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Original Article

STRUCTURAL AND FUNCTIONAL ASSESSMENT OF CHRONIC KIDNEY DISEASE OF DOGS

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Abstract: Chronic kidney diseases in dogs were clinically manifested as anorexia, weight loss, vomiting, pale to blanched mucus membrane, polyuria, polydipsia, melena and abnormal urine. The haematology analysis revealed highly significant (P<0.01) reduction in mean haemoglobin (Hb), haematocrit (PCV), total erythrocyte count (TEC) and platelets count and highly significant (P<0.01) increase in mean white blood cells (WBC), lymphocyte and monocyte count. Serum biochemistry revealed highly significant (P<0.01) reduction in mean serum albumin, albumin: globulin ratio and highly significant (P<0.01) increase in creatinine, blood urea nitrogen (BUN), phosphorus and chloride. Ultrasonogram of kidney revealed significant (P<0.05) reduction in kidney size and kidney pulsatility index and other changes were irregular renal countour (80%), indistinct corticomedullary junction (80%), medullary ring sign (30%), increased cortical echogenicity and cortical thickening (100%) and increased medullary echogenicity (70%) were observed in CKD dogs to the control group.

Key words: Chronic kidney diseases, Dogs

INTRODUCTION

Chronic kidney disease (CKD) is defined as the structural and functional abnormalities of kidneys for period of three months or more. The kidney's functional abnormality is assessed by haemato-biochemical parameters and the structural abnormality is imaged by ultrasonogram. CKD is an irreversible kidney disease [1] and the most common renal disease in dogs and cats [2]. Primary renal diseases or secondary to a variety of systemic diseases are the major cause for morbidity and

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mortality in dogs [3]. McGrotty [4] recorded oral ulcer, halitosis and acute blindness (due to hypertension) are the additional clinical signs in CKD dogs. Gradual reduction in Hb, PCV and TEC values [5] and the severity of anemia is typically proportional to the loss of kidney function [6]. Serum creatinine level is the common criterion to estimate the kidney dysfunction [7, 8], reduced serum albumin levels [9] and persistent micro albuminuria is a marker in early diagnosis of renal disease [4,10]. Krawiec and Gelberg [11] and Lees et al. [12] suggested that proteinuria is a marker for renal disease and a potentially cause of renal injury. Green [13] reported atrophic kidneys are common ultrasonogram finding in CKD dogs. Hence, both structural and functional assessment is an ideal indicator to detect the stage of kidney failure for effective treatment and declaring the prognosis. Early diagnosis of CKD and therapeutic management may slow or halt the rate of progression and improve patient quality and quantity of life.

MATERIALS AND METHODS

Ten dogs irrespective of age, breed, sex with history and clinical manifestations suggestive of chronic kidney disease were compared with a control group (n=10) which were apparently healthy and free of infections. Three millilitre of venous blood were collected in a glass vial with EDTA (1mg / ml) for complete haemagram and were estimated by standard methods as described by Schalm et al. [14]. Five millilitre of blood was collected and allowed to clot and serum was separated by centrifugation and was subjected for estimation of total protein, albumin, globulin, albumin: globulin ratio blood urea nitrogen, creatinin, phosphorus, calcium, sodium, potassium and chloride. Urine samples were obtained by cystocentesis, catheterization or natural void were subjected to physical, chemical and microscopic examination [15]. Ultrasonographic examinations were carried out using an aeroscan scanner as per the procedures described by Nyland et al. [16]. The kidneys were imaged using 5 MHz and 7.5 MHz transducer by making the animals in either dorsal or lateral recumbency. Nephrosonogram measurements were both left and right kidney size (length, width and diameter), abdominal aortic diameter, both kidneys resistive index (RI) and pulsatility index (PI) were taken. The ratio of kidney length to aortic diameter is used to estimate the size of the kidney, the normal kidney aortic ratio in dogs is 5.5 to 9.1. Ratio is less than 5.5 indicate that the kidneys undergo atrophic (small) changes and the ratio is more than 9.1 indicative of renal enlargement (hypertrophy). The kidneys were subjected for the following qualitative parameters were renal countour (regular/irregular), corticomedullary junction (distinct/Indistinct), medullary rim sign (present / absent), cortical echogenecity (normal/increased / decreased) and medullary echogenecity (normal / increased/decreased). The data collected were statistically evaluated as per Snedecor and Cochran [17]. Student's t-test was used to analyze haemato-biochemical and ultrasonogram values between healthy and diseased animals.

RESULT

In the present study the apparently healthy dogs were compared with the dogs affected with chronic kidney disease. The prominent clinical signs recorded (Table 1) in dogs with chronic kidney disease were dull, progressive weight loss, anorexia, vomiting, pale mucus membrane, oral ulcer/halitosis, pedal edema, melena, polyuria, polydipsia, recumbency and abnormal urine colour and output. In the present study pedal edema was reported in 30 percent of cases in dogs with CKD. The haematological values of apparently healthy dogs and dogs with CKD were given in Table 2. Study revealed a highly significant ($P<0.01$) decrease in mean Hb (7.9 ±1.5g/dl), PCV (22.2 ±4.4%), TEC (3.6 ±0.9x 10^6cells/cmm),

Table 1: Clinical finding in dogs with Chronic Kidney Disease

S.No	Clinical finding	Percentage (n=10)
1	Weight loss	100
2	Anorexia	100
3	Vomiting	80
4	Pale mucus membrane	80
5	Oral ulcer/ halitosis	30
6	Pedal edema	30
7	Melena	60
8	Polyuria	60
9	Polydipsia	60
10	Recumbency	20
11	Change in urine color/output	60

Table 2: Hematology in dogs with Chronic Kidney Disease. p value ** Highly significant (p<0.01), * Significant (p<0.05), NS: Not significant(p>0.05

S.no	Parameters	Control (n=10)	Ckd (n=10)	T test
1	Haemoglobin (g/dl)	13.7±0.98	7.9 ±1.5	0.000**
2	Packed cell volume (%)	32.5±2.86	22.2 ±4.4	0.000**
3	Total erythrocyte count (x10^6 cells/cmm)	6.7±0.64	3.6 ±0.9	0.001**
4	Mcv (fl)	48.5±3.2	62±0.5	0.001**
5	Mch (pg)	20.5±1.34	22.2±2.0	0.059**
6	Mchc (%)	42.2±0.83	35.8± 2.0	0.000**
7	Total leucocyte count (x10^3 cells/cmm)	6.7±1.1	12.45 ±5.5	0.001**
8	Platelets (x10^5 cells/cmm)	4.3±0.71	2.0 ±0.7	0.000**
9	Neutrophils (%)	71.3±6.25	79±9.2	0.121^{ns}
10	Lymphocyte (%)	27.5±6.25	15.8±9.1	0.027**
11	Eosinophil (%)	1±0.89	1.3±2.4	0.758^{ns}
12	Monocyte (%)	0.2±0.41	3.8±2.1	0.000**

Table 3: Serum biochemistry in dogs with Chronic Kidney Disease. p value ** Highly significant (p<0.01), * Significant (p<0.05), NS: Not significant(p>0.05)

S.No	Parameters	Control (n=10)	CKD (n=10)	t TEST
1	Total protein (g/dl)	6.4±0.5	6.6±0.8	0.567^{NS}
2	Albumin (g/dl)	3.3±0.3	2.6±0.4	0.017*
3	Globulin (g/dl)	3.1±0.3	4.0±1.0	0.064^{NS}
4	Albumin/ Globulin	1.05±0.13	0.71±0.25	0.015**
5	BUN (mg/dl)	13.6±4.36	96±30	0.000**
6	Creatinine (mg/dl)	0.7±0.17	8.6±5.7	0.007**
7	Phosphorus (mg/dl)	3.9±1.4	12.2±3.2	0.000**
8	Calcium (mg/dl)	10±0.83	11.4±1.4	0.072^{NS}
9	Sodium (mmol/L)	145.95±3.27	147.4±6.2	0.630^{NS}
10	Potassium (mmol/L)	4.9±0.28	5.4±0.5	0.080^{NS}
11	Chloride (mmol/L)	110.25±0.28	105.7±2.4	0.019**

Table 4: Ultrasonogram in dogs with Chronic Kidney Disease. p value ** Highly significant (p<0.01), * Significant (p<0.05), NS: Not significant(p>0.05)

S. No	Parameters	Control (n=6)	CKD (n=6)	t TEST
1	Right kidney size (cm)	5.42±0.73	4.8±0.6	0.153^{NS}
2	Left kidney size (cm)	5.58±0.8	4.4±0.8	0.029*
3	Aorta size (cm)	0.78±0.07	0.7±0.2	0.606^{NS}
4	Right kidney/ Aorta	6.94±0.82	7.0±2.1	0.972^{NS}
5	Left kidney/ Aorta	7.17±1.04	6.3±2.1	0.391^{NS}
6	Right kidney RI	0.72±0.01	0.7±0.03	0.673^{NS}
7	Right kidney PI	1.57±0.05	2.1±0.5	0.032*
8	Left kidney RI	0.72±0.01	0.7±0.03	0.673^{NS}
9	Left kidney PI	1.57±0.05	2.1±0.5	0.032*

MCHC (35.8± 2.0 %) and mean platelets count (2.0 ±0.7 x10^5cells/cmm) and highly significant (P<0.01) increase in mean MCV (62 ± 0.5fL), MCH (22.2 ± 2.0 pg), TLC (12.45 ± 5.5 x10^3cells/ cmm), lymphocyte (15.8±9.1%) and monocyte (3.8 ± 2.1%) count of CKD dogs when compared with control group. The mean serum biochemistry values of apparently healthy dogs and dogs with CKD were given in Table 3. In the present study, the CKD dogs revealed highly significant (P<0.01) increased in mean serum creatinine (8.6 ± 5.7 mg/dl) and BUN (96 ± 30g/dl) in compared with control group. There was no significant change between the CKD and control group in the total protein 6.6 ± 0.8 g/dl and globulin 4.0 ± 1.0 g/dl but albumin 2.6 ± 0.4 g/dl and albumin: globulin 0.71 ± 0.25 shows significantly decreased compared with the control group. There were no significant changes in the mean electrolytes concentration of sodium (147.4 ± 6.2mmol/L), potassium (5.4 ± 0.5mmol/L) and calcium (11.4 ± 1.4 mg/dl) in present study compared to the control group. The concentration of mean serum chlorides and phosphorus were (105.7 ± 2.4mmol/L) and 12.2 ± 3.2 mg/dl respectively was highly significant (P<0.01) increased in CKD dogs than the control group in the present study. Urine samples

examination revealed abnormal colour with slightly viscous in CKD dogs. The mean urine specific gravity recorded in control group was 1.035, whereas isosthenuria (1.013) was noticed in chronic kidney disease dogs. Control group dogs urine samples were negative for protein, glucose and ketone bodies whereas CKD dogs had proteinuria (60%), glucosuria(60%) and ketonuria (50%) in the present study. The microscopic examination of the urine samples revealed increased number of pus cells, epithelial cells and erythrocytes in CKD dogs compared with control group. Ultrasonogram values of apparently healthy dogs and dogs with CKD were given in the Table 4. In the present study there was significant ($P<0.05$) decrease in the left kidney size and both kidneys pulsatility index of CKD dogs compared with the control group. In the present study the ultrasonogram of kidney showed irregular renal countour (80%), indistinct corticomedullary junction (80%), medullary ring sign (30%), increased cortical echogenicity and cortical thickening (100%) and increased medullary echogenicity (60%) were recorded in CKD dogs.

DISCUSSION

In the present study, chronic kidney disease was recorded as common disease in older dogs [2] and cause high mortality [3]. Chronic kidney disease cause functional and structural changes in the kidney [18] which were recorded through clinical manifestation, heamto-bochemical and ultrasonogram examination. The prominent clinical signs in dogs with CKD recorded in the present study which is in accordance with McGrotty [4], Scottline [19] and Mrudula et al. [20]. Vomiting and anorexia were caused due to the stimulation of chemoreceptor trigger zone (CTZ) as per Forrester and Lees [21]. Melena is result of gastro intestinal bleeding due to an increased blood urea as a consequence of increased GIT absorption of nitrogenous compounds [22]. Haematological alternation includes severe anemia, thrombocytopenia of CKD dogs when compared with control group which is in accordance with Nandy and Pradhan [5] and Polzin [6] reported that dogs with CKD typically have a normochromic, normocytic and regenerative anemia. As per Krawiec [23] and Martiarena et al. [24] decreased haemogram was due to gastrointestinal bleeding and deficiency of erythropoietin from the kidney.

In the present study, the CKD dogs revealed highly significant ($P<0.01$) increased in mean serum creatinine and BUN in compared with control group which is in accordance with Kaneko et al. [25] and Oburai et al. [26]. Grauer [7] and Brown et al. [8] reported that serum creatinine level was the common criterion to estimate the kidney dysfunction. There was no significant change between the CKD and control group in the total protein and globulin but albumin : globulin shows significantly decreased compared with the control group. Bush [27] and Vaden [9] and Oburai et al. [26] recorded reduced serum albumin and total protein levels in renal failure cases respectively. The mean electrolytes concentration of serum chlorides and phosphrous were significantly high and no significant changes in the mean serum sodium, potassium and calcium in present study compared to the control group. Rise in serum phosphorous was due to poor glomerular filtration through damaged kidney as per Devaux et al. [28] and Cowgill [29]. Urine samples examination of CKD dogs isosthenuria was noticed in the present study which were in accordance with Oburai et al. [26]. Control group dogs urine samples were negative for protein, glucose and ketone bodies whereas CKD dogs had proteinuria, glucosuria and ketonuria in the present study which was in accordance with Jacob et al. [30] and Brown et al. [31] reported proteinuria has been confirmed as a risk factor for increased mortality in CKD dogs. Ultrasonogram showed significant ($P<0.05$) decrease in the left kidney size and both kidneys pulsatility index of CKD dogs compared with the control group. In the present study the ultrasonogram of kidney showed irregular renal countour, indistinct corticomedullary junction, medullary ring sign, increased cortical echogenicity and cortical thickening and increased medullary echogenicity were recorded in CKD dogs which is in agreement with Nyland et al. [32] and Oburai et al.[26]. In the present study, ultrasonogram is an important tool to assess the structural changes of the kidney. The dogs which showed severe haemato-biochemical values

alteration had significant change in the nephrosonogram size, contour, architecture and PI values. Hence, in chronic kidney disease the hemato-biochemical values revealed the functional assessment of the kidney and nephrosonogram showed the structural changes of kidney, which were complimentary to each other which reveals the prognosis of the patients.

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