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Comparative clinical and diagnostic assessment of dilated cardiomyopathy and pericardial effusion in dogs

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Abstract

The present study was undertaken to comprehensively evaluate cardiac diseases in dogs using clinical, haemato-biochemical, and radiographic approaches. A total of 507 dogs presented to the Veterinary Clinical Complex, Post Graduate Institute of Veterinary and Animal Sciences, Akola were screened, of which 63 (12.4%) were suspected and 30 (47.62%) were confirmed with cardiac disease, including dilated cardiomyopathy (DCM; n=24) and pericardial effusion (PE; n=6), while 10 apparently healthy dogs served as controls. Clinical examination revealed inappetence, exercise intolerance, and dyspnoea as predominant signs, with significant increases ($p \leq 0.01$) in respiratory and heart rates in affected dogs. Haematological and biochemical parameters showed non-significant variation, indicating limited diagnostic utility. Radiographic evaluation demonstrated cardiomegaly and significantly increased vertebral heart score ($p < 0.01$), aiding in assessment of cardiac enlargement. Overall, the study highlights that a comprehensive diagnostic approach is essential for accurate evaluation and differentiation of cardiac diseases in dogs.

Keywords: Cardiac diseases, dogs, dilated cardiomyopathy, pericardial effusion, clinical evaluation, radiography.

Introduction

Cardiac diseases are increasingly recognized as a significant cause of morbidity and mortality in dogs, accounting for approximately 10–15% of clinical cases and representing one of the most frequently encountered systemic disorders after neoplastic conditions. Among these, acquired cardiac diseases such as dilated cardiomyopathy (DCM) and pericardial effusion (PE) are of particular clinical importance due to their progressive nature, late clinical presentation, and potential to result in congestive heart failure or cardiac tamponade. Previous studies have reported a considerable prevalence of cardiac disorders in dogs across different regions, with DCM being predominant in large and giant breeds, while PE has been associated with both idiopathic and secondary causes (Hoque *et al.*, 2019; Sagar *et al.*, 2020; Sahoo *et al.*, 2022; Sawhney *et al.*, 2022; Yadav *et al.*, 2023) [5, 12, 13, 14, 18].

Clinical manifestations such as dyspnoea, exercise intolerance, coughing, ascites, and syncope often appear only in advanced stages, thereby limiting early diagnosis based solely on clinical signs. Consequently, a multimodal diagnostic approach incorporating haemato-biochemical analysis, thoracic radiography, electrocardiography, and echocardiography has been emphasized in previous investigations. However, several authors have reported that haematological and biochemical parameters show limited specificity in cardiac diseases and are mainly useful for assessing concurrent systemic involvement (Thirunavukkarasu *et al.*, 2018; Jan *et al.*, 2018; Patowary *et al.*, 2022) [16, 6, 9]. In contrast, radiographic evaluation, particularly vertebral heart score (VHS), has been widely used as a practical and reliable indicator of cardiac enlargement and has shown good diagnostic utility in both DCM and PE (Guglielmini *et al.*, 2012; Parmar *et al.*, 2021) [4, 8].

Despite these advancements, most available studies have focused on individual cardiac conditions or single diagnostic modalities, with limited comparative evaluation of different cardiac disorders under field conditions, especially in Indian clinical settings. Furthermore, there is a paucity of region-specific data correlating clinical findings with haemato-biochemical and radiographic changes in dogs affected with DCM and PE.

Therefore, the present investigation was undertaken to comparatively assess dilated cardiomyopathy and pericardial effusion in dogs using clinical examination, haemato-biochemical parameters, and thoracic radiography. The purpose of this study was to identify and characterize affected cases, evaluate the diagnostic relevance of selected parameters, and establish a practical approach for differentiation of these conditions under routine clinical conditions. This article builds upon and complements previous research by providing a comparative, field-based evaluation of two major cardiac disorders, thereby contributing to improved diagnostic strategies in canine cardiology.

Objectives of the Study

1. To identify dogs suffering from cardiac ailments
2. To evaluate haemato-biochemical parameters
3. To perform radiographic evaluation

Materials and Methods

The present study was conducted at the Department of Veterinary Medicine, Veterinary Clinical Complex and Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Sciences, Akola, and included clinical and referral cases presented to the Outpatient Department. Apparently healthy dogs presented for vaccination and routine health check-ups, with no clinical or diagnostic evidence of cardiac disease, were included as the control group (T₁), whereas dogs of any age, breed, or sex exhibiting clinical signs suggestive of cardiac disorders such as dyspnoea, tachypnoea, coughing, exercise intolerance, syncope, cyanosis, ascites, oedema, or cardiac murmur were included in the study groups and categorized as dilated cardiomyopathy (T₂) and pericardial effusion (T₃). Dogs previously treated for cardiac or other systemic diseases were excluded from the study.

Clinical and Physical Examination

A detailed anamnesis was obtained, followed by thorough clinical examination including rectal temperature, hydration status, mucous membrane colour, pulse rate, respiratory rate, heart rate, systolic blood pressure, and auscultation of cardiac and pulmonary sounds. Cardiac murmurs were graded from Grade I to VI as per standard classification. Systolic blood pressure was measured non-invasively using a cuff-based device.

Haematological and Biochemical Analysis

Blood samples were collected aseptically for haemato-biochemical evaluation. Haematological parameters including haemoglobin, packed cell volume, total erythrocyte count, total leukocyte count, differential leukocyte count, and platelet count were analysed using an automated analyser. Biochemical analysis included liver function tests (AST, ALT, ALP, total protein, albumin, globulin, bilirubin) and kidney function tests (BUN and creatinine).

Radiography

Thoracic radiography was performed in right lateral view without sedation, and vertebral heart score (VHS) was calculated to assess cardiac enlargement.

Statistical Analysis

Statistical analysis of the data was performed using WASP 2.0 software, and results were analysed using one-way ANOVA as per standard procedures.

Results and Discussion

Occurrence of Cardiac Diseases

Out of 507 dogs examined, 63 (12.4%) were suspected to be suffering from cardiac diseases and out of that 30 (47.62%) were confirmed with cardiac diseases. DCM was predominant (80%) followed by PE (20%), indicating its higher prevalence in clinical cases.

Signalment

Breed-wise distribution revealed that dilated cardiomyopathy (DCM) was most commonly observed in Labrador Retrievers (41.67%), followed by Doberman Pinschers and Pomeranians (12.50% each), while Non-descript, Pug and Rottweiler breeds showed moderate occurrence (8.33% each), and Golden Retriever and German Shepherd breeds were least affected (4.17% each). In contrast, pericardial effusion (PE) was most frequently recorded in Doberman Pinschers (33.33%), whereas Labrador Retriever, Non-descript, Rottweiler, and German Shepherd breeds each accounted for 16.67% of cases, with no occurrence in Pomeranian, Pug, and Golden Retriever breeds. The predominance of Labrador Retrievers in DCM cases suggests a breed predisposition, which is in agreement with earlier reports by Thirunavukkarasu (2019)^[15], Sagar *et al.*, (2020)^[12], Parmar *et al.*, (2021)^[8], Rao *et al.*, (2021)^[10], Sahoo *et al.*, (2022)^[13], Sawhney *et al.*, (2022)^[14], and Yadav *et al.*, (2023)^[18]. This may be attributed to genetic susceptibility as well as their higher population and presentation rates. Similarly, the higher occurrence of PE in Doberman Pinschers may be associated with breed-related cardiac vulnerability; however, the distribution across multiple breeds indicates that cardiac diseases are not strictly breed-specific.

Age-wise distribution showed that both DCM and PE were predominantly observed in dogs older than 6 years (DCM: 50%; PE: 66.67%), followed by dogs between 3–6 years (DCM: 50%; PE: 33.33%), with no cases recorded below 3 years of age. These findings are consistent with the observations of Sagar *et al.*, (2020)^[12], Parmar *et al.*, (2021)^[8], Sawhney *et al.*, (2022)^[14], and Yadav *et al.*, (2023)^[18], who reported a higher prevalence of cardiac diseases in middle-aged and geriatric dogs. This trend may be attributed to progressive degenerative changes in the myocardium and cardiac valves associated with ageing.

Sex-wise occurrence revealed a slightly higher prevalence in males compared to females in DCM (Males: 54.16% and Females: 45.83%), while PE showed equal distribution between sexes (50% each). Similar findings have been reported by Thirunavukkarasu (2019)^[15], Sagar *et al.*, (2020)^[12], Parmar *et al.*, (2021)^[8], and Sawhney *et al.*, (2022)^[14]. The higher occurrence in males may be influenced by behavioural factors and increased clinical presentation; however, the comparable distribution between sexes suggests that gender is not a definitive risk factor for cardiac diseases.

Clinical and Physical Examination

Clinical and Physical examination revealed that in DCM affected dogs (n=24), inappetence (91.6%), exercise intolerance with lethargy (87.5%) (Fig.4.1), and dyspnoea (79.1%) (Fig. 4.2) were the predominant signs, followed by coughing (50%), whereas abdominal distension (8.3%) (Fig. 4.3), cardiac cachexia (4.1%) (Fig. 4.4), and syncope (4.1%) were less frequently observed. In PE affected dogs (n=6), inappetence (100%) and exercise intolerance with lethargy (100%) (Fig. 4.1) were consistently observed, followed by dyspnoea (83.3%) (Fig. 4.2), coughing (50%), abdominal distension (33.3%) (Fig. 4.3), and cardiac cachexia (33.3%) (Fig. 4.4), with vomiting also noted in 50% of cases. The predominance of inappetence, lethargy, and dyspnoea in both groups reflects reduced cardiac output and hemodynamic compromise, as reported by Yadav *et al.*, (2024) ^[19], Elsharkawy *et al.*, (2022) ^[2], and Kumar *et al.*, (2025) ^[7]. Abdominal distension observed in PE cases may be attributed to increased pericardial pressure impairing diastolic filling, particularly affecting the right heart, whereas coughing in PE may result from airway compression due to pericardial fluid accumulation, and in DCM it is likely associated with pulmonary edema secondary to left-sided heart failure.

Clinical parameters such as rectal temperature showed a non-significant difference among groups, with comparable values

in healthy, DCM and PE affected dogs. In contrast, respiratory rate was significantly elevated ($p \leq 0.01$) in DCM (47.42 ± 1.60 breaths/min) and PE (44.67 ± 1.91 breaths/min) groups compared to healthy dogs (19.00 ± 1.21 breaths/min), indicating respiratory compromise associated with cardiac dysfunction. Similarly, heart rate was significantly increased ($p \leq 0.01$) in DCM (132.25 ± 1.04 bpm) and PE (131.33 ± 1.20 bpm) compared to control (121.80 ± 1.29 bpm), with 36.6% of affected dogs showing tachycardia. However, pulse rate and systolic blood pressure showed non-significant variation among groups, indicating relatively preserved peripheral circulation and arterial pressure.

Clinically, hypokinetic pulse (13.3%) and pulse deficit (33.3%) were observed in affected dogs, reflecting reduced cardiac output and arrhythmias. Mucous membrane evaluation revealed variations including normal pink (40%) (Fig. 4.5), pale (43.33%), congested (10%) (Fig. 4.6) and pallor (6.66%) (Fig. 4.7), suggestive of altered perfusion and oxygenation status. Cardiac murmurs were detected only in DCM dogs (10%), consistent with valvular insufficiency. Hydration status varied, with dehydration more pronounced in PE dogs, likely due to impaired diastolic filling and reduced effective circulating volume, whereas in DCM it may be associated with reduced myocardial contractility and peripheral perfusion compromise.

Table 1: Mean $\pm$ SE values of Clinical parameters of Dogs in Healthy & Affected Dogs.

Parameters	Control group (T ₁ ; n=10)	Study groups		CD value
		DCM affected group (T ₂ ; n=24)	PE affected group (T ₃ ; n=06)	
Rectal temperature (°F)	101.84 $\pm$ 0.16	101.95 $\pm$ 0.12	102.33 $\pm$ 0.22	
Respiratory rate (bpm)	19.00 $\pm$ 1.21 ^b	47.42 $\pm$ 1.60 ^a	44.67 $\pm$ 1.91 ^a	10.47 ($p < 0.01$)
Heart rate (bpm)	121.80 $\pm$ 1.29 ^b	132.25 $\pm$ 1.04 ^a	131.33 $\pm$ 1.20 ^a	7.22 ($p < 0.01$)
Pulse rate (bpm)	121.80 $\pm$ 1.29	124.67 $\pm$ 1.24	123.50 $\pm$ 1.84	
Blood pressure (mmHg)	127.10 $\pm$ 1.17	128.96 $\pm$ 0.86	131.00 $\pm$ 2.53	

Means bearing different superscript(s) are significantly different

Haematological and Biochemical Findings

Haematological evaluation revealed that parameters including Hb, TEC, PCV, PLT, TLC, and differential leukocyte count showed non-significant variation among healthy, DCM and PE affected dogs and remained within normal physiological limits, although slight reductions in Hb, PCV, and PLT were observed in PE cases. A mild increase in TLC and neutrophil count in affected dogs may be attributed to underlying inflammatory conditions. These findings are in agreement with Thirunavukkarasu *et al.*, (2018) ^[16], Jan *et al.*, (2018) ^[6], and Patowary *et al.*, (2022) ^[9], suggesting that haematological parameters have limited diagnostic value in cardiac diseases and are mainly useful for detecting concurrent disorders.

Similarly, biochemical parameters including liver and kidney function tests showed non-significant differences among groups. A slight increase in ALP in DCM cases may be

associated with congestive hepatopathy, while mild reduction in albumin in PE cases may reflect hepatic involvement or altered protein metabolism. Blood urea nitrogen (BUN) showed a mild increase in affected groups, whereas creatinine remained unchanged, indicating possible prerenal azotemia secondary to reduced cardiac output and compromised renal perfusion. These findings are consistent with Thirunavukkarasu *et al.*, (2018) ^[16], Birmole (2025) ^[1], and Reddy (2021) ^[11].

Overall, the results indicate that haematological and biochemical parameters remained largely within normal limits and showed non-significant variation, supporting previous reports that these investigations are primarily useful for ruling out concurrent systemic conditions rather than for definitive diagnosis of cardiac diseases.

Table 2: The Mean $\pm$ SE of haematological parameters in apparently healthy control dogs group (T₁) and study groups (T₂ and T₃)

Parameters	Control group (T ₁ ; n=10)	Study groups	
		DCM affected group (T ₂ ; n=24)	PE affected group (T ₃ ; n= 06)
Hb (g/dl)	13.87 $\pm$ 0.10	13.40 $\pm$ 0.70	11.10 $\pm$ 0.67
TEC (x10 ⁶ / μ l)	6.35 $\pm$ 0.06	6.38 $\pm$ 0.26	5.85 $\pm$ 0.24
PCV (%)	41.91 $\pm$ 0.22	40.95 $\pm$ 1.97	32.93 $\pm$ 2.80
PLT (x10 ³ / μ l)	2.95 $\pm$ 0.13	2.64 $\pm$ 0.21	2.21 $\pm$ 0.66
TLC (x10 ³ / μ l)	15.74 $\pm$ 0.28	16.43 $\pm$ 0.14	15.90 $\pm$ 0.38
Lymphocyte (%)	17.98 $\pm$ 0.25	17.11 $\pm$ 0.86	17.13 $\pm$ 2.86
Monocyte (%)	4.15 $\pm$ 0.20	4.16 $\pm$ 0.34	4.53 $\pm$ 0.66
Neutrophil (%)	74.47 $\pm$ 0.78	77.44 $\pm$ 0.93	79.43 $\pm$ 1.72
Eosinophil (%)	1.49 $\pm$ 0.11	1.53 $\pm$ 0.22	1.59 $\pm$ 0.72
Basophil (%)	0.04 $\pm$ 0.00	0.04 $\pm$ 0.00	0.03 $\pm$ 0.01

The values represent non-significant variations between the group

Table 3: The mean $\pm$ SE of serum biochemical parameters in apparently healthy control group (T₁) and study groups (T₂ and T₃)

Parameters	Control group (T ₁ ; n=10)	Study groups	
		DCM affected group (T ₂ ; n=24)	PE affected group (T ₃ ; n=06)
Total protein (g/dl)	5.84 $\pm$ 0.10	5.31 $\pm$ 0.18	5.03 $\pm$ 0.26
ALP (IU/L)	92.55 $\pm$ 6.17	121.84 $\pm$ 7.50	114.83 $\pm$ 4.13
AST (IU/L)	47.80 $\pm$ 2.86	60.41 $\pm$ 8.36	76.50 $\pm$ 9.68 62
ALT (IU/L)	60.49 $\pm$ 3.85	62.45 $\pm$ 5.06	60.53 $\pm$ 6.49
Albumin (g/dl)	2.80 $\pm$ 0.07	2.49 $\pm$ 0.08	2.48 $\pm$ 0.15
Globulin (g/dl)	3.37 $\pm$ 0.15	2.48 $\pm$ 0.09	2.53 $\pm$ 0.16
Total Bilirubin (mg/dl)	0.41 $\pm$ 0.02	0.52 $\pm$ 0.03	0.50 $\pm$ 0.08
Direct Bilirubin (mg/dl)	0.19 $\pm$ 0.02	0.22 $\pm$ 0.04	0.13 $\pm$ 0.01
Creatinine (mg/dl)	1.12 $\pm$ 0.02	1.33 $\pm$ 0.19	1.16 $\pm$ 0.10
BUN (mg/dl)	23.33 $\pm$ 13.75	26.81 $\pm$ 0.92	25.35 $\pm$ 1.58

The values represent non-significant variations between the group

Radiographic Findings

Thoracic radiographic evaluation revealed cardiomegaly (90%) as the most common abnormality, followed by pulmonary edema (73.3%), tracheal elevation (40%), globoid cardiac silhouette (30%), and pleural effusion (10%). In DCM affected dogs, cardiomegaly (91.6%) (Fig. 4.7) and pulmonary edema (79.1%) (Fig. 4.7) were predominant, indicating chamber dilatation and left-sided heart failure, whereas globoid cardiac silhouette (100%) (Fig. 4.8) was the characteristic finding in PE dogs, reflecting pericardial fluid accumulation. tracheal elevation (66.6%) (Fig. 4.9) and Pleural effusion (50%) (Fig. 4.10) were more frequently observed in PE cases, likely due to cardiac tamponade and

altered thoracic anatomy.

The mean $\pm$ SE vertebral heart score (VHS) (Fig. 4.11 and Fig. 4.12) was significantly increased ($p < 0.01$) in DCM (11.43 $\pm$ 0.13) and PE (10.93 $\pm$ 0.31) groups compared to healthy dogs (10.22 $\pm$ 0.08), indicating cardiac enlargement, while no overlap in statistical significance was observed between study and control groups. These findings are consistent with previous reports (Guglielmini *et al.*, 2012; Parmar *et al.*, 2021; Yadav *et al.*, 2023) [4, 8, 18]. The increased VHS in DCM may be attributed to ventricular dilatation, whereas in PE it reflects pericardial fluid accumulation leading to an enlarged cardiac silhouette.

Table 4: The mean $\pm$ SE of VHS in apparently healthy control dogs group (T₁) and study groups (T₂ and T₃).

Parameter	Healthy Control Group (T ₁ ; n=10)	Study Groups	
		DCM affected group (T ₂ ; n=24)	PE affected group (T ₃ ; n=06)
Vertebral Heart Score (VHS)	10.22 $\pm$ 0.08 ^b	11.43 $\pm$ 0.13 ^a	10.93 $\pm$ 0.31 ^a

Means bearing different superscript(s) are significantly different ($p < 0.01$)

CD for group ($p < 0.01$) = 0.92

**Fig 1:** Exercise intolerance and lethargy observed in a dog affected with cardiac ailments**Fig 3:** Abdominal distension (ascites) observed in a dog affected with cardiac ailments**Fig 2:** Dyspnoea and open mouth breathing observed in a dog affected with cardiac ailments**Fig 4:** Cardiac cachexia observed in a dog affected with Cardiac ailments



Fig 5: Congested mucous membrane observed in a dog affected with cardiac ailments



Fig 6: Pale mucous membrane observed in a dog affected with cardiac ailments

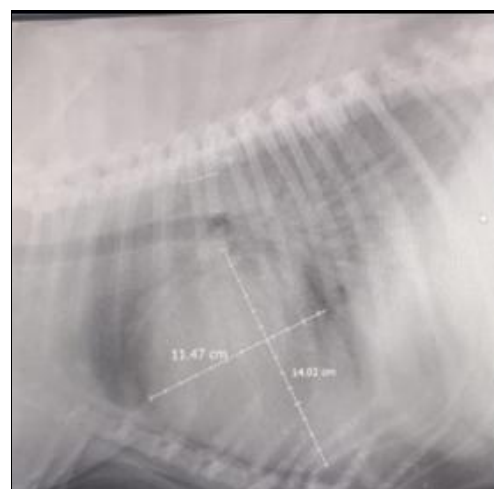


Fig 7: Cardiomegaly with pulmonary edema and elevated trachea in a dog affected with DCM



Fig 8: Thoracic radiography showing Globoid cardiac silhouette with cardiomegaly in a dog affected with PE



Fig 9: Thoracic radiography showing Elevation of trachea with pulmonary edema in a dog affected with PE



Fig 10: Thoracic radiography showing Pleural Effusion with pulmonary edema in dog affected with PE



Fig 11: Thoracic radiography showing cardiomegaly with increased VHS in a dog affected with DCM



Fig 12: Thoracic radiography with increased VHS in a dog affected with PE

Conclusion

The present study demonstrated that dilated cardiomyopathy

(DCM) was the most prevalent cardiac disorder in dogs, followed by pericardial effusion (PE), predominantly affecting middle-aged and geriatric animals. Clinical signs such as inappetence, lethargy, and dyspnoea reflected underlying hemodynamic compromise, with significant increases ($p \leq 0.01$) in respiratory and heart rates, while other clinical parameters showed non-significant variation. Haematological and biochemical parameters remained largely within normal limits, indicating limited diagnostic value. Radiographic findings, particularly cardiomegaly and increased vertebral heart score, aided in identifying cardiac enlargement. Overall, a comprehensive diagnostic approach is essential for accurate evaluation and differentiation of cardiac diseases in dogs.

Abbreviation

DCM – Dilated cardiomyopathy

PE – Pericardial effusion

VHS – Vertebral heart score

Conflict of Interest

The authors declare no conflict of interest.

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