International Journal of Livestock Research, Vol. 10 (11) Nov' 2020
http://www.ijlr.org
eISSN: 2277-1964
NAAS Rating 2020 – 5.36

Original Research

Clinico-Diagnostic Studies on Acquired Heart Diseases in Geriatric Dogs

Laimi Elizabeth Shaju[1]*, Syaama Sundar[2], Vaikunta Rao[3], Aswani Kumar[4]

[1]Assistant professor (contractual), Department of Veterinary Medicine, NTR CVSc Gannavaram INDIA
[2]Professor & University Head, Department of Veterinary Medicine, CVSc Tirupati INDIA
[3]Professor & Head, VCC, CVSc Tirupati INDIA
[4]Associate Professor & Head, Department of Veterinary Biochemistry, NTR CVSc Gannavaram INDIA

*Corresponding Author: laimielizabeth@gmail.com

How to cite this paper: Manimalayil, L., Nandyala, S., Velamala, V., & Kumar, A. (2020). Clinico-Diagnostic Studies on Acquired Heart Diseases in Geriatric Dogs. *International Journal of Livestock Research*, 10(11), 158-165. doi: http://dx.doi.org/10.5455/ijlr.20200530043624

Received : May 30, 2020
Accepted : Sep 30, 2020
Published : Nov 30, 2020

Abstract

A clinical study to investigate certain systemic diseases in geriatric dogs was conducted in 172 geriatric dogs including 10 apparently healthy dogs. The dogs which were suspected for acquired heart diseases based on history and clinical signs subjected to electrocardiography, thoracic radiography, and echocardiographic examination for confirmatory diagnosis. Out of 172 geriatric dogs screened, 39 dogs were diagnosed with acquired heart diseases (24.68 %). Acquired heart diseases diagnosed in the study were mitral valve insufficiency in 17 dogs (43.58%), dilated cardiomyopathy in 7 dogs (17.94%), tricuspid valve insufficiency in 8 dogs (20.51%), pericardial effusion in 4 dogs (10.5%), and hypertrophic cardiomyopathy in 3 dogs (7.6%).

Keywords: Dilated Cardiomyopathy, Echocardiography, Hypertrophic Cardiomyopathy, Mitral Valve Insufficiency, Pericardial Effusion and Tricuspid Valve Insufficiency

Introduction

Acquired heart diseases (AHD) are common and often fatal in dogs characterized by cardiac dysfunction, sodium and water retention and increase in left ventricular filling pressures. Acquired heart diseases of dogs include chronic degenerative valvular diseases (endocardiosis), pericardial diseases, cardiac neoplasia, dilated cardiomyopathy (DCM), arrhythmogenic right ventricular cardiomyopathy (ARVC), pulmonary hypertension (PH), infective endocarditis and heart rhythm disturbances, some of which represent primary electrical disorders and others that develop secondary to cardiac remodeling. These conditions can lead to clinical signs of limited exercise capacity, heart failure, weakness/collapse, or sudden cardiac death. Acquired heart diseases arise either due to degenerative process (acquired valvular disease and cardiomyopathy), infection (endocarditis & myocarditis) or neoplasia. Early recognition of acquired heart diseases is of clinical importance. Signalment, patient history, results of physical examination, electrocardiography, thoracic radiography and cardiac biomarkers provide a practical means of diagnosing acquired heart diseases in dogs. The echocardiography is useful for confirmatory diagnosis of acquired heart diseases in dogs and to quantify the systolic and diastolic cardiac dysfunction

Material and Methods

The clinical study was conducted in 162 dogs brought to the Small Animal Medicine Ward of Teaching Veterinary Clinical Complex, N.T.R College of Veterinary Science, Gannavaram and NTR Veterinary Super Speciality Hospital, Vijayawada. In this study, 46 animals that showed clinical signs related to acquired heart diseases were subjected to thorough clinical examination, laboratory examination and imaging techniques for confirmatory diagnosis. 10 apparently healthy geriatric dogs brought for vaccination were selected as control groups for obtaining normal data for comparison and to evaluate various parameters under study. Clinical signs and hemato-biochemical changes in dogs with acquired heart diseases were recorded. Approximately 5 ml of blood was collected from the recurrent tarsal vein/ cephalic vein, of which 2 ml blood was transferred into a sterile vacutainer containing K3 E.D.T.A as an anticoagulant and thoroughly mixed for 15-20 seconds. The rest of blood was transferred to clot activator vacutainer. Serum was separated out and stored at -20 ºC until further use. Haematological parameters estimated were Total leukocyte count (TLC), Hemoglobin (Hb), Packed cell volume (PCV) and Differential leukocyte count (DLC) as per the standard methods described in Essentials of Veterinary Hematology by Jain (1993). Serum biochemical parameters were estimated using Erba Mannheim ready to use kits. Thoracic radiographs were taken at inspiration in lateral view and abdominal radiographs were taken in lateral recumbency. They were analysed as per Fagin (1988) and Root and Bahr (2002). Then, the vertebral heart size (VHS) wascalculated from lateral thoracic radiographs of the dogs, according to modified Buchanan and Bucheler's measurement (Buchanan and Bucheler, 1995; Spasojevic Kosic *et al*., 2007). The Electrocardiography (ECG) wasrecorded using the standard bipolar and augmented unipolar limb leads at 25 mm/sec and interpreted as described by Tilley (1992). Confirmatory diagnosis was based on echocardiographic findings. Echocardigraphy was performed using Prosound α6LT Aloka US system with a cardiac probe 6 MHz to obtain two dimensional, M – mode, Colour Doppler images of heart as per standard protocols of Boon *et al.,* (1983) and Miller *et al.,* (1989). The echocardiographic parameters were interpreted as per Thomas *et al.,* (1993).

Results and Discussion

Five types of acquired heart diseases were diagnosed in the study. They were mitral valve insufficiency in 17 dogs (43.58%), dilated cardiomyopathy in 7 dogs (17.94%), tricuspid valve insufficiency in 8 dogs (20.51%), pericardial effusion in 4 dogs (10.5%), and hypertrophic cardiomyopathy in 3 dogs (7.6%).

Cough associated with mitral valve disease was attributed to lifting of trachea, compression of the main stem bronchi by enlarged atrium and pulmonary edema (Abbott, 1998). In hyertrophic cardiomyopathy, a small left ventricular cavity and diastolic dysfunction associated with decreased left ventricular compliance and increased filling pressure. These results in inadequate cardiac output, pulmonary edema and leads to dyspnea, exercise intolerance and lethargy (Maron and Epstein, 1979). The prominent physical examination findings in dogs with mitral valve disease were tachycardia, systolic murmur, tachypnoea, gallop rhythm and pale mucous membrane. Murmurs recorded were associated with turbulent flow of blood (Gugleilmini *et al.,* 2009).

Table 1: Clinical findings in acquired heart diseases of geriatric dogs

Clinical findings	Types of acquired heart diseases									
	Mitral valve insufficiency (n=17)		Dilated cardiomyopathy (n=7)		Tricuspid valve insufficiency (n=8)		Pericardial effusion(n=4)		Hypertrophic cardiomyopathy (n=3)	
	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
Inappetence	5	29.4	7	100	4	50	4	100	1	33.33
Cough	9	52.9	5	71.42	2	25	-	-	2	66.66
Poor exercise tolerance	4	24	6	85.71	1	12.5	2	50	1	33.33
Weight loss	2	11.8	4	57.14	-	-	-	-	-	-
Lethargy	11	64.7	3	42.85	-	-	4	100	-	-
Dyspnea	3	17.6	4	57.14	-	-	3	75	2	66.66
Syncope	-	-	2	28.57	5	62.5	1	25	-	-
Abdominal distension	3	17.6	5	71.42	4	50	2	50	-	-
Pedal edema	-	-	2	28.57	3	37.5	-	-	-	-

The prominent physical examination findings in dogs with dilated cardiomyopathy were tachycardia, tachypnoea, dyspnoea, pale mucous membranes, crackles, ascites and weak femoral pulse. Dyspnoea and crackles were observed in DCM dogs with left sided heart failure and pulmonary edema, whereas ascites was noticed in DCM dogs with right sided heart failure. The physical examination findings in dogs with pericardial effusions were tachycardia, tachypnoea, muffled heart sounds due to presence of fluid in pericardial sac and ascites and pale mucous membranes due to diastolic failure.

Table 2: Mean ± Se Haemotological Values in Geriatric Dogs with Acquired Heart Diseases

S.No.	Name of the parameter	Control	Acquired heart disease
1	Haemoglobin (g/dl)	12.72±0.15	10.633±0.14**
2	PCV (per cent)	36.26±0.81	32.91±0.34**
3	TEC (106/µl)	7.18±0.10	5.70±0.11**
4	TLC (103/µl)	12.69±0.31	18.88±0.99*
5	Differential leucocyte count		
a.	Neutrophils (per cent)	71.30±1.42	84.07±1.35**
b. .	Lymphocyte (per cent)	24.1±0.43	14.25±1.05**
c.	Monocyte (per cent)	2.1±0.67	1.05±0.29 NS
d.	Eosinophil (per cent)	1.5±0.52	0.71±0.21 NS

**Statistically significant (p≤0.05); **-Statistically highly significant (p≤0.01); NS - Statistically not significant*

In the present study, acquired heart disease group showed a significant decrease in haemoglobin, PCV, TEC, this may be due to decreased bone marrow production, splenomegaly and decreased erythrocyte production. It may also occur due to deficiency of vitamins and minerals. TLC was increased with higher neutrophil count in many cases, which might be due to secondary systemic infection (Pati *et al*, 2015). Serum biochemistry revealed, highly significant decrease in total protein (4.36±0.15 g/dl) and albumin (2.01±0.11g/dl),as well as highly significant increase in ALT (81.66±2.12 U/L), ALP (75.75±4.11 U/L), total bilirubin (0.35±0.06 mg/dl), BUN (38.05±1.25 mg/dl) and creatinine (1.80±0.15 mg/dl) were observed. Decreased value of total protein and albumin concentration with the progressive age are mostly due to chronic kidney disease, liver cirrhosis or malnutrition in geriatric dogs. The increase in the BUN and creatinine value was perhaps due to progression of kidney disease in old dogs (Pati *et al*, 2015).

Table 3: Thoracic Radiographic Findings in Dogs with Acquired Heart Diseases

Radiographic Finding	**Types of acquired heart diseases**									
	Mitral valve insufficiency (n=17)		Dilated cardiomyopathy (n=7)		Tricuspid valve insufficiency (n=8)		Pericardial effusion (n=4)		Hypertrophic cardiomyopathy (n=3)	
	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
Enlargement of left atrium	11	64.7	2	28.57	-	-	-	-	-	-
Rounding of anterior border of heart	4	23.52	-	-	3	37.5	-	-	-	-
Elevation of trachea and carina	5	29.41	-	-	4	50	-	-	-	-
Pulmonary consolidation &edema	6	35.29	3	42.85	-	-	-	-	1	33.33
Cardiomegaly	-	-	5	71.42	-	-	1	25	2	66.66
Right atrial enlargement	-	-	-	-	4	50	-	-	-	-
Right atrial & right ventricular enlargement	-	-	-	-	1	12.5	-	-	-	-
Pericardial effusions	1	5.88	1	14.28	-	-	3	75	-	-

Well-positioned lateral and dorsoventral thoracic radiographs of an aging dog produce an enormous amount of potentially valuable information on which diagnostic, prognostic and therapeutic decisions can be made. Specific observations from radiographs allow for semi- quantitation of the severity of heart disease (Hamlin, 2005). The radiographic signs of chronic mitral valvular degeneration vary according to the severity of the condition. Usually the first chamber to enlarge is left atrium and left ventricular enlargement and hypertrophy as acompensation for the mitral valve regurgitation (Kibar and Alkan,2005). In DCM the pulmonary edama and congestion is due to left sided heart failure (Sullivan et al., 2007 and Martin et al., 2009). In tricuspid valve insufficiency, right atrial enlargement, elevation of trachea and carina and rounding of anterior border of heart were observed. In hypertrophic cardiomyopathy, cardiomegaly, pulmonary congestion and edema observed. These findings were in accordance with findings of Kumar *et al.,* (2010). The electrocardiographic findings observed, in mitral valve insufficiency were sinus tachycardia (41.17 per cent), normal sinus rhythm (29.41 per cent), atrial fibrillation (23.52 per cent) and S-T coving (17.64 per cent) which may be due to myocardial damage, where as in dogs which were in early stage of mitral valve regurgitation ECG was normal. The most common findings in dilated cardiomyopathy were sinus tachycardia (57.14 per cent), left ventricular enlargement (28.57per cent), S-T coving (28.57 per cent), atrial fibrillation (14.28 per cent) and left atrial enlargement (14.28 per cent). Right atrial enlargement (37.5 per cent), normal sinus rhythm (25 per cent), atrial fibrillation (25 per cent) and ventricular premature contractions (12.5 per cent) were the most commonly observed findings in tricuspid valve insufficiency. The prominent electrocardiographic finding in pericardial effusion was sinus tachycardia (50 per cent), these electrical alterations that is the result a specific type of cardiac motion within the pericardium.

Most common electrocardiographic findings in hypertrophic cardiomyopathy were left ventricular enlargement (66.66 per cent) and sinus tachycardia (33.33 per cent). The confirmatory diagnosis was based on echocardiographic findings. The echocardiographic findings in the present study are given in the table-4. The prominent findings in two- dimensional echocardiography were left atrial enlargement (n=4), left ventricular dilatation (n=6), right ventricular dilatation (n=3), pericardial effusion (n=4) and left ventricular hypertrophy (n=7). The dogs with mitral valve insufficiency had significant increase in mean ±SE values of LVIDd, LVIDs, EDV and ESV and significant decrease in values of LVPWd, LVPWs, FS and EF when compared to control group. The values of IVSd, IVSs and LA/AO ratio were not significantly different compared to control group. The elevation in end diastolic

left ventricular dimensions occurs due to volume overload created by mitral valve regurgitation (O'Gara *et al.*, 2008). Progressive deformation of the valve structure eventually prevents effective coaptation and causes regurgitation; this will increase cardiac work, leading to ventricular re-modelling (eccentric hypertrophy) and intercellular matrix changes.

Table 4: M-Mode Echocardiographic Values in Acquired Heart Diseases

Parameter	Types of acquired heart diseases					
	Control	**Mitral valve insufficiency (n=17)**	**Dilated cardiomyopathy (n=7)**	**Tricuspid valve insufficiency (n=8)**	**Pericardial effusion (n=4)**	**Hypertrophic cardiomyopathy(n=3)**
LVIDd (cm)	4.46±0.52	4.97±0.26*	5.21±±0.34**	4.34±0.21 NS	4.51±0.43 NS	3.78±0.61**
LVIDs (cm)	2.92±0.06	3.21±0.51*	4.38±0.53**	2.81±0.07 NS	2.76±0.02 NS	2.98±0.07 NS
LVPWd(cm)	0.96±0.06	0.73±0.08**	0.73±0.06**	0.82±0.05 NS	0.84±0.06 NS	1.94±0.04**
LVPWs (cm)	1.30±0.07	0.97±0.07*	0.86±0.07**	1.34±0.08 NS	1.31±0.04 NS	1.29±2.27 NS
IVSd (cm)	0.86±0.01	0.87±0.02 NS	0.84±0.02 NS	0.82±0.11 NS	0.81±0.21 NS	0.82±0.41 NS
IVSs (cm)	1.32±0.08	1.29±0.03 NS	1.31±0.06 NS	1.29±0.07 NS	1.38±0.04**	1.28±0.07 NS
LA/AO	0.91±0.03	1.43±0.05 NS	1.61±0.08**	0.94±0.03 NS	1.38±0.76*	0.89±0.07 NS
FS (%)	36.84±0.92	29.81±2.08*	20.92±1.6**	34.22±0.81 NS	28.34±0.91*	34.16±0.78 NS
EF (%)	72.68±1.21	58.91±2.08*	40.84±2.28**	69.14±1.88 NS	57.81±2.01*	69.71±2.68 NS
EDV (ml)	72.66±3.37	109.34±3.88*	138±3.11**	89.05±3.98*	92.56±4.91*	82.34±2.34*
ESV (ml)	26.76±1.92	68.97±3.01*	86.28±3.01**	52.34±1.45*	58.78±3.11*	27.33±2.98 NS

**Statistically significant (p≤0.05); **- Statistically highly significant (p≤0.01); NS - Statistically not significant*

Table 5: Mean± SE biochemical values in control and acquired heart diseases (n=39)

Sl. No.	Name of the parameter	Control	Acquired heart disease
1	Total protein (g/dl)	5.81±0.13	4.36±0.15**
2	Albumin (g/dl)	2.32±0.10	2.01±0.11**
3	ALT(U/L)	70.04±2.61	81.66±2.12**
4	ALP(U/L)	71.97±3.71	75.75±4.11**
5	Total bilirubin(mg/dl)	0.22±0.04	0.35±0.06**
6	BUN (mg/dl)	21.56±1.54	38.05±1.25**
7	Creatinine (mg/dl)	0.94±0.12	1.8±0.15**
8	Sodium(mmol/L)	143.77±1.05	131.36±4.01**
9	Potassium(mmol/L)	4.37±0.09	4.69±0.16 NS
10	Glucose (mg/dl)	97.59±4.81	106.42±1.90**

**Statistically significant (p≤0.05); **statistically highly significant (p≤0.01); NS - Statistically not significant*

Echocardiographic evaluation of the heart in pericardial effusion cases were recognized as anechoic space between the epicardium and pericardium. The anechoic effusion surrounded the heart within the pericardium and significant decrease in values of FS and EF were observed. In hypertrophic cardiomyopathy, significant increase in LVPWd and EDV and significant decrease in LVIDd was observed. The most common echocardiographic feature of canine hypertrophic cardiomyopathy was the presence of left ventricular concentric hypertrophy. The thickening of ventricular walls increases myocardial oxygen demand and the distance between capillaries. These multiple structural changes may predispose the myocardium to regional ischemia and subsequent scaring (Kata 1990, Liu *et al*, 1979). Mitral valve regurgitation and tricuspid valve regurgitation were detected in dogs by colour flow Doppler echocardiography. Mitral valve regurgitation was noted in 17 cases (43.58 per cent), tricuspid valve regurgitation in 8 cases (20.51 per cent). Both bicuspid and tricuspid valve regurgitation in 4 cases (10.25 per cent) and dilated cardiomyopathy with mitral valve regurgitation noticed in 5 cases (12.80 per cent). The regurgitant jet

of colour-coded patterns originated at the center of coaptation of the mitral and tricuspid valve.

Exercise intolerance & Ascites | Pedal edema | Weight loss

Figure 1: Clinical signs in geriatric dogs with Acquired Heart Diseases

Cardiomegaly with segmented elevation of trachea | Left atrial enlargement | Right ventricular enlargement

Figure2: Thoracic radiographic findings in Acquired Heart diseases

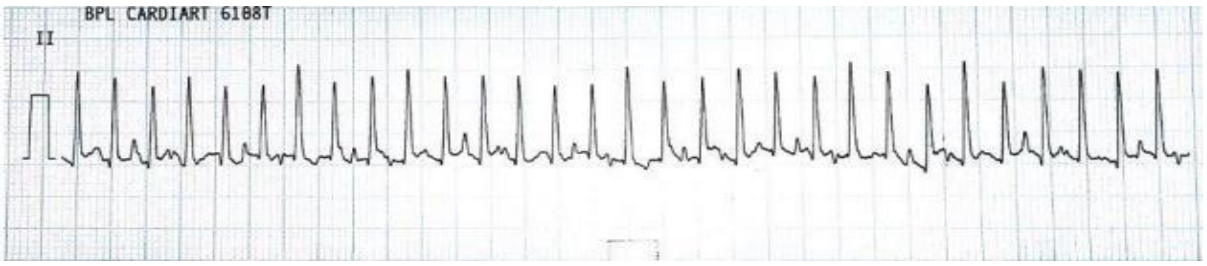


Figure 3 (a): Electrocardiographic findings in Acquired Heart diseases (Sinus tachycardia)

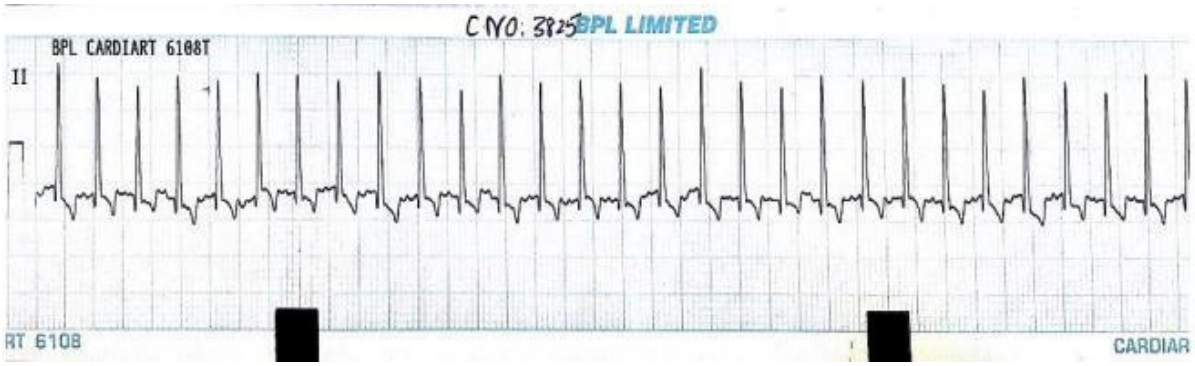
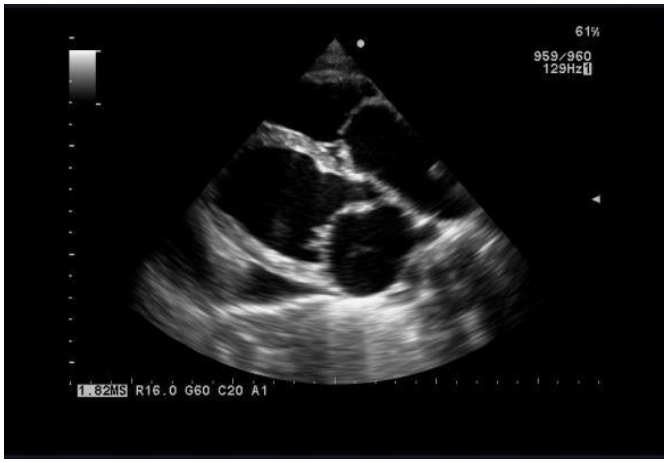
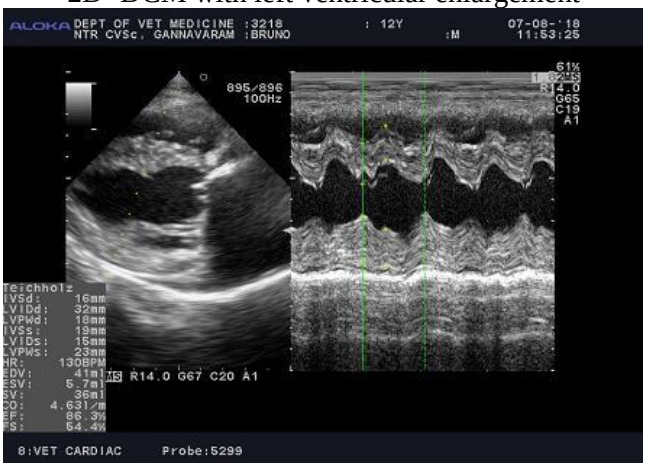


Figure 3 (b): Electrocardiographic findings in Acquired Heart diseases (Atrial fibrillation)

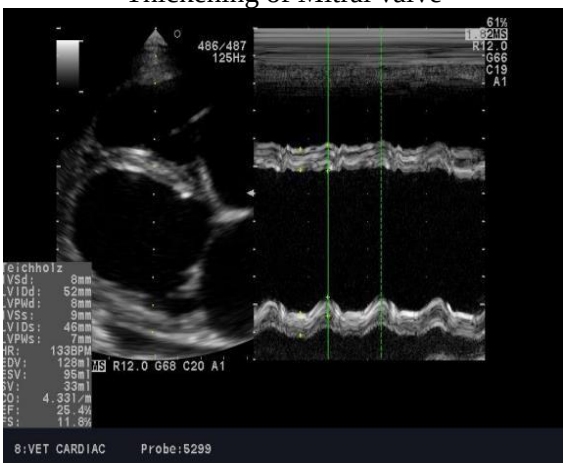


2D- DCM with left ventricular enlargement

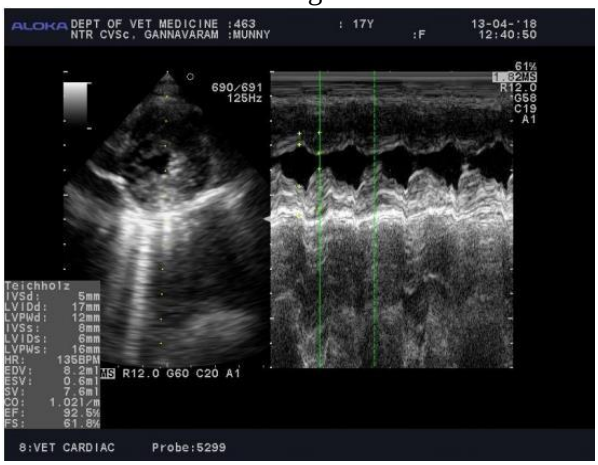
Thickening of Mitral valve



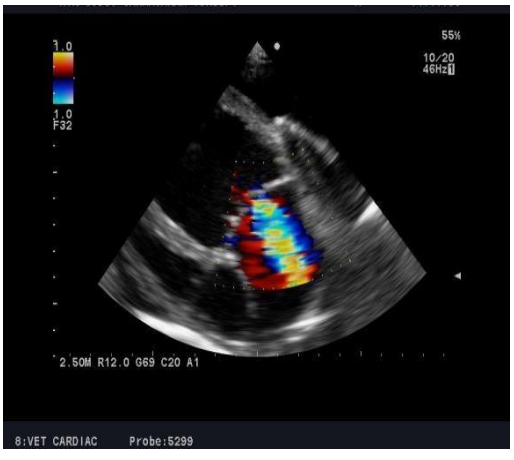
M-mode- Mitral valve insufficiency with left atrial enlargement



M-mode- DCM with decreased contractile indices



M-mode –Hypertrophic cardiomyopathy



Colour flow Doppler-Mitral valve regurgitation with DCM

Figure 4: Echocardiographic findings in Acquired Heart diseases

Conclusion

In the present study, 39 geriatric dogs were diagnosed for acquired heart diseases. The most predominant acquired heart disease diagnosed was degenerative valve disease followed by DCM, pericardial effusion and hypertrophic cardiomyopathy. The diagnosis was done on the basis of history and clinical signs and by applying different cardiac diagnostic modalities *viz.*, radiography, electrocardiography (ECG) and confirmatory diagnosis was based on echocardiography findings. Regular health check up including laboratory and diagnostic imaging tests of

apparently healthy geriatric dogs are required to improve early disease management by means of improved anesthetic, pharmaceutic and dietary recommendations to all geriatric dogs there by prolonging the life span of geriatric dogs as well as strengthening the pet-owner bond more effectively.

Conflict of Interests

There is no conflict of interest.

Publisher Disclaimer

IJLR remains neutral concerning jurisdictional claims in published institutional affiliation.

References

1. Abbott, J.A (1998). Diagnosing congestive heart failure in dogs and cats. *Veterinary Medicine* ,93:811-817
2. Buchanan, J.W., & Bucheler, J. (1995). Vertebral scale system to measure canine heart size in radiographs. *Journal-American Veterinary Medical Association*.15; 206:194.
3. Guglielmini, C., Diana, A., Pietra, M., Di Tommaso, M., & Cipone, M. (2009). Use of the vertebral heart score in coughing dogs with chronic degenerative mitral valve disease. *Journal of veterinary medical science*, 71(1), 9-13.
4. Hamlin, R. L. (2005). Geriatric heart diseases in dogs. *Veterinary Clinics: Small Animal Practice*, 35(3), 597-615.
5. Jain, N. C. (1993). Essential of Veterinary Hematology. copyrights by Lea and Febiger Philadelphia pp
6. Kibar, M., & ALKAN, Z. (2005). Evaluation of radiographical, echocardiographical and color-doppler findings of heart diseases in geriatric dogs. *Turkish Journal of Veterinary and Animal Sciences*, 29(3), 677-684.
7. Kumar, K. S., Pothureddi, N., Kumar, V. V., & Rao, D. S. (2010). Hypertrophic cardiomyopathy in 12 dogs (2004-2008): first report in India. *Veterinarski Arhiv*, 80(4), 491-498.
8. Liu, S., Marion, B. J., & Tilley, L. P. (1979). Hypertrophic cardiomyopathy in the dog. *American Journal of Pathology*. 94: 497-508.
9. Martin, M. W. S., Stafford Johnson, M. J., & Celona, B. (2009). Canine dilated cardiomyopathy: a retrospective study of signalment, presentation and clinical findings in 369 cases. *Journal of small animal practice*, *50*(1), 23-29.
10. Pati, S., Panda, S. K., Acharya, A. P., Senapati, S., Behera, M., & Behera, S. S. (2015). Evaluation of geriatric changes in dogs. *Veterinary world*, 8(3), 273.
11. Root, C.R., & Bahr, R. J. (2002). The heart and great vessels. Textbook of Veterinary Diagnostic Radiology, ed.; 2:316-7.
12. Spasojević-Kosić, L., Krstić, N., & Trailović, R. D. (2007). Comparison of three methods of measuring vertebral heart size in German Shepherd dogs. *Acta veterinaria*, 57(2-3), 133-141.

****