

## Haemato-biochemical alterations in dogs suffering from chronic renal failure

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### Abstract

The present study was conducted to determine the haemato-biochemical alterations in dogs suffering from chronic renal failure. A total of 24 dogs brought to the clinics with the history and clinical signs suggestive of renal failure were included in the study. Blood and serum samples were collected and subjected to haematological and biochemical analysis. All the dogs were found to be suffering from renal failure on the basis of elevated level serum creatinine. Staging following IRIS guidelines suggested 58.3% dogs to be in Stage IV of chronic renal failure 29.16% in Stage III, 8.32% in Stage II and 4.16% in Stage I. Haematological analysis depicted significant reduction in haemoglobin, leucocytosis with neutrophilia, decreased PCV and decreased number of platelets. Biochemical analysis showed significant increase in BUN, creatinine, phosphorous and decreased protein levels in diseased dogs in comparison with apparently healthy control dogs considered in the present study.

**Keywords:** Chronic renal failure, Dogs, Haemato-biochemical alterations

Renal failure is the loss of ability of kidneys to excrete waste products, concentrate urine, electrolytes and fluid balance leading to retention of creatinine, urea and other metabolic waste products that are normally excreted by the kidney. It is of two types depending on the onset of disease condition i.e. acute renal failure and chronic kidney failure or chronic kidney disease. 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) and is manifested by cardiovascular disease, azotemia, hyperphosphatemia, melena, buccal ulcers and anemia (Kralova *et al.*, 2010).

Disease can be diagnosed by clinical examination, urine examination, ultrasonographic findings and serum analysis for biochemical parameters. Estimation of blood urea nitrogen (BUN) and serum creatinine (SC) are widely used for evaluation of glomerular filtration rate (GFR) and renal functions in dogs.

Therefore, present study was conducted to diagnose renal failure cases in dogs on the basis of clinical signs and find haemato-biochemical alteration in the affected dogs.

### Material and Methods

Twenty four dogs presented at Small Animals Clinics, College Veterinary Hospital, Teaching Veterinary Clinical Complex, College of Veterinary Sciences, LUVAS, Hisar, with clinical signs suggestive of renal failure were considered for the study. A total of 24 dogs irrespective of age, sex and breed were diagnosed to be suffering from chronic renal failure on the basis of clinical and ultrasonographic findings. The blood samples collected in vials coated with K3EDTA were immediately analyzed for complete hematological examination using fully automated haematology cell counter (MS4s, Melet Schloesing Laboratories, France). The parameters measured were haemoglobin (Hb) in g/dl, total leucocyte count (TLC) in  $10^3/\text{mm}^3$ , differential leukocyte count (DLC lymphocytes (L) in %, monocytes (M) in %, neutrophils (N) in %, eosinophils (E) in % and basophils (B) in %. and thrombocyte count (THR) in  $10^3/\mu\text{l}$ . The serum samples were analyzed for estimation of biochemical test profile by using fully automated random access clinical chemistry analyzer (EM Destiny 180, Erba Diagnostics Mannheim GmbH-Germany). The serum biochemical parameters measured were alanine aminotransferase (ALT) in U/L, aspartate aminotransferase (AST) in U/L, gamma glutamyl transferase (GGT) in U/L, alkaline phosphatase in U/L, protein in g/dl, albumin in g/dl, bilirubin direct (BID) in mg/dl, bilirubin total (BIT)

in mg/dl, glucose in mg/dl, urea in mg/dl, creatinine in mg/dl, calcium (Ca) in mg/dl and phosphorus (P) in mg/dl. Six apparently healthy dogs brought for general health check up and vaccination formed the control group. Samples from healthy animals were collected and processed for comparison purpose after taking proper ethical permission from the IAEC. Results were analyzed statistically by applying Student t test using SPSS 16.0 software.

## Results and Discussion

The mean values of haemoglobin (Hb) in g/dl, total leukocyte count (TLC) in  $10^3$ /ml, neutrophil in %, lymphocyte in %, monocytes in %, eosinophils in %, packed cell volume in % and platelets in are shown in Table 1 Lower value of Hb was recorded in dogs suffering from renal failure with the mean value  $7.52 \pm 0.69$  g/dl as compared to the mean control value of  $13.43 \pm 0.67$  g/dl. A significant alteration in values ( $p < 0.05$ ) between diseased and control group was recorded. Decreased haemoglobin value can be attributed to lack of erythropoiesis and decrease red blood cell survival because of uremia. Similar results of anemia with same values were recorded by Sharma *et al* (2015); Chibber *et al* (2017) and Devpriya *et al* (2018). TLC count of sick dogs was found to be elevated with a value of  $16.91 \pm 1.96 \times 10^3$  /ml as compared to those of apparently healthy dogs with a value of  $10.46 \pm 1.94 \times 10^3$  /ml without a significant difference between them. Increased TLC count or leucocytosis in cases of renal failure can be observed because of underlying

Table 1: Showing mean hematological value of diseased dogs and healthy dogs and comparison using Student T test

Parameter	Mean $\pm$ SE	
	Diseased dogs	Healthy dogs
Hb g/dl	$7.52^* \pm 0.69$	$13.43 \pm 0.67$
TLC ( $10^3$ /ml)	$16.91 \pm 1.96$	$10.46 \pm 1.94$
N%	$82.70^* \pm 2.21$	$71.10 \pm 3.59$
M%	$1.25^* \pm 0.39$	$4.0 \pm 1.12$
L%	$14.45^* \pm 1.96$	$19.85 \pm 3.31$
E%	$1.041 \pm 0.41$	$0.0 \pm 0.0$
PCV%	$36.45^* \pm 0.94$	$40.9 \pm 2.12$
Platelets ( $10^3$ /ml)	$177^* \pm 1.77$	$241 \pm 51.78$

\* indicates significant alteration in values ( $p < 0.05$ )

inflammation of one or more organs of renal system. Similar findings were also reported by Mrudula *et al* (2005) and Kandula and Karlapudi (2015). Neutrophils count (%) was significantly ( $P < 0.05$ ) increased in diseased dogs with mean values of  $82.70 \pm 2.21$  % as compared to apparently healthy dogs of control group  $71.10 \pm 1.94$  %. Lymphocyte values were found to be significantly lower in dogs suffering from renal failure with mean value of  $14.45 \pm 1.96$  % as compared with that of control healthy dogs ( $19.85 \pm 3.31$  %). This finding of decreased lymphocyte is in exact conjunction with the findings of Kandula and Karlapudi (2015) and Devpriya *et al* (2018). Leucocytosis with neutrophilia and lymphopenia might occur due to variable extent of stress as in cystitis and nephritis as well as a sign of manifestation of induction of body defense mechanism against bacterial infection (Senior *et al*, 1986). Monocyte count ( $1.25^* \pm 0.39\%$ ) was significantly less as compared to mean value of control  $4.0 \pm 1.12$  %. Mean value of eosinophil count was calculated to be  $1.041 \pm 0.41\%$  compared to  $0.0 \pm 0.0\%$  in healthy dogs.

Lower value of PCV was seen in dogs of renal failure with mean value  $36.45 \pm 0.94\%$  as compared to control mean value  $40.9 \pm 2.12\%$ . There was significant difference observed between groups at  $P < 0.05$  level. Similar results was given by Prathan and Roy (2012); Sharma *et al* (2015); and Devpriya *et al* (2018) showing decreased PCV in effected dogs. The mean value of platelets of renal failure cases was significantly lower at  $P < 0.05$   $177 \pm 1.77 \times 10^3$ /ml as compared to control mean value  $241.6 \pm 51.78 \times 10^3$  /ml. This finding of decreased platelet count was also reported by Sharma *et al* (2015) which can be attributed to the reduced thrombopoietic activity in uremic dogs.

The mean values for blood urea nitrogen, creatinine, total protein, albumin, glucose, SGOT, SGPT, ALP, GGT, triglyceride, cholesterol, total bilirubin, total calcium and phosphorus were presented in table II. The mean value of blood urea nitrogen was  $237 \pm 29.5$  mg/dl elevated in dogs suffering from renal failure as compared to mean value  $13.6 \pm 2.20$  of control group with significant difference. Value of serum creatinine was found to be elevated in diseased dogs with mean value of  $7.31 \pm 1.02$  mg/dl as compared to in apparently healthy dogs with mean value of  $0.95 \pm 0.02$  mg/dl. Values were found to be statistically different. Staging of renal failure was done in diseased dogs using

Table 2: Showing mean serum biochemical value of diseased dogs and healthy dogs and comparison using Student T test

Parameter	Renal failure (Mean $\pm$ SE)	Control
BUN (mg/dl)	237* $\pm$ 29.5	13.6 $\pm$ 2.20
Serum Creatinine (mg/dl)	7.31* $\pm$ 1.02	0.95 $\pm$ 0.02
Total protein (g/dl)	5.0 $\pm$ 0.38	5.31 $\pm$ 0.38
Albumin (g/dl)	3.20 $\pm$ 0.97	3.87 $\pm$ 0.04
ALP (U/L)	220 $\pm$ 40.32	94.16 $\pm$ 4.3
T. Bilirubin (mg/dl)	0.64 $\pm$ 0.40	0.55 $\pm$ 0.04
GGT (U/L)	11.04 $\pm$ 4.25	5.5 $\pm$ 2.3
Ca (mg/dl)	8.65* $\pm$ 2.9	7.4 $\pm$ 1.2
Glucose (mg/dl)	67.80* $\pm$ 8.06	91 $\pm$ 12.7
Triglyceride (mg/dl)	92.72* $\pm$ 64	46 $\pm$ 12.8
Phosphorus (mg/dl)	8.5* $\pm$ 1.07	4.2 $\pm$ 1.2
Cholesterol (mg/dl)	218.6 $\pm$ 10.11	198 $\pm$ 5.2
SGOT (U/L)	69 $\pm$ 17.33	24 $\pm$ 4.77
SGPT (U/L)	58 $\pm$ 29.6	17 $\pm$ 4.3

\* indicates significant alteration in values ( $p < 0.05$ )

International Renal Interest Society (IRIS guidelines) as shown in Table 3. Majority of dogs (58.33%) in current study were found to be in Stage IV of chronic renal failure with serum creatinine value greater than 5.0mg /dl followed by 29.16% in Stage III with values between 2.0-5.0mg/dl, 8.32% in Stage II with values between 1.4-2.0mg/dl and 4.16% in Stage I with values less than 1.4 mg/dl. Sharma *et al.*, (2015) also graded the diseased dogs into stages and found significantly increased values in dogs in Stage III and Stage IV. Reason for increased creatinine was its diminished renal excretion in CRF but creatinine is insensitive for early renal disorders, at least 75% loss of functional nephrons occurs before creatinine increases above the reference levels as mentioned by Watson *et al* (2002) and Lefebvre (2011). Increased values of creatinine in cases of renal failure was also reported by Mrudula *et al* (2005); Bradea *et al* (2013); and Devpriya *et al* (2018).

The mean value of total protein and albumin levels in diseased dogs was non-significantly lower 5.0 $\pm$ 0.38g/dl and 3.20 $\pm$ 0.97g/dl as compared to healthy control dogs with a value of 5.3 $\pm$ 0.38g/dl and 3.87 $\pm$ 0.04g/dl. There was no statistical significant. The finding is in accordance with Kandula and Karlapudi (2015); Chibber *et al* (2017) and Devpriya *et al* (2018)

who also depicted reduced protein level in renal disorders. Hypoproteinemia and hypoalbuminemia observed in present study can be attributed to protein loss in urination due to kidney failure and GIT bleeding in uremic dogs. The mean value of phosphorus was recorded 8.5 $\pm$ 1.07 mg/dl with a significant increase as compared to 4.2 $\pm$ 1.2 mg/dl in apparently healthy dogs. In present study, hyperphosphatemia was observed in renal failure cases as compared to healthy. Suggestive reason for hyperphosphatemia is declining kidney function because the kidneys are the primary route of phosphorus excretion and its consequences results in phosphorus retention. In patients with CKD stages 1 and 2, phosphorus typically remain within the normal range because of a compensatory reduction in phosphorous reabsorption in surviving nephrons, thereby enhancing phosphaturia. This compensatory adaptation is a consequence of the phosphaturic effects of fibroblast growth factor 23 (FGF-23) and parathyroid hormone (PTH) (Liu and Quarles, 2007). The tradeoffs or consequences of ameliorating development of hyperphosphatemia include renal secondary hyperparathyroidism and impaired production of calcitriol. In dogs and cats with CKD stages 3 and 4, the usual compensatory mechanisms typically fail to prevent hyperphosphatemia (Polzin, 2011).. The mean value of cholesterol was 218.6 $\pm$ 10mg/dl. Hypercholesterolemia is usually part of a more complex syndrome, the nephrotic syndrome, Hypercholesterolemia has been reported in varying frequencies in dogs with acquired glomerular disease (Xenoulis and Steiner, 2008).

Mean value of total bilirubin was calculated to be on non significantly higher side in diseased animals with mean of 0.64 $\pm$ 0.40 mg/dl as compared to mean value 0.55 $\pm$ 0.04 mg/dl of control. The mean value of alkaline phosphatase was 220 $\pm$ 40 U/L showing elevated level as compared to the mean value of control 94.16 $\pm$ 4.3 U/L. The finding was in accordance with Sharma *et al.* 2015 who also depicted increase in alkaline phosphatase level in renal disorders. This elevated serum alkaline phosphates level was due to secondary renal hyperparathyroidism (Centre 1996) and is found to be associated with increased mortality in CRF (Srinivasn *et al.* 2009)

Mean calcium value was recorded to be significantly higher (8.65 $\pm$ 2.9 mg/dl) in diseased dogs as compared to that of healthy dogs (7.4 $\pm$ 1.2 mg/dl).

**Table 3: Showing grading of diseased dogs suffering from chronic kidney disease (CKD) following IRIS guidelines**

IRIS guidelines	Stage 1	Stage 2	Stage 3	Stage 4
	Serum.creatinine (<1.4mg/dl)	Serum. creatinine (1.4-2.0mg/dl)	serum .creatinine (2.0-5.0mg/dl)	serum.creatinine >5.0mg /dl
No of dogs affected	1 (4.16%)	2 (8.32%)	7 (29.16%)	14 (58.33%)

Mean value of GGT was found to be on higher side in diseased dogs ( $11.04 \pm 4.25$  U/L) in comparison to the values recorded in healthy dogs ( $5.5 \pm 2.3$  U/L). Our findings of elevated serum GGT was in accordance with Sharma *et al.*, (2015) and Pradhan and Roy (2012). Suggestive reason for increased GGT values in CRF might be due to its more release from the damaged renal tubular cell as mentioned by Pradhan and Roy (2012). Mean glucose value in dogs suffering from renal failure ( $67.80 \pm 8.06$  mg/dl) was found to be significantly lower compared to the values observed in healthy control groups ( $131 \pm 12.7$  mg/dl). The present finding might be due to anorexia of long duration which was present in almost all the cases of RF on first day of presentation and the findings are in accordance with the finding of Thornhill (1984).

Mean value of triglyceride was significantly higher in diseased dogs ( $92.72 \pm 64$  mg/dl) compared to mean values of control dogs ( $46 \pm 12.8$  mg/dl). Similar finding was observed by Trevisan *et al.*, (2006) and Mann *et al.*, (2011). They stated that chronic renal disease is accompanied by characteristic abnormalities of lipid metabolism, which appear as a consequence of nephrotic syndrome or renal insufficiency. High cholesterol and triglyceride plasma levels have been demonstrated to be independent risk factors for progression of renal disease in humans.

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