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Characterizing M-mode Echocardiography Findings in Bovines Diagnosed with Pseudopericarditis: A Diagnostic Approach

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ABSTRACT

Background: Pseudopericarditis is a rare phenomenon encountered in day to day clinical practice. A handful of reports have been introduced on pseudopericarditis due to theleriosis. This case study is first of its type that aims to describe the echocardiographic characteristics in cattle and buffaloes with pseudopericarditis due to pulmonary and hepatic hydatid cysts.

Methods: The selected animals were presented with clinical signs mimicking that of cardiac insufficiency *i.e.* brisket edema, jugular engorgement, open mouth breathing, however they did not show any cardiac abnormality upon physical and cardiovascular examination. Thoracic and abdominal ultrasound revealed presence of cystic densities in lungs and/ or liver. These cases were further evaluated using M-mode echocardiography to access the functioning of heart and to see the effect of existing cysts on cardiac function.

Result: This study constitutes the first report on various changes in M-mode echocardiographic parameters in bovines affected with lung and/or liver cysts. M-mode echocardiographic findings were significantly reduced left ventricular internal diameter in both systole and diastole, significantly reduced left ventricular end diastolic and systolic volumes and further significant increase in left ventricular contractility indices as these are directly dependent on the dimensions of the left ventricle as compared to healthy cattle and buffaloes. From the present study it was inferred that presence of single or multiple cysts in the thoracic cavity or hepatic parenchyma by putting pressure at the base of the cranial and caudal vena cava leads to the clinical signs similar to that of cardiac insufficiency. It is further documented that changes in echocardiographic parameters are only seen when there is direct compression of the heart due to the presence of cysts.

Key words: Cattle, Echocardiography, Hydatid cysts, M-mode.

INTRODUCTION

The bovine heart is constituted of three major structures mainly the pericardium, myocardium, endocardium and conductive tissue. The commonly reported cardiac diseases in bovines are traumatic reticulopericarditis, pericarditis secondary to pleural/lung infection primary dilated cardiomyopathy (Sidhu *et al*., 2022), cardiomyopathy secondary to ionophore intoxication, vitamin E/selenium deficiency (Buczinski *et al*., 2011). Other frequently encountered affections include bacterial endocarditis, congenital heart diseases (ventricular septal defect), cor pulmonale and yet another less known condition i.e. Pseudopericarditis. It can oocur due to one-sided pleuritis, diaphragmatic hernia (Sidhu *et al*., 2019a) tumours, abscesses, hydatid cysts (Sidhu *et al*., 2019b), swollen lymph nodes due to tuberculosis, leukosis and theleriosis, causing pressure at the base of the cranial and caudal vena cava (Keles *et al*., 2003).

Pseudopericarditis is a rare phenomenon in bovines with only a handful of reports available, but nowadays it has been associated with multiple disease conditions. In the recent times, it has been most commonly linked with theleriosis (Degirmencay *et al*., 2021; Satheesha *et al*., 2017) and echinococcosis (Sidhu *et al*., 2019b; Kumar *et al.,* 2016). Pseudopericarditis has been identified in bovines with symptoms mimicking that of cardiac affections without any cardiac abnormalities. The mechanism of pseudopericarditis is explained as pressure around caudal vena cava and cranial vena cava which inhibits blood backflow leading to clinical manifestations such as oedema and jugular enlargement (Radostits *et al*., 2007).

Hydatid disease still remains an asymptomatic disease in the intermediate hosts (Tekam *et al.,* 2024) and veterinarians should consider this disease for differential diagnosis while investigating the cause of clinical signs like brisket edema, jugular engorgement and dyspnoea *etc.* (Sidhu *et al*., 2019b). The spectrum of clinical signs may vary and depend on the number, size, severity of cystic lesions and adjacent organs, resulting in impaired function

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of that particular organ (Besbes *et al*., 2010). Keeping this in mind, the present study was designed to evaluate the cardiac functioning with M-mode echocardiography in cases of pseudopericarditis due to hepatic or pulmonary cysts.

MATERIALS AND METHODS

Animals, history and physical examination

This study constituted of one hundred and twenty seven cattle and/or buffaloes showing any one or more of the clinical signs *viz*., brisket edema, dyspnoea, muffled heart sounds and pulsating or distended jugular veins presented to the Teaching Veterinary Hospital, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India. These animals underwent physical and clinical examination. Thoracic and abdominal ultrasonography revealed presence of single and/or multiple hydatid cysts in lung or liver parenchyma (Fig 1) in twelve animals which included (cattle-5, buffaloes-7) presented with clinical signs mimicking that of cardiac insufficiency (Sidhu *et al.,* 2019b). For the comparison of echocardiographic parameters, sixteen healthy cattle and twenty four healthy buffaloes were included in the study that were without any clinical signs of disease or any abnormality on cardiac auscultation (Fig 2).

Two-dimensional echocardiography

Echocardiography was performed on these animals to evaluate the cardiac functioning as described by (Braun *et al.,* 2001) using Sonosite M-turbo portable ultrasound machine (FUJIFILM SonoSite, Inc. USA). In this study 1-5 MHz sector cardiac probe was used in all the patients for cardiac evaluation. The patients were prepared by shaving 25 × 25 cm area over the third, fourth and fifth intercostal spaces in the cardiac region on both left and right side. Ultrasound gel was applied to make good contact with the surface, 2-D and M mode images were recorded. 2-D image was used to correctly place the cursor of the M-mode for measurement of left ventricle indices.

Motion mode echocardiography

Out of 12 animals with cystic disease M-mode echo-cardiographic measurements were recorded in 10 animals with cystic disease (5 cattle and 5 buffaloes). In remaining two animals, the heart was severely compressed by the surrounding cystic lesions that accurate measurement of the cardiac parameters was not possible (Fig 3).

M mode left ventricle view

All M-mode dimensional measurements were obtained in centimetres from the right parasternal short axis view of the left ventricle, with the cursor placed perpendicular to the interventricular septum and left ventricular wall below the tips of the mitral valves at the largest ventricular chamber size as described by Boon (2011), Singh *et al.,* (2019). This imaging method has been referred to as an ice pick view of the heart. The M-mode image has depth through the heart on the Y axis and time on the X axis. All M mode echocardiographic measurements were made in accordance with the guidelines of the American Society of Echocardiography by using the leading-edge to leading-edge method of measurement. Measurement of the cardiac structures was made from the frozen M-mode images on the screen. The M-mode has a right ventricle at the top of the image, followed by the interventricular septum, the left ventricular chamber and then the left ventricular free wall at the bottom of the image (Fig 4). All the parameters were calculated using the machines software.

Statistical analysis

Arithmetic means and standard errors for each evaluated variable and group of animals were calculated using the descriptive statistical procedures. All statistical analyses

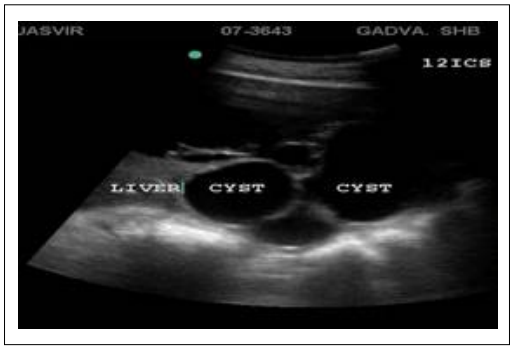

Fig 1: Hepatic parenchyma with multiple cystic densities.

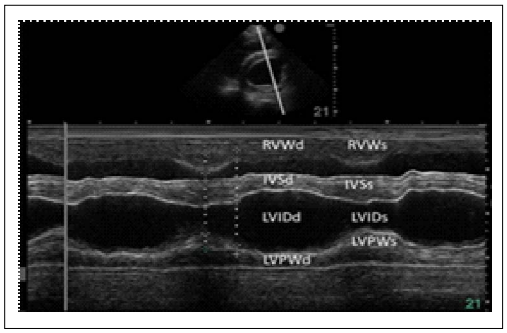

Fig 2: M-mode echocardiographic image in a healthy animal.

Fig 3: Multiple lung cystic densities seen compressing over heart.

were performed using the SAS software. Analysis of mean values variance of different numerical parameters (ANOVA) followed by Duncans multiple range test was used for comparison of the significances of the differences in means between the groups at significance levels of P≤0.05.

RESULTS AND DISCUSSION

M-mode echocardiography

Measurements of various M-mode echocardiographic parameters in all the animals affected by cystic disease are depicted in Table 1 with statistical comparison between healthy and diseased cattle and buffaloes. The right ventricle measurements *i.e.* the wall thickness (RVWd and RVWs) and internal diameter (RVIDd and RVIDs) were non-significantly different in both cattle and buffaloes with cystic disease as compared to healthy animals (Table 1). The interventricular septum during systole and diastole was significantly (P≤0.05) lower in cystic diseased cattle and

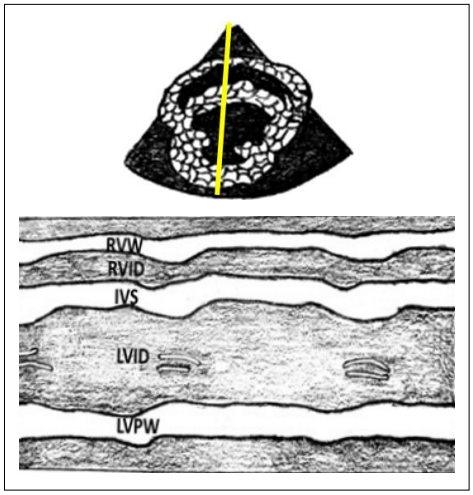

Fig 4: Schematic diagram of M-mode measurement at the level of left ventricle (right parasternal short axis view) (Boon 2011).

Table 1: Comparison of M-mode echocardiographic parameters in healthy and cystic disease affected cattle and buffaloes.

Parameters		Healthy		Cystic disease	
		Cattle (n-16)	Buffalo (n-24)	Cattle (n-5)	Buffalo (n-5)
Right ventricle wall (cm)	RVWd	1.31±0.20A[1] (1.1-1.92)*	1.66±0.09a[2] (1.44-2.01)	1.31±0.20A (1.1-1.92)	1.66±0.09a (1.44-2.01)
	RVWs	2.17±0.20A (1.63-2.59)	2.44±0.13a (2.11-2.89)	2.17±0.20A (1.63-2.59)	2.44±0.13a (2.11-2.89)
Right ventricle internal diameter (cm)	RVIDd	1.96±0.53A (1.25-3.55	2.40±0.55a (1.25-3.74)	1.96±0.53A (1.25-3.55)	2.40±0.55a (1.25-3.74)
	RVIDs	1.01±0.34A (0.48-2.02)	1.21±0.29a (0.47-1.92)	1.01±0.34A (0.48-2.02)	1.21±0.29a (0.47-1.92)
Interventricular septum (cm)	IVSd	1.62±0.06A (1.53-1.82)	1.76±0.10a (1.53-2.11)	1.62±0.06B (1.53-1.82)	1.76±0.10b (1.53-2.11)
	IVSs	2.66±0.11A (2.4-2.8)	2.83±0.12a (2.4-3.2)	2.66±0.11B (2.4-2.8)	2.83±0.12b (2.4-3.2)
Left ventricle Internal diameter (cm)	LVIDd	7.75±0.18A (6.79-9.16	7.56±0.18a (6.43-8.58)	5.49±0.76B (2.69-6.79)	5.09±0.64b (2.69-6.19)
	LVIDs	4.04±0.17A (3.14-5.95)	4.60±0.15a (3.65-5.82)	2.87±0.43B (1.54-3.57)	2.39±0.43b (1.49-3.57)
Left ventricle Posterior wall (cm)	LVPWd	1.74±0.10A (1.29-2.61)	2.30±0.11a (1.25-3.10)	1.64±0.19A (1.15-2.30)	1.85±1.44a (1.43-2.3)
	LVPWs	2.59±0.14A (1.86-3.74)	3.05±0.10a (2.21-3.81)	2.58±0.19A (1.92-3.17)	2.59±0.18a (2.03-3.17)
Volume (mL)	LVEDV	325.224±17.93A (238.44-465.4)	309.77±16.15a (210.75-402.67)	163.04±40.10B (26.76-238.44)	34.71±30.61b 1(26.76-193.27)
	LVESV	72.97±8.59A (39.11-177.58)	101.30±7.79a (56.26-167.87)	36.22±10.56B (6.48-53.34)	24.51±9.77b (5.95-53.34)
Contractility indices (%)	FS	47.92±1.58A (35.04-57.8)	39.35-1.02a (30.65-49.7)	47.56±2.98A (41.66-58.54)	51.84±6.67b (41.66-75.92)
	EF	77.84±1.77A (61.84-86.5)	67.91±1.26a (56.43-79.25)	78.17±2.72A (71.67-88.16)	80.74±4.89b (71.67-96.92)

[1]Values with same uppercase letter in same column do not differ significantly (P<0.05) between different groups of cattle.
[2]Values with same lowercase letter in same column do not differ significantly (P<0.05) between different groups of buffalo.
*Values in parethesis indicate range.

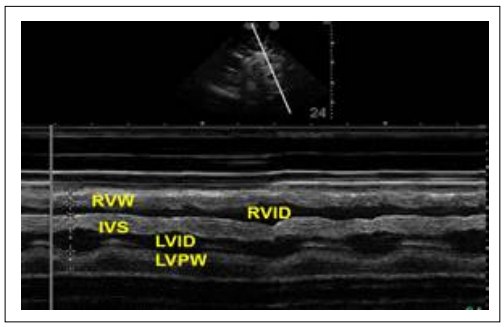

Fig 5: M-mode echocardiographic image showing severe decrease in the lumen of cardiac chambers due to multiple cystic densities.

buffalo as compared to healthy cattle and buffaloes. The left ventricular internal diameter (LVIDd and LVIDs) during systole and diastole was significantly (P≤0.05) decreased in cystic group of cattle and buffaloes as compared to healthy animals (Table 1). This can be attributed to the fact that any space occupying lesion of thoracic cavity compressing over the heart will lead to the decrease in the lumen of the left ventricle (Sidhu *et al*., 2019, Sidhu *et al*., 2024). However, not even a single study could be cited from the prevalent literature similar to this. In the present study, 5/7 buffaloes and 3/5 cattle had severe cystic densities in the lung parenchyma (Fig 1) that were compressing upon the heart and thus leading to the decrease in the internal dimensions of the left ventricle (Fig 5). There was non-significant change in the measurement of LVPWd and LVPWs as compared to healthy animals. The end diastolic and systolic volumes were significantly (P≤0.05) lower in cystic group as compared to the healthy cattle and buffaloes. Here it is important to note that EDV and ESV are the derived values from left ventricular dimensions, so any change in the LV dimensions will subsequently lead to the changes in values of EDV and ESV. For FS% and EF% there was non-significant differences among cystic disease affected cattle and healthy cattle, but significantly (P≤0.05) higher FS% and EF% was observed in cystic disease affected buffaloes as compared to healthy buffaloes. Similar to pericarditis, this increase in FS% and EF% may be attributed to the fact that as the size of heart decreases, it exerts more effort to pump maximum blood into the systemic circulation as a result there is relative increase in left ventricle contractility indices (Sidhu *et al*., 2024). The cardiac output is directly dependent on the values of end diastolic volume and end systolic volume. EDV and ESV are calculated from the dimensions of the left ventricle. So anything which is compressing over the heart (*e.g.*: cysts) is directly going to effect the cardiac output which in turns decides that how well the heart is functioning in an individual.

CONCLUSION

Till date, not a single study on echocardiographic indices in bovines affected with cystic lung and/or liver disease was undertaken. In this study, we have identified the need for a gold standard echocardiographic examination to be performed in all the cases affected with cystic lung and liver disease to evaluate the cardiac functioning that will aid in deciding the prognosis of such cases. We have also re-emphasised the ability for echocardiogram to provide a valid data on cardiac functioning.

Conflict of interest

On behalf of all the authors of this publication, I state that the authors do not have any conflict of interest.

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