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Electrocardiographic abnormalities in dogs suffering from ascites of cardiac origin

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Abstract

Cardiovascular diseases in animals have spiked manifolds in recent past emanating predominantly from diet, genetic factors and stress. Ascites is referred to as accumulation of serous fluid in peritoneal cavity. Etiology of ascites in companion animals includes left-sided heart failure, congestive heart failure, hypoproteinemia, cirrhosis, hepatic diseases, renal diseases, tuberculosis, ancylostomiasis etc. The study highlights the electrocardiographic abnormalities in dogs suffering from ascites of cardiac origin having normal liver function, kidney function and protein concentration. Labrador Retriever dogs aged between 5 to 10 years presented to the Veterinary Clinical Complex, C.V.Sc. and A.H., O.U.A.T., Bhubaneswar, Odisha with distended abdomen were screened. Diagnosis of ascites was based on clinical symptoms, tactile percussion of abdomen and classical ground glass appearance in radiograph. Blood samples were collected from the dogs and serum samples were processed for liver function test (LFT), kidney function test (KFT), total protein (TP) concentration and albumin (A) concentration. The dogs having values of LFT, KFT, TP and A within normal range were subjected to electrocardiography (n=12). A twelve-lead standard ECG recorder, Maestros MRX-12 was used to record ECG. The electrocardiograph was set with a paper speed of 25 mm per sec and sensitivity of 1 (1 cm = 1 mV). The electrocardiograms were analysed. Atrial fibrillation (P wave absent with tachycardia) was observed in two out of twelve electrocardiograms. Arrhythmia characterized by irregular RR intervals was reported in three out of twelve cases. Low voltage ECG (decreased amplitude of R wave) with left axis deviation was interpreted in three out of twelve cases indicating left ventricular enlargement. Two out of twelve electrocardiograms had notable ST segment elevation indicating myocardial injury. R wave greater than 2.5 mV featured in two out of twelve electrocardiograms suggesting left ventricular hypertrophy. The results of the study will aid the veterinarians in diagnosis and treatment of ascites in dogs.

Keywords: Ascites, dogs, ECG, cardiac

1. Introduction

Cardiovascular diseases are prevalent in animal population and most of them are related to diet and genetic factors. Obesity in companion animals can lead to cardiovascular disease (Neto *et al.*, 2010) [10]. Improper feeding, inadequate exercise and managerial negligence favour obesity that may lead to heart diseases in companion animals (Devi *et al.*, 2009) [2]. Environment also influences cardiovascular disease pattern in animals. Conditions of extreme environmental temperature might result in thermal stress leading to disruption in homeostasis of animals (Parida *et al.*, 2020a) [12]. Alterations in electrocardiograms and injury to myocardial cells has been reported in cattle under heat stress (Mohapatra *et al.*, 2021) [9]. Parida *et al.*, 2020b [13] highlighted the detrimental effects of thermal stress on cardiac cells of goats.

Ascites is referred to as accumulation of serous fluid in peritoneal cavity due to escape of fluid between the parietal and visceral peritoneum from blood vessels, lymphatics, internal organs or abdominal masses (Gattani and Gupta, 2011) [3]. Most common etiology of ascites in pets include left-sided heart failure, congestive heart failure, hypoproteinemia, cirrhosis, hepatic diseases, renal diseases, tuberculosis, ancylostomiasis (Nwoha, 2019) [11]. Canine patients presented to the clinics with ascites are often subjected to kidney function tests (KFT), liver function tests (LFT), total protein (TP), albumin (A) and electrocardiography (ECG). The present study aims to highlight the electrocardiographic abnormalities in dogs suspected to have ascites of cardiac origin with LFT, KFT, TP and A within normal range.

2. Materials and Methods

Labrador Retriever dogs aged between 5 to 10 years presented to the Veterinary Clinical

Complex, C.V.Sc. and A.H., O.U.A.T., Bhubaneswar, Odisha with distended abdomen were screened. Diagnosis of ascites was based on clinical symptoms, tactile percussion of abdomen and classical ground glass appearance in c-arm (Figure 1). Blood samples were collected from the dogs, serum was harvested and sent for evaluation of LFT, KFT, TP and albumin. The dogs having normal serum values of LFT

(AST= 18-56 U/L, ALT= 17-95 U/L), KFT (Urea- 3-8 mmol/l, Creatinine= 0.6 -1.4 mg/dl), TP (5.5-7.2 g/dl) and albumin (3.2-4.1 g/dl) were subjected to electrocardiography (n=12). A twelve-lead standard ECG recorder, Maestros MRX-12 was used to record ECG. The electrocardiograph was set with a paper speed of 25 mm/sec and sensitivity of 1 (1 cm = 1mV). The electrocardiograms were analysed.

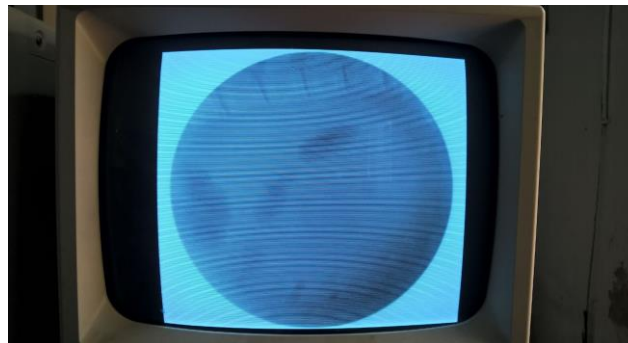


Fig 1: c-arm of an ascitic dog showing ground glass appearance of abdomen

3. Results and Discussion

Atrial fibrillation was interpreted in two out of twelve electrocardiograms characterized by absence of P waves and average ventricular response rate more than 180 (Figure 2). Atrial fibrillation is one of the commonest arrhythmias in dogs (Mohapatra *et al.*, 2015) [8]. Atrial contractile function

might get affected during atrial fibrillation which along with shorter diastolic filling time resulting from higher ventricular response rate could reduce cardiac output. If the heart fails to pump normally, there will be rise in venous pressure and capillary pressure causing increased capillary filtration leading to ascites.

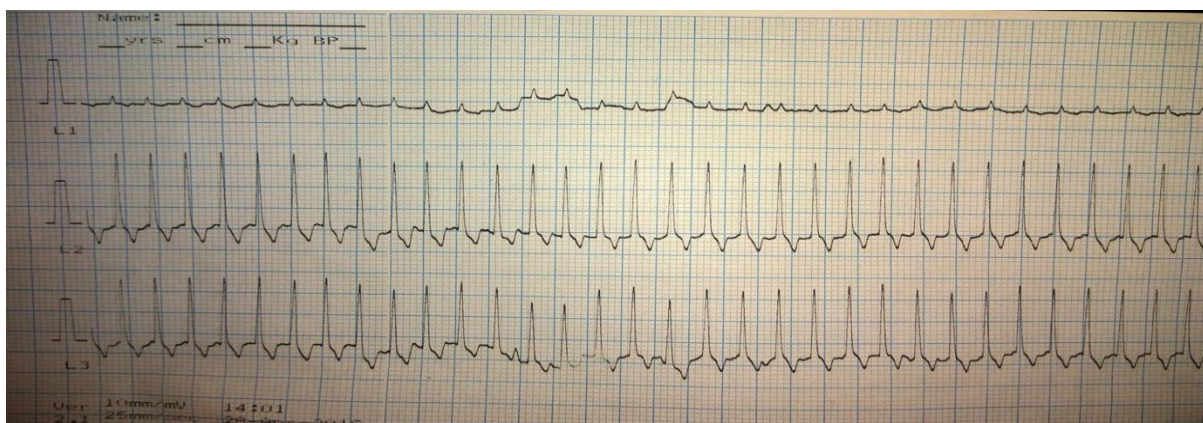


Fig 2: ECG of an ascitic dog showing atrial fibrillation (absence of P waves, tachycardia)

Arrhythmia characterized by irregular RR intervals (Figure 3) was reported in three out of twelve cases of ascites. Clark *et al.*, 1997 [1] reported that an irregular sequence of RR interval decreases cardiac output. Decreased cardiac output will lead

to fall in arterial pressure, causing decreased excretion of salt and water by the kidneys which will elevate blood volume raising capillary hydrostatic pressure leading to ascites.

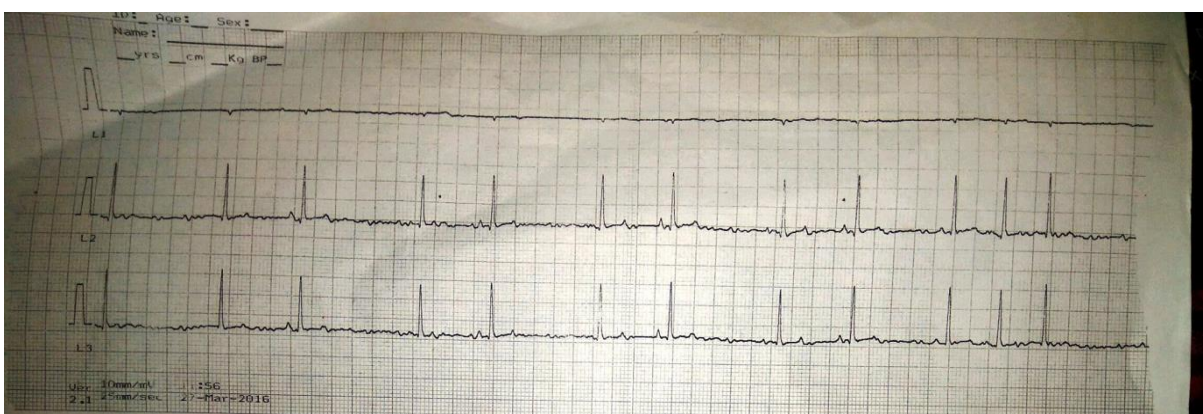


Fig 3: ECG of an ascitic dog revealing arrhythmia (irregular R-R interval)

Low voltage ECG was interpreted in three out of twelve cases (Figure 4). Low voltage QRS complex due to effusion in body cavities was considered significant electrocardiographic abnormalities in ascitic dogs (Kumar and Srikala, 2014) [6].

When the mean electrical axis was calculated using lead I and lead III, a left axis deviation was observed. A shift in mean electrical axis towards left indicates left ventricular enlargement (Martin, 2007) [7].

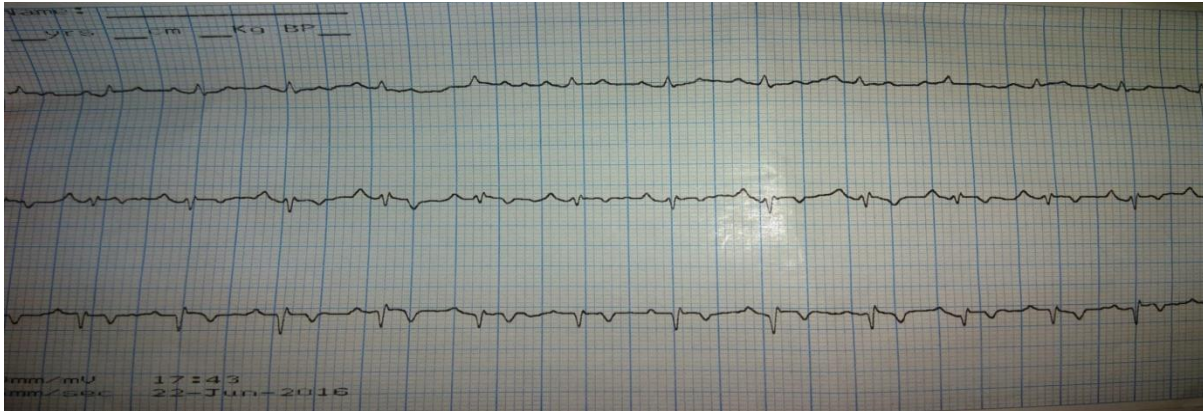


Fig 4: ECG of an ascitic dog showing low voltage ECG (low QRS complex amplitude)

Two out of twelve electrocardiograms had notable ST segment elevation (Figure 5). Generally, ST-segment elevation is attributed to myocardial (and epicardial) ischemia, but it can also be associated with epicarditis and pericarditis (Stem, 2016) [14]. Unlike skeletal muscles, cardiac

muscles have no satellite cells. Thus, when cardiac cells die, they are not replaced. Loss of viable myocardium might impair cardiac function which can reduce cardiac output leading to increased hydrostatic pressure in veins and capillaries resulting in ascites.

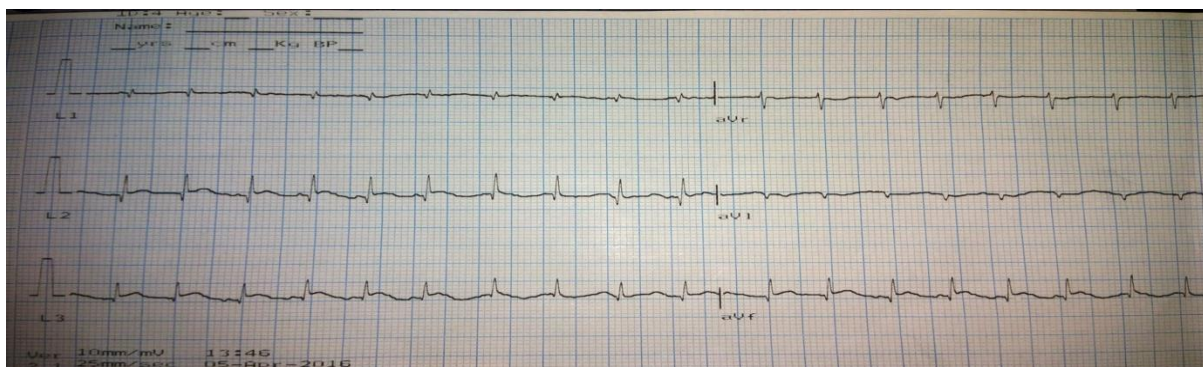


Fig 5: ECG of an ascitic dog showing ST elevation (ST segment above baseline)

R waves greater than 2.5 mV were characteristic feature of two out of twelve electrocardiograms (Figure 6). Higher R wave in ECG indicates left ventricular hypertrophy. Hypertension is the most common cause of left ventricular hypertrophy. Hypertension elevates the left ventricular afterload as the left ventricle needs to pump harder to eject blood into the aorta. Complications of left ventricular hypertrophy include atrial fibrillation, heart failure and death

(Katholi *et al.*, 2011) [5]. Initially, low cardiac output due to cardiac affection diminishes renal perfusion, stimulating secretion of renin and causing increased formation of angiotensin II which leads to increased retention of salt and water by the kidneys leading to hypertension. Left ventricular hypertrophy might be a compensatory remodelling of the heart during chronic hypertension.

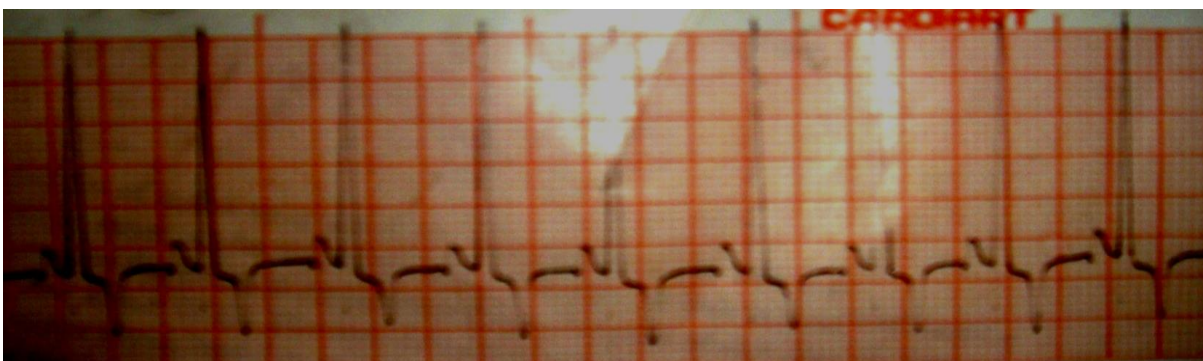


Fig 6: ECG of an ascitic dog showing left ventricular hypertrophy (amplitude of QRS complex > 2.5 mV)

Conclusion

The study reported some of the electrocardiographic abnormalities in ascitic dogs having normal values of LFT, KFT, albumin and total protein. The outcome of this study will aid the veterinarians in diagnosis and treatment of ascites.

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