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Renal disorders and haematobiochemical parameters pertaining to therewith in geriatric dogs

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Abstract
Chronic renal failure (CRF) is a commonly encountered problem in small animal practice and typically progressive, resulting in significant morbidity and mortality in companion animals (McGrotty, 2008). Despite the irreversible nature of disease, proper treatment can alleviate clinical signs and slow the progression (May, 2006). Cystitis and urolithiasis are also common problems encountered in case of geriatric dogs. In the present study, a total of 176 geriatric dogs (>7 years) were considered for evaluation of disorders of various body systems and 8 dogs were suffering from renal disorders with a prevalence of 4.55%. The study was conducted at Department of Veterinary Medicine, C.V.Sc and A. H, Durg, Chhattisgarh from January 2020 to July 2020. Out of 176 affected geriatric dogs 8 suffered from urinary disorders. Blood and urine samples were collected and subjected to analysis. Haematobiochemical analysis was carried out to assess the severity of condition and thus, make therapeutic intervention. Specific gravity, pH, Protein levels were the parameters considered under urinalysis. Out of 8 geriatric dogs suffering from urinary disorders, 6 dogs suffered from chronic renal failure and one each case of urolithiasis and cystitis. The overall prevalence of urinary tract affections in geriatric dogs was 4.55% (08/176) with a prevalence of 75% (06/08) in male dogs and 25% (02/08) in female dogs respectively. The most common presenting signs were partial or complete cessation of urination, vomiting, inappetance, weight loss, diarrhoea, melena, polydipsia, polyuria, uraemic breath, oral ulcers, lethargy etc. Early cases of renal dysfunction are often difficult to detect and animals with clinically apparent renal dysfunction tend to have advanced kidney disease by the time clinical or biochemical changes are noted. Hence, early diagnosis of condition is of paramount importance in alleviating the progression of disease.

Keywords: Geriatric, renal dysfunction, haematobiochemical, CRF

Introduction
Renal failure has been reported as the second most causative reason of non-accidental death in case of canines (Krawiec, 1989) [15]. The average age of onset of renal failure in dogs is reported to be 6.95 years (Cowgill and Spangler, 1981) [5]. The presentation of disease in young animals and geriatric animals varies greatly. Signs of disease are often more insidious, non-specific and atypical in geriatric animals (Samiy, 1983) [29].

As the animal approaches senility, the size and weight of kidney decreases, glomerular numbers decrease and there is decrease in tubular size. Further, there is increased magnesium and fibrosis. Over a period of time there is decreased renal function due to many reasons one of which is regular consumption of high protein diet. The structural abnormalities in renal anatomy lead to proteinuria (Samiy, 1983) [30]. The average age at which the dogs were affected with urolithiasis was 7 years and above (Hesse, 1990) [9]. The mean age of dogs affected with cystitis was 9.5 years. This reflects a higher prevalence of the disease in middle-to old-aged dogs, similar to humans (Lippi, 2019) [19].

Plasma creatinine and urea levels are typically used as biochemical markers of kidney disease. Creatinine is eliminated from the body almost exclusively by glomerular filtration. So, a decrease in GFR leads to accumulation of creatinine. CRF is commonly associated with progressive non-regenerative anaemia due to shortened red blood cell life span, erythropoietin deficiency and intestinal blood loss (Mcgrotty, 2008) [23]. Male dogs are more affected than female dogs aged more than 8 years and this might be due to loss of nephrons with advancement of age (Katoch, 2017) [12].

Dogs with progressive renal failure will register hematobiochemical alterations of different intensities depending on severity of disease. In the present study, the objective was to analyse the hematobiochemical parameters of geriatric dogs affected with renal disorders and compare against the control group i.e. apparently healthy geriatric dogs.

Materials and Methods

Blood and urine samples were collected from 08 geriatric dogs suffering from urinary disorders presented at Out Patient Department, Small Animal Clinic, TVCC, CVSc and AH, DSVCKV, Durg along with Government Veterinary Hospital, Supela, Bhilai and private pet clinics in and around Durg. The study was conducted at the Department of Veterinary Medicine, College of Veterinary Science and Animal Husbandry, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh from January, 2020 to July, 2020.

After proper restraining of animals, approximately 5 ml of blood was collected aseptically at weekly interval for haemato-biochemical analysis from the cephalic vein or the recurrent tarsal vein. About 1 ml of blood was transferred immediately into EDTA vacutainer and thoroughly mixed for 15-20 seconds. The remaining blood sample was transferred into clot activator vacutainer. After 30 minutes, the blood samples were centrifuged at 3000 rpm for 15 minutes and serum was harvested. Serum samples were stored at -20 °C for estimation of biochemical parameters.

Whole blood (EDTA mixed) was used for haematological examination by following standard methods for estimation of haemoglobin (Hb, g/dL), packed cell volume (PCV, %), Total erythrocyte count (TEC, $\times 10^6/\mu L$), Total leucocyte count (TLC, $\times 10^3/\mu L$), Differential leucocyte count (DLC, %) and Platelet count ($\times 10^3/\mu L$) using semi-automatic blood analyzer.

The serum samples were used for estimation of following biochemical parameters- Serum glutamic oxaloacetic transaminase/ Aspartate amino transferase SGOT/AST (U/L), Serum glutamic pyruvic transaminase/ Alanine amino transferase SGPT/ALT (U/L), Alkaline phosphatase ALP (U/L), Total bilirubin (mg/dL), Total protein (g/dL), Albumin (g/dL), Globulin (g/dL), A: G ratio, Gamma glutamyltransferase (GGT), Creatinine (mg/dL) and Blood urea nitrogen (BUN) (mg/dL), Glucose (mg/dL), Cholesterol (mg/dL) and Triglycerides (mg/dL). Analysis of all biochemical parameters was carried out by using semi-automatic biochemical analyzer and commercially available biochemical kits.

The urine samples of healthy adult, healthy geriatric and dogs suffering from renal failure and lower urinary tract problems were subjected to analysis. Urine of affected geriatric dogs was collected aseptically in sterile plastic vials by catheterization or cystocentesis. The dipstick method was used to detect specific gravity, presence of protein and pH by strip paper.

Results and Discussion

The haematobiochemical analysis of blood and urinalysis was done for apparently healthy geriatric dogs and geriatric dogs suffering from renal dysfunction.

Table 1: Hematobiochemical parameters of geriatric dogs suffering from urinary system disorders

Sl. No.	Parameters	Apparently healthy geriatric dogs (n=6)	Geriatric dogs suffering from urinary system disorders (n=8)
1.	Haemoglobin (g/dL)	14.41±0.40	9.15±1.23*
2.	PCV (%)	43.62±2.60	29.67±2.13*
3.	TEC ($x10^6/\mu L$)	5.30±0.26	3.47±0.74*
4.	TLC ($x10^3/\mu L$)	7.57±0.54	16.32±4.12*
5.	Neutrophils (%)	69.57±2.34	82.33±2.76*
6.	Lymphocytes (%)	20.19±1.18	11.00±2.08*
7.	Monocyte (%)	2.94±0.19	3.25±0.78
8.	Eosinophils (%)	5.13±0.58	4.66±0.32
9.	Basophils (%)	0.00±0.00	0.00±0.00
10.	Platelet count ($x10^3/\mu L$)	368.83±36.24	305.54±65.17
11.	AST (U/L)	41.55±3.88	65.34±10.92*
12.	ALT (U/L)	42.67±3.55	82.13±17.43*
13.	Total protein (g/dL)	8.24±0.25	4.85±0.58*
14.	Albumin (g/dL)	2.98±0.62	1.27±0.17*
15.	Globulin (g/dL)	5.55±0.36	3.58±0.30*
16.	A:G ratio	0.53±0.09	0.35±0.03*
17.	ALP (U/L)	127.24±32.23	234.13±57.19*
18.	Total bilirubin (mg/dL)	0.13±0.02	0.15±0.04
19.	Glucose (mg/dL)	85.00±0.75	69.13±9.56*
20.	GGT (U/L)	1.04±0.19	3.22±0.89*
21.	BUN (mg/dL)	18.35±2.25	96.45±15.72*
22.	Creatinine (mg/dL)	1.33±0.07	3.05±0.42*
23.	Cholesterol (mg/dL)	242.39±44.34	351.34±45.22*
24.	Triglycerides (mg/dL)	69.44±2.62	260.29±13.02*

*Significant difference within row at $p<0.05$.

Urinary system disorders were observed in a total of 08 geriatric dogs and the overall prevalence of urinary tract affections in geriatric dogs was 4.55% (08/176) with a prevalence of 75% (06/08) in male dogs and 25% (02/08) in female dogs respectively. Jain (2013) has also reported incidence of urinary disorders in dogs to be 4.80%. In the same study, a higher prevalence of urinary system disorders in male dogs (66.66%) was also reported. During the study period, 6 geriatric dogs (75.00%) were suffering from chronic renal failure while cystitis and urolithiasis was recorded in 1 case each (12.5% each). The prevalence of urinary system disorders was 50% each in 7 to 9 and 9 to 11 years age group in our study. Kumar (2017) [16] has also reported incidence of urinary system disorders in dogs of age ranging from 8 to 12 years with 100% prevalence in male dogs only. Similarly, Amar (2014) [1] reported maximum incidence of urinary system disorders in age group of 10 to 13 years. The clinical signs of geriatric dogs with urinary system affections were

partial or complete cessation of urination, vomiting, inappetance, weight loss, diarrhoea, melena, polydipsia, polyuria, uraemic breath, oral ulcers, lethargy etc. Higher risk of renal failure in older dogs could be attributed to loss of nephron with the advancement of age (Katoch *et al*., 2017) [12]. The higher prevalence of renal failure in male dogs as observed in our study could be due to more risk associated with urolithiasis in male than female due to several anatomical characteristics (Bjorling, 2003) [2]. Another probable reason for the increased prevalence of renal failure in male dogs in our study could be due to more number of male dogs presented for the treatment in our study. However, Kandula and Karlapudi (2014) [11] observed higher prevalence of renal failure in female dogs (63.16%) while only 36.84% of males were affected. Similarly, Tilley and Smith (2007) [35] did not find any significant relation of sex with occurrence of renal failures in dogs. Clinical signs of oliguria/anuria (urolithiasis), vomiting, reduced appetite, diarrhoea, melena, polydipsia, polyuria, uraemic breath, ulcers in mouth etc. have also been reported by Eriksen and Grondalen (1984) [6]; Robinson *et al*. (1989) [28]; Hoppe *et al*. (1990) [10] and Shaw and Ihle (1997) [31].

A significant (p<0.05) decrease in Hb, PCV and TEC values was recorded in our study in dogs affected with urinary system disorders. Similar findings of reduced Hb, PCV and TEC values have also been documented by Bradea *et al*. (2013) [3], Kavitha *et al*. (2013) [13], Amar (2014) [1] and Kumar (2017) [16]. Anaemia in chronic renal diseases is thought to be produced due to decreased erythropoietin secretion from peritubular interstitial cells of inner renal cortex and outer medulla in the kidney (Erslev and Besarab, 1997; Codreanu, 2008) [7, 4]. It has been assumed that as the renal diseases progress, there is gradual decrease in erythropoietin-producing cells within kidney (Lulich *et al*., 1992) [20]. However, the values of TLC and neutrophils were significantly (p<0.05) increased in geriatric dogs having urinary system disorders (King *et al*., 1992; Kumar *et al*., 2011 and Srivastava *et al*., 2011) [14, 17, 33]. A significant (p<0.05) decrease in lymphocyte value (11.00±2.08 v/s 20.19±1.18) in dogs affected with urinary system disorders are in agreement with the findings of earlier workers (Polzin *et al*. 2005; Kumar *et al*., 2011 and Bradea *et al*., 2013) [25, 3, 17]. Chronic renal failure was generally associated with neutrophilic leucocytosis along with lymphopenia which reflects the effect of endogeneous glucocorticoids or stress of chronic disease (Robertson and Seguin, 2006) [27]. The other hematological parameters in dogs suffering from urinary system affections revealed non- significant (p>0.05) changes in monocytes, eosinophils, basophils and platelet count.

The biochemical parameters revealed significant (p<0.05) increase in values of ALT, AST, ALP, GGT, BUN, creatinine, cholesterol and triglycerides during the present study go in conformity with findings of (Kavitha *et al*., 2013; Puri *et al*., 2015 and Sumit *et al*., 2018) [13, 26, 34] reporting higher values in dogs with hepatic insufficiency arising due to uraemia in dogs affected with renal disorders. Significant increase in values of BUN and creatinine in dogs affected with urinary system disorders have also been documented earlier by Srinivasan *et al*. (1993) [32]; Polzin (2010) [24]; Srivastava *et al*. (2011) [33] and Girishkumar *et al*. (2011) [8]. Azotemia observed in our study could be attributed to reduced glomerular filtration rate and retention of non-protein nitrogeneous substances in geriatric dogs with renal disease (Srivastava *et al*., 2011 and Girishkumar *et al*., 2011) [33, 8]. Significant increase in triglycerides and cholesterol values obtained in our study has also been reported to arise due to high osmolality of serum in dogs affected with renal disorders (Kavitha *et al*., 2013) [13].

However, the values of total protein, albumin, globulin and A: G ratio were significantly (p<0.05) decreased in dogs affected with urinary system affections. The findings of our study are in concordance with those stated by Markwell *et al*. (1996) [21] and Shaw and Ihle (1997) [31]. Uraemia has also been reported to arise due to catabolic breakdown of dietary protein metabolism (Krawiec, 1989) [15]. Hypoproteinemia in geriatric dogs affected with urinary disorders are attributed to reduced renal function and loss of protein in urine (Laurence *et al*., 1999) [18]. However, non-significant (p>0.05) changes were observed in values of total bilirubin and glucose in both groups.

Table 2: Urine parameters of apparently healthy geriatric and dogs affected with renal disorders

Sl. No.	Parameters	Apparently healthy geriatric dogs (n=6)	Dogs affected with renal disorders (n=8)
1	Specific gravity	1.015±0.002	1.008±0.001
2	pH	6.40±0.15	5.98±0.09
3	Protein	0.24±0.19	1.03±0.17

There is decrease in urine specific gravity in dogs suffering from renal dysfunction as the urine concentrating ability is decreased. The ongoing renal injury and parenchymal damage will decrease the ability of kidneys to excrete acid resulting in metabolic acidosis further leading to hypokalemia (McGrotty, 2008) [23]. The damage to glomerular vascular endothelium will result in protein leakage into the glomerular space and proteinuria. Hence, there is markedly increased protein in urine of dogs affected with renal disorders. This should be addressed at the earliest because protein in the glomerular space is irritating and will cause inflammation and sclerosis.

Fig 1: Urolithiasis in a female dog (lateral radiograph)

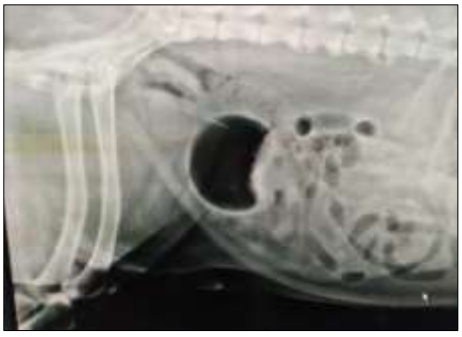

Fig 2: Cystitis in a male dog (Negative contrast radiograph)

Fig 3: Uremic ulcer in a Labrador suffering from chronic renal failure

Conclusion

Disorders pertaining to the renal system are inevitable in senile dogs. Conservative medical management depending on the severity of condition is necessary not only to slow the progression of disease but also alleviate the ongoing symptoms due to alterations in hematobiochemical parameters. The Hb, BUN, creatinine and GGT levels unambiguously reflect the extent of renal involvement and also help in prognosis of the case. Cases are difficult to detect in initial stages as uremia is evident only once the disease progresses to worser condition. Hence, when the case is presented one should ask about milder symptoms like polyuria and polydipsia even if client does not complain about it.

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