretion or reduced renal clearance of gastrin hyper secretion of gastric acid and direct damage to the gastric mucosa, sub-mucosa and vasculature by uremic toxins contribute further to the gastritis. Acute and chronic renal failure cause gastric mucosal damage (Cheville, 1979). Uremic toxins cause direct injury to gastric epithelial cells, mucosal vessels and decreased renal metabolism of gastrin causes excess acid secretion. Icterus, fever, abdominal pain, muscle pain and stiffness, uveitis, dyspnoea and coagulopathies occur as well but with less frequency (Harkin, 2009).

4. CONCLUSION

Early diagnosis of renal failure can be done easily by several modern techniques, but ultrasonographic scanning of kidneys, urinalysis and biochemical estimation are the most common. Clinical manifestations of the disease are also very important feature to diagnose renal affected dogs. There are several renal specific syndromes that can easily be identified by the clinician and can be further confirmed by advanced diagnostic tools and can manage the renal patients accordingly.

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