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Management of pleural and pericardial effusions in dogs with congestive heart failure

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Abstract

Five dogs were presented to the Referral Veterinary Polyclinic, ICAR-Indian Veterinary Research Institute, Izatnagar with a history of inappetance, weakness, reduced urination, respiratory distress, exercise intolerance and cachexia. On observation, dyspnoea and animal reluctance to move were noticed. On physical and clinical examination, rapid shallow respiration, tachycardia, slight pale mucous membrane, normal rectal temperature, distended abdomen and petechial haemorrhages on body surface were noticed. Thoracic auscultation suggested wet rales, cardiac murmurs and muffled heart sounds with increased cardiac area. Neutrophilic leukocytosis was evident in haematological evaluation. Peripheral blood smear was negative for any haemoprotozoan. Serum biochemistry revealed high creatine kinase-MB (CK-MB) levels in affected animals. Electrocardiogram showed low-voltage QRS complexes, and ventricular tachycardia and ventricular premature complexes in some cases. Echocardiography revealed severe pleural and pericardial effusion along with reduced left ventricular chamber dimension at diastole. The diagnosis was made as congestive heart failure with pleural and pericardial effusions. Thoracocentesis and pericardiocentesis were performed as an emergency procedure to safeguard the life and to stabilise the animals. The clinical condition was managed using Inj. Amoxycillin-Clavulanate, Inj. Theophyllin, Inj. Frusemide, Inj. Vitamin B complex & C, and further with Tab. Digoxin, Tab. Enalapril, Tab. Frusemide-Spirinolactone and Tab. Levocarnitine for managing congestive heart failure. Animals showed improvement in clinical signs after therapeutic intervention.

Keywords: Electrocardiogram, Echocardiography, Pleural and pericardial effusions, Thoracocentesis, Pericardiocentesis

Pleural space is defined by visceral pleura covering the lung and parietal pleura covering the chest wall, diaphragm and mediastinum (Feller-Kopman and Light, 2018). Pleural effusion is the accumulation of excess fluid in the pleural space, which may occur due to congestive heart failure, pneumonia and cancer (Light, 2013). Visceral pleura play an important role in absorption of fluids produced by the parietal sheet (Miserocchi, 1997). Various mechanisms involved in this process are capillary pressure, permeability of pleural capillaries, oncotic pressure and the lymphatic drainage of the thorax (Sabev *et al.*, 2008). Restrictive respiration, tachypnoea, dyspnoea, open mouth breathing, cyanosis and lethargy are the common clinical signs noticed in congestive heart failure (CHF), and in chronic condition, coughing will be present.

Pericardial effusion is an abnormal accumulation of fluid within the pericardial space and is the most common disease of the pericardium in dogs. The most common causes are neoplasia or idiopathic pericarditis (IP). Electrocardiography is important diagnostic tool but it does not differentiate between various etiologies of effusion. Echocardiography is considered as the most useful non-invasive tool for differentiating the cause of effusion (Johnson *et al.*, 2004). In the present report, successful management of pleural and pericardial effusions in dogs with CHF has been described.

Clinical History and Observations

Five dogs were presented to the Referral Veterinary Polyclinic, ICAR-Indian Veterinary Research Institute, Izatnagar with a history of inappetance, weakness, reduced urination, respiratory distress, exercise intolerance and cachexia. The case details have been depicted in Table 1. On observation, dyspnoea and reluctance in movement was noticed. On physical and clinical examination, rapid shallow respiration, tachycardia, slight pale mucous membrane, normal rectal temperature, distended abdomen and petechial haemorrhages on body surface were noticed. Thoracic

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auscultation suggested wet rales, reduced lung sounds ventrally, cardiac murmurs and muffled heart sounds with increased cardiac area. Haematological examinations revealed leukocytosis with neutrophilia (Table 2). On blood smear examination, no haemoprotozoans could be detected. Serum biochemistry results showed increase in creatine kinase-MB (CK-MB) levels (Table 2). Electrocardiogram (ECG) showed low-voltage QRS complexes, and ventricular tachycardia and ventricular premature complexes in some cases (Table 1) (Fig. 1, 2, 3, 4 and 5). Echocardiography revealed severe pleural effusion and pericardial effusion along with reduced left ventricular chamber dimension at diastole, increased inter ventricular septal diameter (suggestive of left ventricular hypertrophy) and increased ejection fraction (Table 1) (Fig. 6).

Treatment and Discussion

For stabilising the patients, immediate thoracocentesis and pericardiocentesis were performed. Animals were restrained manually in sternal recumbency and a 21 gauge scalp vein, connected with a 3-way tap and syringe was inserted at the upper third of 7^{th}- 8^{th} inter-costal space along the cranial border of the rib (Fig. 7) (Murphy and Papasouliotis, 2011). Pericardiocentesis was performed between the 4^{th}-5^{th} inter-costal spaces (Fig. 8) (Celona *et al.,* 2017). After proper placing of scalp vein, the 3-way stopper was opened and a clear plasma-like or reddish tinged fluid was removed. About 500 mL of fluid was removed within 10 min using syringe without applying much pressure. After thoracocentesis and pericardiocentesis, animals exhibited reduction in respiration discomfort and were treated with Inj. Amoxycillin-Clavulanate @ 8.75 mg/Kg BW, I/V, Inj. Theophyllin @ 10 mg/Kg BW, I/M, Inj. Frusemide @ 2 mg /Kg BW, I/V and Inj. Vitamin B complex & C @ 1 mL/10 kg BW, I/M. Further, the owners were advised to give Tab. Amoxycillin-Clavulanate @ 12.5 mg/kg BW, bid for 4 days and Tab. Digoxin @ 5 µg/Kg BW, bid, Tab. Enalapril @ 0.5 mg/Kg BW, bid, Tab. Frusemide-Spirinolactone @ 2 mg/Kg BW, bid, Tab. Levocarnitine 500 mg, sid, Tab. Theophyllin @ 10 mg/Kg BW, bid for managing congestive heart failure and animals showed improvement in clinical signs after therapeutic intervention.

The precise and timely diagnosis of CHF can be difficult most of the time. Worsening of respiratory distress with excessive manipulations can limit diagnostic evaluation (DeFrancesco *et al*., 2007). Abnormal accumulation of pleural fluid is attributable to increased capillary hydrostatic pressure or capillary permeability, or impaired lymphatic drainage (Gheorghiade *et al*., 2006).

Table 1: History, clinical, ECG and echocardiogram findings of the dogs with pleural and pericardial effusions

Sl. No.	Case No.	Breed	Age/Sex	History and clinical findings	ECG findings	Echocardiogram findings
1	7585	Spitz	4 years/M	Previous history of ascites, respiratory distress, muffled heart sound	Low PQRST	Pleural effusion
2	2827	Labrador Retriever	2 years/M	Exercise intolerance, reduced urination, dullness, cachexia, tachycardia, muffled heart sounds	Low QRS	Pleural and pericardial effusions
3	3233	Great Dane	5 years/F	Weakness, inappetence, respiratory distress, petechial haemorrhages, cardiac murmurs	Low QRS and widened QRS	Pleural and pericardial effusions
4	5328	German Shepherd	1 year/F	Exercise intolerance, cachexia, cardiac murmurs, increased area of cardiac auscultation	Arrhythmia and low QRS complexes	Pleural and pericardial effusions
5	7901	German Shepherd	8 years/M	Exercise intolerance, tiring, cardiac murmurs, open mouth breathing, abdominal type of respiration, orthopnoea	Ventricular tachycardia and fibrillations	Pleural and pericardial effusions

Table 2: Haemato-biochemical parameters of dogs on day 0 and day 28

Parameter	Day 0	Day 28	Reference range*	Remarks
TEC ($\times 10^6/\mu L$)	5.12±0.15	5.87±0.89	4.95-7.87	N
PCV (%)	35.15±1.34	36.67±1.02	35-57	N
Hb (g/dL)	12.31±2.11	12.47±1.38	11.9-18.9	N
MCV (fL)	66.27±2.83	67.52±1.93	66-77	N
MCH (pg)	21.89±0.96	22.78±1.03	21.0-26.2	N
MCHC (%)	34.86±1.08	35.18±1.31	32.0-36.3	N
TLC ($\times 10^3/\mu L$)	20.475±2.27	9.169±1.35	5.0-14.1	Leukocytosis
Neutrophils (%)	85.67±1.25	68.21±0.23	58-85	Neutrophilia
Lymphocytes (%)	8.78±2.38	23.43±1.58	8-29	N
Monocytes (%)	5.35±0.27	4.79±0.52	5-11	N
Basophils (%)	0.4±0.14	0.5±0.22	0-4	N
Eosinophils (%)	1.78±0.14	4.48±0.75	0-9	N
Platelets (lakhs/ mm^3)	2.73±0.21	2.94±0.18	2.11-6.21	N
Total protein (g/dL)	6.32±0.27	6.91±0.77	5.4-7.5	N
Albumin (g/dL)	2.74±0.15	2.92±0.23	2.3-3.1	N
Globulin (g/dL)	3.57±0.41	3.98±0.09	2.4-4.4	N
Albumin:Globulin	0.76±0.03	0.73±0.14	0.6-1.3	N
ALT (U/L)	77.58±5.36	49.98±4.85	10-109	N
AST (U/L)	38.89±3.58	33.58±2.37	05-55	N
BUN (mg/dL)	19.51±1.96	18.58±1.25	8-28	N
Creatinine (mg/dL)	1.15±0.04	1.08±0.08	0.5-1.7	N
CK-MB (U/L)	227.39±5.427	74.87±3.83	25-125	Cardiomyopathy

*2016: Haematological and serum biochemical reference ranges, 11th edn. The Merck Veterinary Manual, N: Normal

Pleural effusion is generally classified as transudates or modified transudates; septic or non septic exudates; chylous, hemorrhagic or neoplastic effusion. Clinical signs are mostly related to respiratory system. Clinical signs of pleural space disease include an increased respiratory rate and effort characterized by rapid and shallow breaths, dyspnoea, and coughing, rarely (Syring and Drobatz, 2000). Signs of exercise intolerance, tachypnea, dyspnoea, cyanosis have been seen in dogs and cats with pleural effusion (Murphy and Papasouliotis, 2011). Localized or diffuse reduction in heart and lung sounds on thoracic auscultation are common in pleural effusions. Auscultation may help to differentiate pleural effusion from other causes, as in pleural effusions, heart and lung sounds are diminished ventrally (Sigrist, 2011). Fluid line with hyporesonant sounds ventrally and normal sound dorsally can be demonstrated by thoracic percussion.

Low voltage QRS complexes were recorded in electrocardiographic examination in the present cases. Similar findings with attenuated QRS complexes in case of pericardial effusion have also been reported by previous workers (Stepien *et al*., 2000). Ultrasonography and radiography are used for definitive diagnosis. Ultrasonography may aid in the identification of appropriate site for thoracocentesis, diagnosis of cardiac problems and visualization of intra thoracic mass. Systemic inflammation is seen in animals having severe heart failure and inflammatory mediators can be released from failing heart itself which may cause neutrophilic leukocytosis (Petrič *et al*., 2018). CK-MB has been used as biochemical marker for cardiac injury in humans, so raised levels of CK-MB in serum biochemical analysis may be due to myocardial infarction (Diniz *et al*., 2007).

Thoracocentesis and pericardiocentesis are simple minimally invasive procedures that are well tolerated by most canine patients in respiratory distress. Thoracocentesis and pericardiocentesis may help in both diagnosis and management of animals with pleural and pericardial effusion, respectively (Celona *et al.,* 2017; Holden and Drobatz, 2018). If the animal is severely

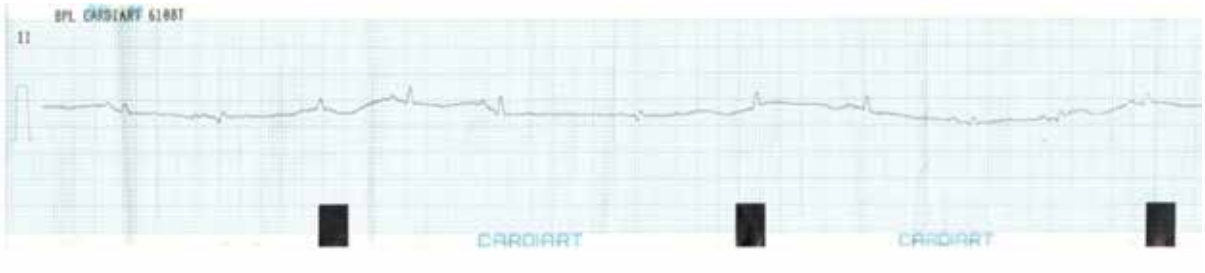

Fig. 1: Electrocardiogram showing low PQRST complexes in a Spitz dog with pleural effusion (Lead II, Paper speed: 50 mm/sec. Sensitivity: 1 mV = 1 cm)

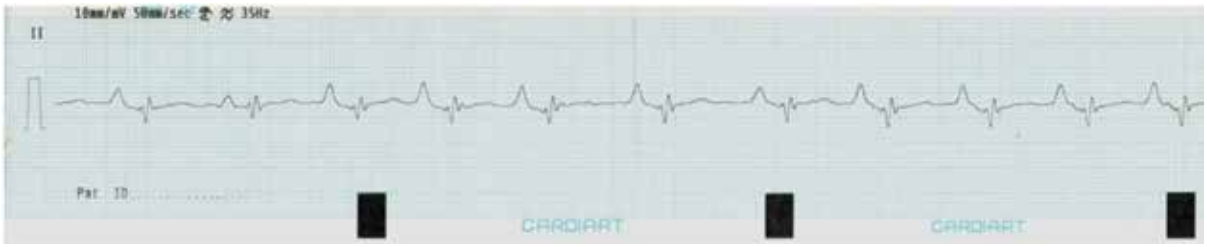

Fig. 2: Electrocardiogram showing low QRS complexes in a Labrador dog with pleural and pericardial effusion (Lead II, Paper speed: 50 mm/sec. Sensitivity: 1 mV = 1 cm)

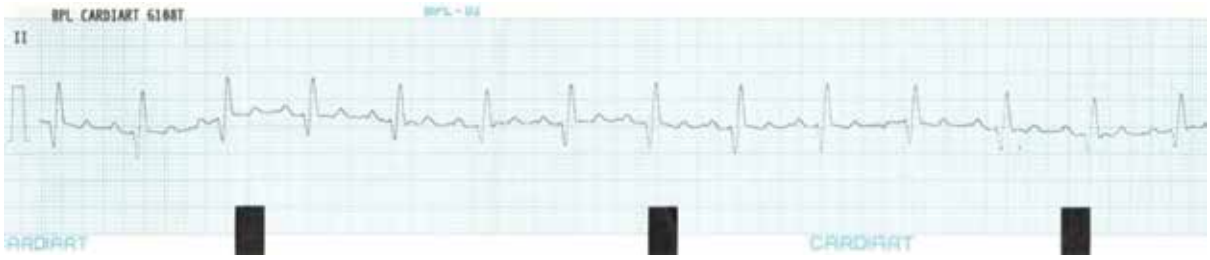

Fig. 3: Electrocardiogram showing low QRS complexes in a Great Dane dog with pleural and pericardial effusion (Lead II, Paper speed: 50 mm/sec. Sensitivity: 1 mV = 1 cm)

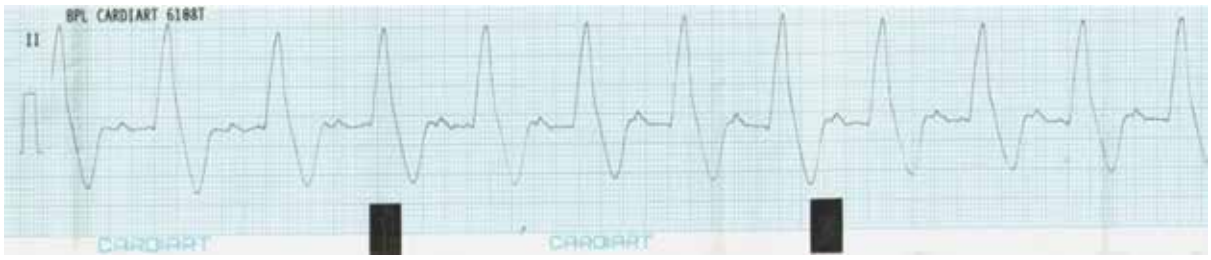

Fig. 4: Electrocardiogram showing ventricular tachycardia in a German Shepherd dog with pleural and pericardial effusion (Lead II, Paper speed: 50 mm/sec. Sensitivity: 1 mV = 1 cm)

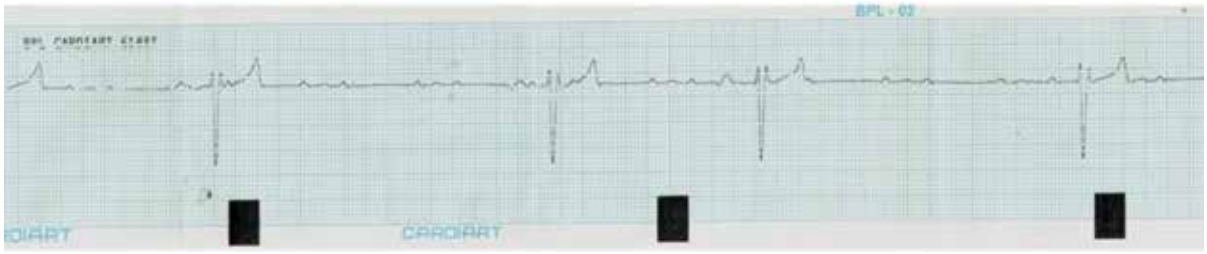

Fig. 5: Electrocardiogram showing multifocal ventricular premature complexes in a German Shepherd dog with pleural and pericardial effusion (Lead II, Paper speed: 50 mm/sec. Sensitivity: 1 mV = 1 cm)

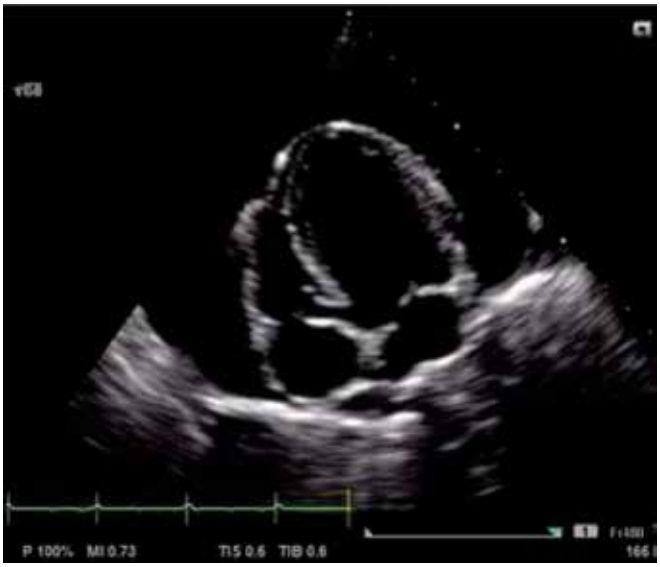

Fig. 6: Long axis four chambered view of echocardiogram showing severe pericardial effusion in a German shepherd dog

Fig. 7: Thoracocentesis being performed in a Spitz dog with pleural effusion

Fig. 8: Pericardiocentesis being performed in a German Shepherd dog with pericardial effusion

dyspnoeic and auscultation of thorax reveals presence of fluid or air, thoracocentesis should be performed immediately. In the present cases, there was reduction in respiratory discomfort of animals after thoracocentesis and pericardiocentesis. Alteration in the pleural fluid protein content and cellularity can give some clue on underlying disease. Low protein effusions are generally caused by cardiac, renal, or hepatic disease. Effusion with high protein content (>3 g/dL) suggests increased vascular permeability or caused by inflammatory or neoplastic conditions.

Frusemide acts on loop of Henle of kidney and promotes excretion of water, sodium, chloride, potassium and hydrogen ions. Frusemide at the dose rate of 1-4 mg/Kg BW has proven to be beneficial in the management of congestive heart failure (Atkins *et al.,* 2009). For counteracting CHF-associated vasoconstriction and inhibiting fluid retention by reducing ventricular load, angiotensin converting enzyme inhibitors (ACEI) are given (Bonagura and Keene, 2014). Enalapril at the dose rate of 0.25-0.5 mg/Kg BW is most commonly used ACEI in canine. Although digoxin is a very weak positive ionotrope, it slows the ventricular rate in order to allow better ventricular filling, particularly during atrial fibrillation. For this reason, its use at the dose rate of 0.005 to 0.01 mg/kg BW is considered in the treatment of CHF (Opie and Gersh, 2001).

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Conflict of interest

The authors declare that they have no conflict of interest.

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