ELECTROCARDIOGRAPHIC OBSERVATIONS IN URINARY TRACT DISEASES AFFECTED DOGS[#]

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ABSTRACT

The present study was conducted to investigate characteristics of electrocardiography in urinary tract diseases (UTD) in dogs. The positive cases of UTD (Group B) affected dogs were screened for ECG and haemato-biochemical parameters as per the standard procedure and the outcome was compared and correlated statistically with healthy dogs (Group A). A decreased in amplitude of P wave, T wave and QRS complex were observed in Group B as compared to Group A. Additionally, a significant ($P < 0.05$) decreased Hb and TEC and increased in BUN, creatinine and ALP were observed in Group B. There was significant ($P< 0.05$) positive and negative correlations between electrocardiogram and haemato-biochemical parameters were observed UTD affected group. The study revealed that ECG and haemato-biochemical parameters had a significant role in urinary tract diseases in dogs

Key words: ECG, UTD, dog

Introduction

Electrocardiography, a non-invasive and relatively inexpensive technique has now generally been accepted as an important diagnostic tool in detecting cardiac abnormalities in dogs Tilley (1992). It detects not only the disturbances of cardiac rate and rhythm but also cardiac enlargement, myocardial disease, ischaemia, pericardial diseases, certain electrolyte imbalances and some drug toxicities. The electrocardiogram is a basic and valuable diagnostic test in veterinary medicine and is relatively easy to acquire. The electrocardiogram is the initial test of choice in the diagnosis of cardiac arrhythmias and may also yield information regarding chamber dilation and hypertrophy. Electrocardiography (ECG) is an important diagnostic tool in the practice of veterinary medicine. It is not only evaluates the electrical function of the heart, but ECG is also able to give information regarding non-cardiac illness. An ECG should be evaluated to diagnose dysrhythmias associated with hyperkalaemia requiring immediate treatment.

There is no set potassium level that predicts a dysrhythmia. ECG changes associated with hyperkalaemia include tall T-waves, prolonged P-R interval, bradycardia, sino-ventricular rhythm, sine wave and asystole (Ettinger *et al*., 1974). In experimental settings, hyperkalaemia has been associated with a defined series of ECG abnormalities, including shortening of QT interval, peaking of T waves, QRS prolongation, shortening of PR interval, reduction in amplitude of the P wave, loss of sinoatrial conduction with onset of a wide-complex 'sine-wave' ventricular rhythm, and ultimately asystole (Ettinger *et al*., 1974). Although no uniform threshold has been documented in animal models, the most severe cardiac manifestations have been shown to occur with serum potassium concentrations >9 mEq/L. Hence the study was conducted to know the ECG pattern in extra-cardiac diseases and its correlation with haemato-biochemical alterations.

Materials and Methods

The present study was carried out at Teaching Veterinary Clinical Complex (TVCC) and Division of Veterinary Medicine, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology, R.S. Pura, Jammu. Dogs showing increase BUN and creatinine level above 25 mg/dl and 1.5 mg/dl, respectively were taken as UTD patients. The dogs brought to TVCC for routine checkup and having up to date vaccination and deworming status and normal clinico-physiological parameters were taken as healthy control. The animals were divided into two groups' *viz*. Gr. A (healthy dogs), Gr. B (UTD affected dogs) comprising six dogs in each group. Under clinical examination, the conjunctiva, oral mucosa, heart rate, pulse, respiration and temperature were recorded. A detailed auscultation of all the four quarters was done. The size and shape of chest and abdominal cavity were also determined. A 12 lead standard ECG recorder, BPL CARDIART-6208 machine under all standard prescribed conditions was used in present study.

The electrocardiograph has been standardized 1 cm = 1 mV so that each small box on the vertical axis equals 0.1 mV. The tracings were recorded at a paper speed of 50 mm per second so each small box on horizontal axis equals 0.02 seconds. The details of lead- II were included in this study. Electrocardiogram was then analyzed for the presence of ECG abnormality, if any. The ECG was recorded with dog in standard body position Tilley (1992) *i.e*. restrained in right lateral recumbency on a wooden table with legs positioned parallel to each other and perpendicular to the long axis of body, and keeping the head and neck flat. The skin and electrodes were moistened with gel. The owner's presence at the end of the table was ensured in all cases to keep the dog calm and comfortable. No pharmacological preparation was used for restrain prior to ECG examination. The front leg leads or electrodes (RA and LA) were attached to the appropriate forelegs just above the elbow. The rear leg leads (RL and LL) are likewise attached to the appropriate rear leg immediately proximal (above) to stifle (knee). The ECG parameters *viz.* P wave, QRS complex, T wave amplitude and duration, PR

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interval, QT interval and ST segment were recorded in each case . Eight ml of blood samples from each dog were collected from cephalic vein/saphenous vein. Two ml of blood was transferred to a EDTA vial for haematology estimation and 6 ml blood was transferred to clot activator vial and serum was separated and kept in -20 degree centigrade for future study. Haematological parameters *viz.* Hb, PCV, TEC, MCV, MCH, MCHC, RDW, TLC and DLC (Neutrophil and lymphocyte) were determined as per the standard procedure (Jain *et al*., 1986). The serum biochemical parameters *viz*. total protein, albumin, globulin, Albumin:Globulin (A:G ratio), creatinine, blood urea nitrogen (BUN), asparatate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), total bilirubin, Indirect bilirubin, calcium, phosphorus, sodium, potassium and chloride were analyzed by automated biochemical analyzer (Chem-7, ERBA Company Ltd.) with the help of commercial kits (ERBA company Ltd).

Results and Discussion

Electrocardiography studies

The results of ECG of Gr. B affected dogs are shown in Table 1 and Fig. 1, 2, 3. Present study revealed that Pa (0.15 ± 0.12mv and 0.13 ± 0.10mv), QRSa (1.68± 0.24mv and 0.78 ± 0.11mv) and Td (0.04 ± 0.02sec and 0.04 ± 0.01sec) in Gr. B were significantly (P<0.05) decreased as compared to Gr. A dogs (Table 1). The Ta value (0.18 ± 0.04mv) of Gr. B was also significantly decreased as compared to Gr. A. The rest ECG parameters did not show any significant alteration in both the groups as compared to health dogs. These findings particularly are in agreement with previous workers (Mohan *et al.,* 1994 and Dhanapalan *et al*., 1993), who studied the effect of acute haemorrhage and urinary tract diseases on QRS amplitude in the lead II canine electrocardiogram. In case of Gr. B, decreased in Pa, Ta and Td might be due to increase serum potassium causes reduction in resting membrane potential and quicken depolarization reported by Dhanapalan *et al*. (1993).

Alteration of Haemogram:

There was significant (P<0.05) decrease in Hb, PCV, TEC and MCHC in Gr.B when compared to Gr. A (Table 2, 4 and 5). But there was significant (P<0.05) increase in MCV in Gr. B dogs as compared to healthy dogs in present study (Table 2). There was no significant difference of the other haematological parameters among the two groups (Table 2). Decreased levels of haemoglobin, total erythrocyte count and packed cell volume were also noticed by Dharmadheeran *et al*. (2003), Biswas *et al*. (2005), Lee *et al*. (2012) and Ali *et al*. (2014). Observed decrease HB, PCV, TEC and MCHC in Gr. B might be due to anaemia in haemorrhagic gastroenteritis (Mohan *et al*., 1994), dehydration (Rai *et al*., 1994) and mechanical obstruction and massive sloughing of intestinal epithelial cells (Mallela *et al*., 2006). In case of Gr. B, decreased level of haematological parameters might be depressed renal erythropoietin factor production from impaired kidney. Blood loss in the form of haematemesis or malena and decreased RBCs survival due to impaired kidney function (Dharmadheeran *et al*., 2003; Biswas *et al*., 2005 and Baruah *et al*., 2005). Increase in MCV might be due to macrocytic normochromic type of anaemia found in chronic renal failure and sort of liver involvement (Mallela *et al*., 2006).

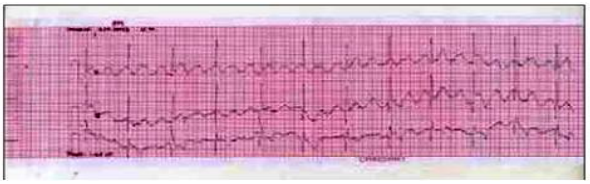

Fig.1: ECG of 6 year old male GSD suffering from CKD. Decrease in Pa, QRSa and Ta along with increase in Td is noticeable

Fig.2: ECG of 4 year old male Spitz suffering from ARI. Decrease in Pa, QRSa, Ta and Td is visible.

Fig.3: ECG of 6 year old female GSD suffering from CKD. Decrease in Pa, QRSa and Td along with increase in Ta is appreciable

Biochemical analysis

Biochemical analysis in present study (Table 3, 4 and 5) revealed that there was significant (P<0.05) decrease of AST (76.33 ± 5.46 IU/L and 110.83 ± 4.91 IU/L), ALP (114.44 ± 8.20 IU/Land 133.83 ± 5.55 IU/L) in Gr. B as compared to Gr. A (AST-58.28 ± 3.97 IU/L and ALP-92.35 ± 6.85 IU/L). But ALT (95.5 ± 3.87IU/L), BUN (188.5 ± 7.61 mg/dl), creatinine (6.81 ± 1.92 mg/dl) and P (8.62 ± 2.56 mg/dl) in Gr. B were significantly (P<0.05) increase as compared to Gr. A and Gr. B (Table 3). The rest biochemical did not show any significant alteration as compared to healthy dogs. These observations were in corroboration with the findings of (Dharmadheeran *et al*., 2003) and (Shah *et al.,* 2013). Decrease in albumin and increase AST in gastroenteritis infected dogs might be due to involvement of liver and severe protein losing enteropathy due to intestinal villi damage or intestinal haemorrhage (Grigonis *et al*., 2002). Increase in ALP might be due to hepatic hypoxia secondary to severe hypovolaemia or the absorption of toxic substances due to loss of the gut barrier (Shah *et al.,* 2013). Increased BUN and serum creatinine concentration indicated the renal dysfunction. These values were elevated, when 70-75 per cent of the nephrons become non-functional. Loss of phosphorus homeostasis due to excretion failure in chronic kidney disease results in hyperphosphataemia (Craver *et al*., 2007).

Correlation studies

The correlation statistic between ECG and haematology of UTD affected dogs revealed a positive correlation between STs and MCH. The study also revealed positive correlation of Pd with TP and albumin and QRSd with ALT and PRi with TP,

Albumin and A/G ratio. But there was negative correlation of PRi with ALP (Table 4 and 5).

These findings are in agreement with other workers who also reported about correlation between ECG and haemato-biochemical changes (Tatina *et al.*, 2013), (Tilley, 1992). Decrease HB, PCV and TEC lead to anaemia and as result myocardial hypoxia developed which showed increased T wave amplitude, P wave duration, QRS complex and QT interval (Tatina *et al*., 2013), (Tilley, 1992), (Scheet *et al*., 1985).

Table 1: Electrocardiogram of healthy and urinary tract diseases affected dogs (Mean± SE)

ECG Parameters	Gr. A (n=6)	Gr. B (n=6)
Pa (mV)	0.31±0.09	0.13±0.10*
Pd (sec.)	0.03 ± 0.13	0.02 ± 0.01
QRSa (mV)	2.50 ± 0.21	0.78 ± 0.11*
QRSd (sec.)	0.05 ± 0.00	0.05 ± 0.10
Ta (mV)	0.35 ± 0.15	0.18 ± 0.04*
Td (sec.)	0.23 ± 0.81	0.04 ± 0.01*
STs (sec.)	0.15 ± 0.05	0.13 ± 0.03
QTi (sec.)	0.17 ± 0.02	0.17 ± 0.03
PRi (sec.)	0.07 ± 0.01	0.07 ± 0.05

*P≤ 0.05; Gr. A=Healthy, Gr.B=Urinary Tract Diseases

Table 2: Haematologial parameters of healthy, urinary tract diseases in dogs

Parameters	Gr. A (n=6)	Gr. B (n=6)
Hb (g/dl)	15.28 ± 1.35	6.56 ± 1.24*
PCV (%)	44.53 ± 2.30	34.0 ± 2.44*
TEC (x106/µl)	6.96 ± 0.48	1.38 ± 0.80*
MCV (fL)	65.71 ± 6.83	93.86 ± 0.87*
MCH (pg)	22.07 ± 2.97	25.44 ± 0.94
MCHC (g/dl)	33.58 ± 2.80	27.08 ± 0.34*
RDW (%)	12.69 ± 0.48	12.69 ± 0.48
TLC (x103/µl)	11.88 ± 0.84	10.51 ± 1.58
Neutrophils (%)	72.58 ± 2.73	71.48 ± 2.30
Lymphocytes (%)	18.68 ± 3.33	21.6 ± 1.00

*P≤ 0.05

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Table 3: Serum biochemical profile of healthy and urinary tract diseases affected dogs

Parameters	Gr. A (n=6)	Gr. B (n=6)
AST (IU/L)	58.28 ± 3.97	110.83± 4.91*
ALT (IU/L)	31.96 ± 6.07	95.5 ± 3.87*
ALP (IU/L)	92.35 ± 6.85	133.83 ± 5.55*
TB (mg/dl)	0.30 ± 0.17	1.52 ± 0.12
IB (mg/dl)	0.10 ± 0.08	0.74 ± 0.50
TP (g/L)	6.73 ± 0.19	6.34 ± 0.24
Albumin (g/L)	3.55 ± 0.40	4.89 ± 0.09
AG Ratio	1.13 ± 0.24	0.29 ± 0.05
BUN (mg/dl)	14.26 ± 5.13	188.5 ± 7.61*
Creatinine (mg/dl)	0.83 ± 0.36	6.81 ± 1.92*
Ca (mg/dl)	8.76 ± 0.89	9.34 ± 0.89
P (mg/dl)	4.38 ± 0.35	8.62 ± 2.56*
Na (mEq/L)	143.66±9.13	127.16±9.27
K (mEq/L)	4.53 ± 0.53	6.08 ± 0.58
Cl (mEq/L)	117.5 ± 5.52	109.66 ± 5.08

*P≤ 0.05

Table 4: Correlation between ECG and haemogram of urinary tract diseases affected dogs

Parameters	Pa	Pd	QRSa	QRSd	Ta	Td	STs	QTi	PRi
Hb	0.01	0.45	-0.09	0.15	-0.32	-0.21	-0.44	-0.58	0.32
PCV	-0.31	0.40	-0.48	0.59	-0.31	-0.31	-0.32	-0.51	0.56
TEC	-0.08	0.45	-0.39	0.22	0.46	0.46	0.22	0.04	0.54
MCV	0.06	0.16	0.23	0.16	-0.31	-0.31	0.48	0.36	-0.29
MCH	-0.36	-0.25	0.49	0.34	-0.35	-0.35	0.86 *	0.77	-0.52
MCHC	-0.07	0.04	0.46	0.11	-0.49	-0.49	0.25	0.16	-0.33
RDW	0.27	0.13	0.21	-0.66	0.38	0.38	-0.69	-0.61	0.26
TLC	0.20	-0.47	0.53	-0.77	0.35	0.35	-0.25	-0.01	-0.32
Neutrophil	0.16	-0.10	0.41	-0.223	0.13	0.13	0.56	0.57	-0.422
Lymphocyte	-0.21	-0.73	0.86	-0.46	0.17	0.89	0.36	0.54	-0.60

*P≤ 0.05

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Table 5: Correlation between ECG and biochemical of urinary tract diseases affected dogs

Parameters	Pa	Pd	QRSa	QRSd	Ta	Td	STs	QTi	PRi
AST	-0.65	-0.03	-0.24	0.78	-0.13	-0.21	0.49	0.30	0.26
ALT	-.828	-0.16	0.04	0.878	-0.41	-0.13	0.69	0.50	-0.20
ALP	-0.26	-0.69	0.50	0.29	-0.79	-0.05	0.57	0.68	-931**
TB	-0.41	-0.30	0.71	0.11	-0.12	0.37	0.77	0.69	-0.43
IB	0.07	-0.01	0.38	-0.17	0.22	0.14	0.56	0.52	-0.26
TP	0.38	0.85*	-0.40	-0.25	0.65	-0.133	-0.39	-0.57	0.814
Albumin	0.23	0.90*	-0.60	0.02	0.46	-0.32	-0.45	-0.66	0.935**
Globulin	0.35	-0.21	0.57	-0.71	0.42	0.51	0.20	0.33	-0.40
AG ratio	0.15	0.88	-0.64	0.12	0.38	-0.37	-0.44	-0.66	0.93**
BUN	-0.17	-0.10	-0.36	0.25	-0.26	-0.12	-0.45	-0.39	0.18
Creatinine	0.915	0.60	-0.56	-0.41	0.31	-0.60	-0.41	-0.38	0.233
Ca	0.597	-0.13	0.41	-0.70	0.11	-0.18	-0.04	0.12	-0.49
P	0.025	0.26	0.24	0.17	-0.37	-0.26	0.28	0.13	-0.16
Na	0.0894	0.49	-0.26	-0.58	0.14	-0.35	-0.62	-0.54	0.10
K	0.51	0.19	-0.19	-0.29	0.41	-0.26	0.21	0.25	-0.06
Cl	0.71	0.00	-0.24	-0.35	-0.10	-0.41	-0.29	-0.10	-0.31

*P≤ 0.05** P≤ 0.01

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