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Ferroscopy for detection of metallic foreign body in traumatic pericarditis and pleural effusions in cattle and buffaloes

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Abstract
This study was conducted on 50 bovines including 33 buffaloes and 17 cattle. Animals included in the study were confirmed cases of traumatic pericarditis (n=38) and pleural effusions (n=12). Ferroscopic examination was done in all animals for foreign bodies in the reticulorumen around 5th to 10th intercostal space. Results of ferroscopy were correlated with radiographic and ultrasonographic findings. Among animals suffering from traumatic pericarditis foreign body was detectable cranial to 6th intercostal space in 21 out of 38 animals, however radiography could reveal a penetrating foreign body in 13 animals only. Also in more than 65% cases of traumatic pericarditis foreign body was detectable on the left side. Radiography missed foreign body in all cases suffering from pleural effusions, but it was detectable on ferroscopy in 5 out of 12 animals selected. Therefore, ferroscopy is a useful tool for confirmation of foreign bodies in cases suspected for traumatic pericarditis and pleural effusion in field practices where facilities for radiography and ultrasonography are not available.

Keywords: Ferroscope, traumatic pericarditis, pleural effusions, intercostals space, radiography.

1. Introduction
Foreign body syndrome (FBS) and its sequel are one of the oldest recognized digestive disorders of cattle and buffalo. The indiscriminating feeding habit of cattle and buffaloes predisposes them to ingestion of various foreign bodies and these ingested foreign bodies settle in the reticulum as the honeycomb-like structure of the reticulum provides sites for fixation [1]. The most fatal sequel of FBS is traumatic pericarditis (TP) and is one of the important causes of death in cattle and buffaloes, throughout the world. TP has characteristic symptoms of jugular venous distension and pulsation, tachycardia bilaterally muffled heart sounds, edema of brisket region(sometimes of jaw and ventral abdominal region), anorexia, sudden drop in milk yield, reluctance to walk, fever, increased pulse rate and abducted elbows[2, 3].
Traumatic pericarditis is still a concern in veterinary practice all over the world, due to its high prevalence and great economic losses mainly due to death of the affected animals [4, 5, 6]. During the clinical course the economic losses are mainly due to loss of milk, treatment costs and many times due to fetal losses [1, 7, 8]. Another important aspect of this disease is the early recognition of the disease by the farmers and prognosis by the clinicians [9]. Furthermore industrialization and mechanization of agriculture have worsened the situation increasing the prevalence of foreign body syndrome and hence TP [10, 11]. Prevalence of FBS varying from 23% [7] to 87% [5] has been reported.
The confirmation of FBS needs advanced diagnostic tools like radiography for visualization of metallic foreign bodies [6, 12-17] but it has limited use for detecting any tissue reaction/s due to massive inflammatory response of TP. The detection of pericardial effusion and tissue inflammation in TP requires ultrasonographic examination [9, 18-23].
Pleural effusion is one of the least studied and researched disease conditions of bovine medicine. Under field conditions, diagnosis of pleural effusion is the diagnostic challenge due to lack of specialised clinicians and availability of modern diagnostic facilities at the Government Veterinary hospitals in India. The causes of pleural effusion can be lung diseases, ascites or it can be a sequel in TP/FBS [24].
In absence of availability of X-ray and ultrasonograhy for large animal practices under field conditions, there is a paucity of the diagnostic aid for confirmation of TP and pleural effusions

in bovines, particularly under Indian conditions. Even if the X ray facility may be available at some referral Veterinary hospitals, to perform the radiography, the animals need to be casted in lateral recumbency and can result in instant death of animals affected with TP and/or pleural effusion. For ultrasonography, the already compromised and stressed animals may not be cooperative for carrying out this diagnostic aid. So the need of the hour is to find some non-invasive and less time consuming diagnostic aid especially for TP. The metal detector which is an important auxiliary test (as it allows an earlier diagnosis thereby improving the possibility of success of the treatment) has not been used widely for diagnosis and detection of foreign bodies in TP and pleural effusions, especially under Indian scenario. Therefore the aim of the present study was to evaluate the efficacy of ferroscope to localize foreign bodies and provide a diagnosis in cases of TP and pleural effusion in cattle and buffaloes.

2. Materials and Methods

This study was conducted on 50 bovines (33 buffaloes and 17 cattle), referred for treatment to the Large Animal Clinics of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana from February 2013 to June 2014. The animals selected for the study included confirmed cases of traumatic pericarditis (n=38) and pleural effusions (n=12) on basis of history, physical examination, clinical signs, haematology, peritoneal fluid/pleural fluid examination, radiography and ultrasonographic findings.

Diagnostic confirmation of traumatic pericarditis was on basis of radiography in 13/38 animals, which revealed a foreign body in the chest while in remaining 25 animals diagnosis was confirmed by ultrasonography which revealed large amounts of hypoechogenic to echogenic fluid and echogenic deposits and strands of fibrin around the heart. All cases of pleural effusion were confirmed by ultrasonographic findings which included the presence of a large amount of hypoechogenic fluid and interlacing pattern of fibrin and fluid in thorax and lungs displaced medially and caudally. However no foreign body was seen on radiography in any of these animals suffering having pleural effusions.

The animals were restrained in a wooden trevis and metallic chains tied to the animals were removed to exclude interference in ferroscopic evaluation. Subsequently the animals were examined with ferroscope for the presence and position of foreign bodies in the reticulo-rumen by holding probe of the instrument (Hauptner Ferroscope, Art-Nr 39500; H. Hauptner & Richard Herberholz GmbH & Co. KG, Solingen, Germany) against body wall from 5th to 10th intercostal space, both laterally and ventrally. For knowing the exact location of the foreign body the ventral abdominal quadrant was divided into right, left and central parts, taking mid of xiphoid cartilage as the central point. Sixth intercostal space was taken as the reference point because of the fact that this position is a demarcation between reticulum and diaphragm. All the animals were examined at sensitivity 1 of the instrument (Fig. 1). The presence of the foreign body was indicated on the ferroscope in the form of deflection of its ammeter and the site that produced maximum deflection on ammeter (in µA) of the ferroscope was taken as the site of foreign body. Ferroscopic findings were correlated with radiographic and ultrasonographic observations.

2.1. Statistical analysis

The data with respect to the location of a foreign body at right, left and central abdominal quadrants (ventrally) was presented as frequency. The ferroscopic deflection was presented as Mean±S.E. The mean ferroscopic deflection of traumatic pericarditis and pleural effusion affected animals was compared by independent t test.

Fig 1: Photograph of the Ferroscope used for the study

3. Results and discussion

All the studied animals were adult females with mean age of 6.4±0.87 years. Majority of the animals were non pregnant (33/50). The buffaloes were Niliravi, Murrah or their crosses and cattle were Cross bred Holstein Fresian.

3.1. Traumatic pericarditis

Foreign body was detectable with ferroscope cranial to 6th intercostal space (ICS) in 21/38animals, out of which it was within a distance of 2 inches cranial to 6th ICS in 11 animals and 2-5 inches cranial to 6th ICS in 10/21 animals (Table 1, Fig. 2). However, radiography had revealed the presence of foreign body in thoracic area in only 13/21 animals. Therefore ferroscopy was more effective in localizing foreign bodies and providing an improved diagnosis over radiography in cases of traumatic pericarditis. Radiographic visualization of foreign body in the thorax in small number of animals could be due to presence of fluid and thick radiodense adhesions which could have obscured the foreign body from the view [22]. In remaining 17/38 animals a foreign body was detected caudal to 6th ICS (i.e. in reticulum) and this could be due to the fact that after initial penetration of pericardium, some foreign bodies migrate back to reticulum [17].

Sideways distribution revealed that foreign body was detectable in 25/38 cases (65.8%) on the left side, on centre in seven (18.4%) and on right side in six animals (15.8%) (Table 2, Fig. 3). More than 65% cases of traumatic pericarditis having a foreign body on left side could be due to the fact that pericardium is closest to diaphragm on this side [1].

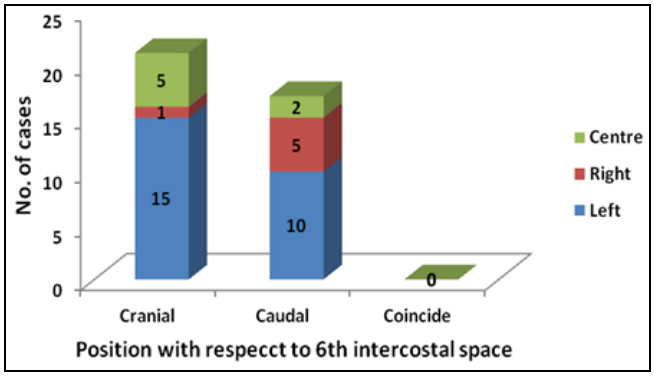

Fig 2: Position of foreign body with respect to 6th intercostal space in traumatic pericarditis

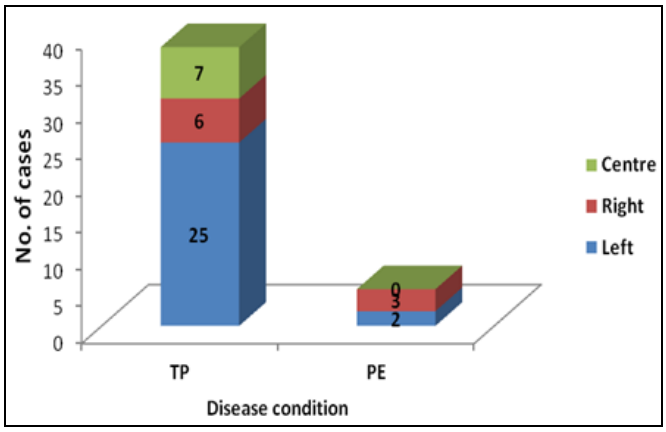

Fig 3: Distribution of foreign body with respect to longitudinal axis

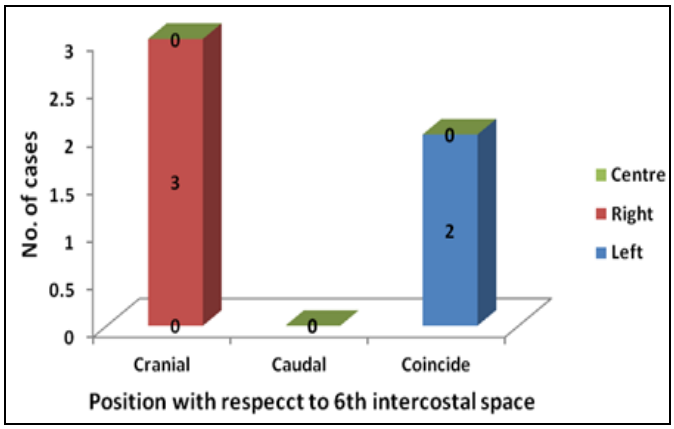

Fig 4: Position of foreign body with respect to 6th intercostal space in pleural effusions

3.2. Pleural effusions

Out of 12 animals with pleural effusion, a foreign body was detectable in five animals on ferroscopic examination. Foreign body was present 2 inches cranial to 6th ICS in 3/5 animals and on 6th ICS in other two animals (Table 1, Fig. 4). Although, there was probable foreign body in the thorax of five animals, as suggested by Ferroscopy, these five animals were negative for TP, on the basis of ultrasonographic findings and negative for foreign body on radiography. So, foreign body syndrome can be considered as one of the causes of pleural effusion in bovines. In other words, it may be inferred that foreign body can pass from the reticulum into thorax, without the noticeable symptoms of TP or without causing TP. The current findings corroborate with that of Divers and Peek [24] who reported that ingested foreign bodies that penetrate thorax may lead to pleural effusions. However, Braun [22] reported that a significant number of cases of pleural effusions occur due to traumatic pericarditis caused by penetrating foreign bodies ingested by cattle. Radiography was unable to detect the foreign body in animals with pleural effusions. Similar to our findings, Braun [22] reported that fluid and adhesions may obscure the view of foreign body on radiography in these cases. So, ferroscopy may be an improvement over radiography for detection of foreign bodies in this condition. Sideways distribution revealed no particular pattern of distribution and foreign body was present on left side in two and on right side in three animals (Table 2, Fig.3).

3.3. Mean ferroscopic deflection (µA)

The mean ferroscopic deflection in traumatic pericarditis was 12.98±2.76µA and 10.40±2.81µA in pleural effusions (Table 2, Fig. 5). There was no significant ($p<0.05$) difference in mean deflection of the two disease conditions. This could be due to accumulation of fluid in thoracic cavity in both traumatic pericarditis and pleural effusions. The deflection could be higher than the present values, provided the disease condition does not result in accumulation of fluid in the area of foreign body location.

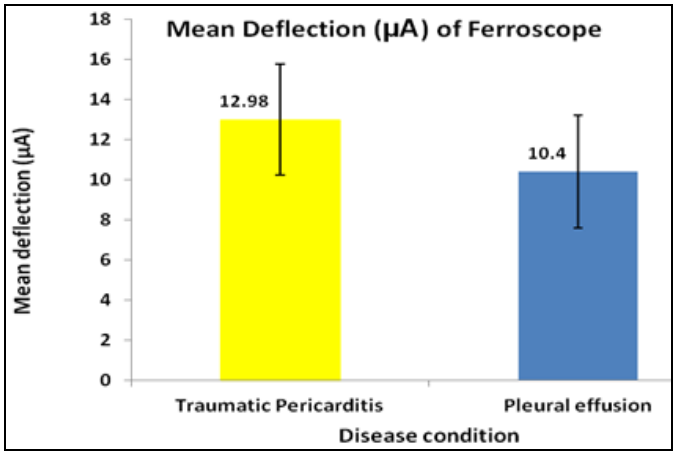

Fig 5: Mean ferroscopic deflection

Table 1: Distribution of foreign bodies along longitudinal axis with respect to 6th intercostal space in traumatic pericarditis and pleural effusion

Condition	FB seen on x-ray	Positive on ferroscopy	Position of Foreign Body w.r.t 6th intercostal space					
			Caudal			Cranial		Coincide
Distance (inches)			2"	2-5"	>5"	2"	2-5"	0"
Traumatic Pericarditis (38)	13	38	10	7	0	11	10	0
Pleural Effusions(12)	0	5	0	0	0	3	0	2

Table 2: Position of foreign body on Ferroscopy in traumatic pericarditis and pleural effusion in cattle and buffalo

Condition	No. of animals	Positive on Ferroscopy	F.B. observed on x-ray	Position of Foreign Body on ferroscopy with respect to 6th intercostal space												Mean deflection (µA)	Total		
				Cranial				Caudal				Coincide							
				L	R	C	T	L	R	C	T	L	R	C	T		L	R	C
Traumatic Pericarditis	38	38	13	15	1	5	21	10	5	2	17	0	0	0	2	12.98±2.76[a]	25	6	7
Pleural Effusions	12	5	0	0	3	0	3	0	0	0	0	2	0	0	2	10.40±2.81[a]	2	3	0
Total	50	43	13	15	04	05	24	10	05	02	17	02	00	00	04		27	09	07

L=Left, R= Right, C= Centre and T=Total; Mean deflection values with similar superscripts do not differ significantly ($P<0.05$)

4. Conclusion

To authors knowledge this is the first study of its kind that attempted to evaluate the diagnostic potential of ferroscope in cases of traumatic pericarditis and pleural effusions, by comparing findings with radiography and ultrasonograhy. Ferroscopy was more effective in localizing foreign bodies and providing an improved diagnosis over radiography in cases of traumatic pericarditis. The present study also revealed that foreign body syndrome can be one of the causes of pleural effusion in bovines, in absence of traumatic pericarditis. We advocate the use of ferroscope as a non-invasive, cheap, safe and highly sensitive tool for detection of foreign bodies in cases of traumatic pericarditis and pleural effusion under field conditions where facilities like radiography and ultrasonograhy are not available.

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