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Haemato-biochemical Alterations in Obstructive and Non-obstructive Renal Diseases

P. Gupta, H.R. Bhardwaj, A.K. Gupta, R.B. Kushwaha, A. Sharma, D.K. Dwivedi, A. Kumar 10.18805/IJAR.B-4729

ABSTRACT

Background: Diseases involving urinary system are very common in dogs causing significant morbidity and mortality in dogs. Renal failure and urinary obstruction are frequently encountered in clinical cases. Early diagnosis and treatment increase the survival rate and decreases the chances of complications related to renal failure. The present study was conducted to evaluate haemato-biochemical alterations in dogs having urinary system dysfunction.

Methods: The study was conducted on 38 dogs to observe the haemato-biochemical parameter changes in dogs suffering from obstructive and non-obstructive renal system affections as compared to healthy dogs. Various haemato-biochemical parameters *viz*. Hb, PCV, TEC, TLC, DLC, BUN, creatinine, ALT, AST, ALP, TP, albumin and A:G ratio were evaluated. Qualitative analysis of urine was done using Multistix dip stick method.

Result: In the present study the values of various haemato-biochemical parameters showed different pattern in both obstructive and non-obstructive renal diseases. Significant haematobiochemical changes reported in renal failure dogs were anemia, azotemia, increased alkaline phosphatase and AST values and decreased A:G ratio and in dogs with urinary obstruction the significant changes were uremia and leukocytosis. The results of the study suggested that the evaluation of various haemato-biochemical parameters help in diagnosis and predicting the prognosis of a renal disease.

Key words: Dog, Haemato-biochemical, Proteinuria, Renal failure, Urinary obstruction.

INTRODUCTION

Urinary system disorders in dogs are very common and are presented as the most important clinical problem. The initial signs usually go un-noticed until and unless there is enough damage to the nephrons leading to systemic manifestation of disease or there is complete obstruction or marked change in the urination behavior of the patient. Such late presentation requires quicker diagnosis (Sarma and Kalita, 2019). A haemato-biochemical evaluation stands first in diagnostic plan and in any disease condition points towards the systemic disturbances. Changes which occur in the physical and chemical constituents of blood provide a better understanding of the disease processes and are helpful in differential diagnosis, therapy and prognostication (Kaneko *et al.,* 2008). Earlier studies suggested that haemato-biochemical alterations can be used for diagnosis of renal insufficiency (Kandula and Karlapudi, 2015; Sumit, 2018; Devipriya *et al*., 2018). The most common kidney disease in dogs is chronic kidney disease (CKD), with prevalence varying from 0.05 to 3.74% (Sumit *et al.,* 2018). Chronic kidney disease (CKD) is defined as the presence of structural or functional abnormalities of one or both the kidneys that have been present for an extended period, usually three months or longer (Polzin, 2011) or azotemia of renal origin that has been present for more than two weeks (Barber, 2003). Predisposing factors contributing for renal diseases are age, breed, body size and obesity (Devipriya *et al.,* 2018). Polzin (2007) reported that though renal insufficiency cannot be cured completely, early diagnosis can help in symptomatic and supportive therapy to reduce consequences of renal dysfunction. Another common affection of urinary system in dogs is urolithiasis. Urolithiasis can be defined as the formation of sediment anywhere within the urinary tract which consists of one or more poorly soluble urine crystalloids (Tion *et al.,* 2015). Osborne *et al.* (1999) reported that 3% of dogs seen at veterinary hospitals are affected by urolithiasis. Cystolithiasis occurs in 0.4-2% of the canine population (Morgan, 1997) and smaller dog breeds are more prone than larger breeds (Lulich *et al*., 2000). The patients biochemical profile and complete blood count may be normal, however, in some cases abnormalities may suggest certain urolith type, such as association of hypercalcemia with calcium oxalate or calcium phosphate uroliths. Urine analysis is an important part of diagnostic evaluation for all urinary disorders and is of great importance since it enables us to provide early treatment and

Division of Veterinary Surgery and Radiology, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University Agricultural Sciences and Technology of Jammu, R.S. Pura-181 102, Jammu and Kashmir, India.

Corresponding Author: P. Gupta, Division of Veterinary Surgery and Radiology, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University Agricultural Sciences and Technology of Jammu, R.S. Pura-181 102, Jammu and Kashmir, India. Email: drpankaj.skuast@gmail.com

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thereby enhance chances of recovery. Urine analysis when performed properly is a highly reliable index of renal disease (Parrah *et al*., 2013).

MATERIALS AND METHODS

The study included 38 dogs divided into three groups *viz.* Group I, II and III. Group I (control group) included six healthy dogs brought for routine checkup or vaccination, Group II included 14 dogs presented with signs of renal failure and Group III comprised of 18 dogs with signs of urinary obstruction. In all dogs, 5 ml of venous blood was collected aseptically of which 1 ml was used for haematological analysis and 4 ml was centrifuged at 3000rpm for five minutes for serum separation. Haematological parameters *viz*. haemoglobin (Hb), packed cell volume (PCV), total leucocyte count (TLC), total erythrocyte count (TEC) were determined using Mythic 18 vet, haematology analyzer. Differential leukocyte count (DLC) was done by standard slide method using Leishman's stain. Clotting time (CT) and bleeding time (BT) were determined by capillary tube method and toe nail bleeding method, respectively. The biochemical parameters *viz.* blood urea nitrogen (BUN), creatinine, alanine amino-transferase (ALT), aspartate amino-transferase (AST), alkaline Phosphatase (ALP), total protein (TP), albumin and total bilirubin were estimated using ERBA kits (Bayer Diagnostic Ltd., Baroda, India) on a chemistry analyzer (Chemistry analyser, RT 1904C KAYTO, Japan) and albumin globulin ratio (A:G) was obtained by manual calculations.In all the dogs, qualitative analysis of urine was done using Siemens Multistix® dip sticks after collecting urine aseptically either by catheterization or by cystocentesis.

RESULTS AND DISCUSSION

Haemato-biochemical parameters

Haematological and biochemical parameters of Group I, II and III are given in Table 1 and Table 2, respectively. The haemato-biochemical parameters of Group I were within normal physiological limits which indicated their healthy status. The values were similar to those reported by Kaneko *et al.* (2008), Morgan (2008) and Porter and Kaplan (2011).

The mean of Hb, PCV and TEC values were lowest in Group II (9.09±0.79 g/dl, 28.17±2.44% and 4.25 ±0.24 x10^6/µL) followed by Group III (11.66 ± 0.28 g/dl, 35.49 ±0.99% and 4.85±0.14x10^6/µL) and Group I (12.55±0.38 g/dl, 40.00±1.19% and 5.06 ±0.10x10^6/µL), respectively. The decrease in Hb, PCV and TEC values could be due to various pathogenesis involved such as hemolysis of RBCs due to uremia, decreased survival period of RBCs (Ly *et al.,* 2004), loss of blood in GIT as melena and haematemesis, loss from urinary tract in haematuria due to poor platelet production and due to deficiency of erythropoietin production by diseased kidneys leading to bone marrow suppression (Silverberg *et al.,* 2002). Similar findings of lower Hb, PCV and TEC were reported by Pradhan and Roy (2012); Sharma *et al.* (2015) and Sumit *et al.* (2018). The mean of TLC and neutrophilic count was significantly higher in Group III (15.30 ±1.65×10^3/µL and 75.38 ±1.32%) as compared to Group I (7.09±0.30×10^3/µL and 66.62±0.90 %) and Group II (11.98 ± 0.91×10^3/µL and 67.86±1.85%). High leuckocyte count in GROUP II and Group III may be due to infection and inflammation of urinary tract. Leuckocytosis observed in affected dogs was in agreement with Osborne *et al.* (1972) and Robinson *et al.* (1989).

The mean of BUN and creatinine was significantly higher in Group II (146.16±8.83 mg/dl and 8.72±1.60 mg/dl) as compared to Group I (16.56±2.63 and 3.18±0.84) and Group III (44.79±26.97 and 0.95±0.14). Increase in urea and creatinine levels in renal failure might be due to marked reduction in glomerular filtration rate, diminished renal excretion, enhanced tubular absorption of urea and impaired ability of kidneys to excrete proteinaceouscatabolites. Similar findings of increased BUN and creatinine values in renal failure have been reported by other workers (Patil, 2011; Kumar, 2013; Puri *et al*., 2015; Devipriya *et al.,* 2018 and Sumit *et al.,* 2018). Increased mean values of BUN in Group III could be due increased tubular absorption and decreased elimination of urea because of obstruction. Sarma and Kalita (2019) also reported that BUN, serum creatinine and alkaline phosphatase are ideal indicators for detection of any abnormalities in urinary system. The mean AST and ALP values of Group II (67.19±24.69 and 134.24±33.07) were higher than that of Group I (22.15±3.39 and 33.60±3.87) and Group III (35.07±8.87 and 68.76±13.53). In dogs, AST is less specific liver enzyme as there are high levels both in skeletal muscles and red blood cells (Richter, 2004) and the increase in AST value in renal failure might be due to loss of skeletal muscle mass and increased haemolysis, a result of CKD. Increase in AST value in CKD have also been reported by earlier workers (Pradhan and Roy, 2012; Carrero

Table 1: Mean ± SEM of haematological parameters of Group I, Group II and Group III.

Group	Hb (g/dl)	TLC (×10^3/µL)	N (%)	L (%)	O* (%)	PCV (%)	TEC (×10^6/µL)	BT (Min)	CT (Min)
I	12.55	7.09	66.62	28.20	5.183	40.00	5.06	1.62	3.83
(n=6)	±0.32^b	±0.30^a	±0.90^a	±0.59^b	±0.53	±1.19^b	±0.10^b	±0.12	±0.24
II	9.09	11.98	67.86	26.21	5.64	28.17	4.25	1.60	3.95
(n=14)	±0.79^a	±0.91^{ab}	±1.85^a	±1.17^b	±0.86	±2.44^a	±0.24^a	±0.11	±0.20
III	11.66	15.30	75.38	20.51	4.05	35.49	4.85	1.48	3.50
(n=18)	±0.28^b	±1.65^b	±1.32^b	±1.19^a	±0.39	±0.99^b	±0.14^b	±0.13	±0.19

Mean ± SEM values with different superscript differ significantly between the groups (P<0.05). *O Others including Monocytes, basophils and Eosinophils.

Table 2: Mean ± SEM of various biochemical parameters of Group I, Group II and Group III.

Groups	BUN (mg/dL)	CRTN (mg/dL)	ALT (U/L)	AST (U/L)	AP (U/L)	TP (g/dL)	ALB (g/dL)	A:G ratio	TB (mg/dL)
I	16.56±	0.95±	15.17±	22.15±	33.60	6.26±	3.68±	1.38±	0.49±
n=6	2.63[a]	0.14[a]	1.84	3.39	±3.87[a]	0.21	`0.17	0.12[b]	0.06
II	146.16±	8.72 ±	34.52	67.19±	134.24±	6.97±	2.99±	0.81±	0.55±
n=14	8.83[b]	1.60[b]	±6.18	24.69	33.07[b]	0.37	0.30	0.09[a]	0.14
III	44.79±	3.18 ±	28.38	35.07±	68.76±	6.20±	3.03±	1.03±	0.49±
n=18	26.97[a]	0.84[a]	±5.68	8.87	13.53[ab]	0.47	0.23	0.11[ab]	0.10

Mean±SEM values with different superscript differ significantly between the groups (P<0.05).

et al., 2016; Sumit *et al.,* 2018). Increased ALP in renal failure might be due to secondary renal parathyroidism, which has been reported to be associated with increased mortality in chronic renal failure dogs (Beddhu *et al.,* 2009). Many earlier workers had also reported elevated serum ALP in dogs suffering from CKD (Ross *et al.,* 2007; Kumar, 2013 and Sumit *et al.,* 2018). There was no significant difference in TP and ALB values between any groups, however the lowest albumin values were recorded in Group II (2.99±0.30) followed by Group III (3.03± 0.23) and Group I (3.68± 0.17). The A:G ratio was significantly lower in Group II (0.81±0.09) as compared to Group I (1.38±0.12), however there was non-significant difference between Group I (1.38±0.12) and Group III (1.03±0.11). The decreased A:G ratio might be due to hypoalbuminemia due to gastrointestinal or renal protein loss of albumin and increased globulin levels in renal failure. Similar findings were also observed by Pradhan and Roy (2012) and Sumit *et al*. (2018). High values of globulin might be the reason for normal levels of protein observed in the present study. Girishkumar *et al.* (2011) conducted a study on chronic renal failure and found that there was reduced level of albumin in serum of dog with chronic renal failure. Decreased production and increased loss of albumin during inflammation was responsible for mild hypoalbuminemia which might be accompanied by normal or even elevated serum globulin concentrations (Throop and Cohn, 2004 and Fransson *et al.,* 2007). The progress of infection is usually associated with marked changes in the serum proteins, production of acute phase proteins (APPs) by liver and most of the APPs are globulins (Kaneko *et al.,* 2008). The concurrent infection might be the reason for increased globulin and total protein level. Similar findings were also observed by Pradhan and Roy (2012) and Sumit *et al.* (2018), whereas, Kandula and Karlapudi (2014) reported hypoproteinemia and hypoalbuminemia in dogs with CKD.

Urinalysis

Colour of urine in healthy dogs was normal, however in diseased animals colour varied from light yellow, dark yellow, red and brown to muddy brown. Light yellow colour indicates diluted urine with low specific gravity which is common in CKD. Brown colour of urine indicates mixing of blood in urine which could be due to haematuria or nephritis and red colour of urine indicates haematuria which could be due to injury caused by calculi (Kannan and Lawrence, 2010). Blood and leucocytes were present in 60% of dogs having calculi, whereas only 30% of cases with renal failure had leucocytes in urine. Presence of blood and leucocytes in urine in Group III indicates infection and mucosal irritation/ mucosal injury in cases of calculi. Glucose, ketone bodies, urobilinogen and nitrite were not seen in any group. The pH and specific gravity of urine in Group I, II and III were 6.25±0.52, 1.024±0.0058; 6.41±0.64, 1.018±0.0069; and 6.85 ±0.65, 1.021±0.0102; respectively. Although there was no significant difference in pH and specific gravity between the groups, however the lowest specific gravity was recorded in renal failure group (Group II) indicting inability of kidneys to concentrate urine. These findings were similar to Kumar *et al.* (2011) who reported isosthenuria with significant azotemia in end stage kidney disease which might be related to malfunctioning of more than 2/3rd of nephrons. Protein was absent in Group I, whereas protein was significantly higher in Group II (177.78±27.78) as compared to Group III (73.75±12.80). Highest protein concentration in Group II indictates glomerular leakage of proteins in renal failure cases. Proteinuria in Group III may be because of infection and inflammation of urinary tract as reported by Nagy (2009).

CONCLUSION

In the present study the significant haemato-biochemical changes reported in renal failure dogs were anemia, azotemia, increased alkaline phosphatase and AST values and decreased A:G ratio, whereas in dogs with urinary obstruction the significant changes were uremia and leukocytosis. Thus the present study concluded that the evaluation of various hemato-biochemical parameters help in making early diagnosis and also in predicting the prognosis of a renal disease.

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