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Research Article

Ultrasonographic features of the reticulum in normal and hardware diseased buffaloes

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Abstract

The aim of this study was to investigate the ultrasonographic reticular features in normal and hardware diseased buffaloes. The study was conducted on 20 apparently normal and 85 hardware diseased buffaloes. Transcutaneous ultrasonography was performed in standing buffaloes without sedation. The area from 6th to 8th intercostal space was examined with a 3.5-5 MHz convex transducer. The ventral aspect of the thorax on the left and right of the sternum as well as the left and right lateral thorax up to the level of elbow were examined. Buffaloes with local peritonitis, abdominal and thoracic abscesses, traumatic pericarditis and pleuropnemonia exhibited significantly lower frequency of reticular contractions than the control. There was a significant increase of reticular thickness between buffaloes with traumatic pericarditis, local peritonitis, abdominal and thoracic abscesses and normal buffaloes. The distance between reticulum and abdominal wall was significantly higher in hardware diseased than normal buffaloes. There was a significant difference in the durations of 1st, 2nd and total reticular contractions and the relaxation period were significantly longer in buffaloes with traumatic pericarditis (except the 1st. contraction), local peritonitis, abdominal and thoracic abscesses than healthy buffaloes. Buffaloes with traumatic pericarditis, local peritonitis, abdominal and thoracic abscesses had significantly lower amplitude of 1st reticular contraction than the normal buffaloes. Buffaloes with all recorded complications of hardware disease had significantly lower amplitude of 2nd reticular contraction than healthy buffaloes. In conclusion, ultrasonography provides exact information concerning the reticular features in the various complications of hardware disease in buffaloes.

Keywords: Buffaloes; reticular contraction; reticular relaxation; reticular thickness; sharp foreign body syndrome

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Introduction

Foreign body syndrome is still a matter of concern in different veterinary practices all over the world (Al-Abbadi et al., 2014; Abdelaal and Floeck, 2015). Sharp foreign body syndrome (SFBS) is one of the most common diseases of the digestive tract of large ruminants. It was recorded in 25% of the examined

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buffaloes in Egypt (Aref and Abdel-Hakiem, 2013). This condition is also known as "Hardware Disease" when a metal object such as a wire or nail is swallowed and punctures the reticular wall. Devastating economic losses result from severe reduction in milk and meat production, treatment costs, potential fatalities and foetal losses in affected pregnant animals (Nugusu et al., 2013).

Although the reticulum is the main target organ for the swallowed sharp foreign body, various disease outcomes secondary to sharp foreign body syndrome could be developed including localized or diffused peritonitis, reticular adhesion, diaphragmatic hernia, pericariditis and other minor complications such as reticular abscess, vagal indigestion, hepatic abscess, splenic abscess, rupture of left gastro-epiploic artery, traumatic pneumonia and pleurisy and mediastinal abscess (Radostits et al., 2000).

Most of these complications are difficult to be detected during the clinical examination. On last decade, various sequelae of SFBS in both cattle and buffaloes were clarified by ultrasound (Abdelaal et al., 2009).

Ultrasonographically, normal reticulum of cattle appeared as a half-moon-shaped structure with a smooth or even contour; it contracted at regular intervals. The different layers of the reticular wall usually cannot be imaged, and the honeycomb-like structure of the mucosa is not often seen clearly (Abouelnasr et al., 2012).

On the left side of the abdominal wall, the wall of the craniodorsal blind sac of the rumen, the ruminoreticular groove and the wall of ventral sac of rumen are seen as echogenic lines caudal to the reticulum. The omasum, abomasum, and sometimes liver are imaged from the right ventral thorax. The abomasum is frequently seen between the craniodorsal blind sac of the rumen and ventral abdominal wall, immediately caudal to the reticulum (Braun, 2009). In addition, the foreign bodies and magnets also cannot usually be seen in the reticulum due to the reticular gases (Braun, 2009).

Regarding reticular motility in cattle, Constable et al. (1990) and Braun and Gotz (1994) observed four biphasic reticular contractions usually during a 4 minutes period. Braun and Gotz (1994) mentioned that the reticulum contracts at regular intervals and it is situated immediately adjacent to the diaphragm and ventral portion of the abdominal wall when relaxed.

The reticular features including frequency of reticular contraction, reticular thickness, distance between the reticulum and abdominal wall, duration of 1^{st}, 2^{nd} and total reticular contraction, relaxation period of reticulum, amplitude of $1^{st.}$ and $2^{nd.}$ reticular contractions were previously assessed in cattle (Constable et al., 1990; Braun and Gotz , 1994). In contrast to cattle, there are scarce ultrasonographic studies on the reticulum in buffaloes. Therefore, the aim of the present study was to investigate the ultrasonographic features of reticulum in both normal and hardware diseased buffaloes.

Materials and Methods

The present study was carried out at Faculty of Veterinary Medicine, Cairo and Zagazig Universities, Egypt. Two groups of buffaloes were included in this study.

Control group (Normal buffaloes)

This group had twenty apparently normal buffaloes. These animals were 2.5 to 6.5 years old and weighted 450-650 kg.

Transcutaneous ultrasonography was performed in standing buffaloes after clipping of hair and application of ultrasound coupling gel. The examined animal was controlled inside the stanchion with tying of limbs. The area from 6^{th} to 8^{th} intercostal space was examined. The transducer was applied to the ventral aspect of the thorax on the left and right of the sternum as well as the left and right lateral thorax up to the level of the elbow according to (Braun, 2003). The reticulum was firstly examined from the left side and then the right. A portable ultrasound scanner (SonoSite, USA) equipped with 3.5-5 MHz convex sector was used. Both longitudinal and cross sections were performed then the images were fixed and printed using (Sony Printer, Japan). The reticular features including; frequency of reticular contraction, reticular thickness, distance between the reticulum and abdominal wall, duration of 1^{st}, 2^{nd} and total reticular contraction, relaxation period of reticulum, amplitude of $1^{st.}$ and $2^{nd.}$ reticular contractions were assessed.

Hardware diseased group

During the period between Jun 2012 and April 2014, a total of 85 buffaloes with a confirmed hardware disease were admitted to the veterinary clinic at both Cairo and Zagazig Universities, Egypt. All data concerning the animal identification, case history, clinical findings and ultrasonographic findings were collected.

Measuring of body temperature, respiratory and heart rates, auscultation of the heart, lungs and rumen were performed. In addition, examination of the mucous membrane, jugular and milk veins were carried out. Pain tests including; pinching of withers, side stick method and turning in acute angle were applied according to Kelly (1984). The ultrasonographic features of reticulum were assessed in all diseased buffaloes as mentioned before.

Statistical analysis

Data were analyzed in IBM SPSS (version 20) using one way ANOVA. If the main treatment effect was significant, LSD post hoc tests was performed for pairwise comparison. Differences of P values ≤ 0.05 were considered statistically significant.

Results

Clinical findings

The diseased buffaloes had reduced appetite (100%), ruminal atony (100%), recurrent tympany (92.9%), scanty hard faeces (84.7%), systemic reactions (49.4%), pain reactions (45.9%), positive pain tests (23.5%), jugular veins dissention (20%), brisket oedema (17.7%), respiratory distress (12.9%), abnormal lung sounds (11.8%), abnormal heart sound (11.7%), scanty soft faeces (3.5%), diarrhoea (2.4%) and regurgitation of food (2.4%).

The recorded vital parameters in normal and diseased buffaloes were collected in Table 1.

Ultrasonographic findings

The ultrasonographic reticular features in normal and hardware diseased buffaloes were collected in Table 2.

Ultrasonographic examination confirmed hardware disease in all diseased buffaloes (Fig. 1&2). Seven complications were seen by ultrasound. These complications involved both abdominal and thoracic cavities. Abdominal involvement included local peritonitis (n=34), abdominal abscesses (n=18), diffuse peritonitis (n=8). Thoracic involvement included traumatic pericarditis (n=15), thoracic abscess (n=4), diaphragmatic hernia (n=4) and pleuropneumonia (n=2).

The effect of hardware disease on frequency of reticular contractions

Buffaloes with local peritonitis, abdominal and thoracic abscesses, traumatic pericarditis and pleuronemonia exhibited significantly lower frequency of reticular contractions than the control animals. No significant difference of reticular contraction in animals with local peritonitis, abdominal and thoracic abscesses and traumatic pericarditis was observed. There was a significant difference of frequency of reticular contractions between animals with thoracic abscess and pleuropneumonia. Animals with thoracic abscess showed the lowest frequency of reticular contractions.

The effect of hardware disease on reticular thickness

There was a significant increase of reticular thickness in animals suffered from local peritonitis, abdominal and thoracic abscesses and traumatic pericarditis compared with the normal buffaloes. There was no significant difference between healthy buffaloes and buffaloes with pleuropneumonia. Furthermore, there was no significant difference regarding this parameter between buffaloes with traumatic pericarditis, abdominal and thoracic abscesses. Buffaloes with local peritonitis showed the highest reticular thickness.

The effect of hardware disease on the distance between reticulum and abdominal wall

The distance between reticulum and abdominal wall was significantly higher in hardware diseased buffaloes than healthy buffaloes. A significant difference in the distance was recorded in buffaloes with abdominal abscess compared with buffaloes with thoracic abscess, traumatic pericarditis and pleuropneumonia. There was no significant difference between buffaloes with local peritonitis and buffaloes with thoracic and abdominal abscesses as regard the distance between reticulum and abdominal wall. No significant difference was recorded between buffaloes with thoracic abscess, traumatic pericarditis and pleuropneumonia as regards the distance between reticulum and abdominal wall. Buffaloes with abdominal abscess showed the highest distance between reticulum and abdominal wall.

The effect of hardware disease on the duration of 1st, 2nd and total reticular contractions

The duration of 1st reticular contraction was significantly longer in buffaloes with local peritonitis, abdominal and thoracic abscesses than normal buffaloes. There was no significant difference in the duration of 1st reticular contraction between healthy buffaloes and buffaloes with pleuropneumonia and traumatic pericarditis. The duration of 2nd and total

Table 1: The vital parameters in control and hardware diseased buffaloes

Groups	Temperature (˚c)	Heart rate (min.)	Ruminal movement/2min.	Respiratory rate/min.
Control	38.52±0.32^{a}	72.8±6.6^{a}	2.8±0.5^{c}	25±2.9^{d}
Local peritonitis	39.52±0.32^{b}	74.6±2.6^{b}	0.4±0.2^{a}	31±2.1^{a}
Diffuse peritonitis	37±0.2^{c}	42±2^{d}	0.3±0.9^{a}	18±1.8^{b}
Abdominal abscesses	38.4±1.1^{a}	71±1.6^{a}	0.9±0.5^{ab}	28±2.2^{ad}
Traumatic pericarditis	39.3±1.7^{b}	88±3.5c	0.6±0.1^{ab}	48±3.5^{c}
Thoracic abscesses	39.4±1.4^{b}	79±2.2^{b}	1±0.3^{ab}	45±2.1^{c}
Diaphragmatic hernia	38±2.4^{a}	71±3.4^{a}	0.2±0.78^{a}	34±3.2^{cd}
Pleuropneumonia	38.7±1.8^{ab}	69±2.7^{a}	1.3 ±0.45^{b}	28±2.4^{ad}

Table 2: Mean reticular features in normal and hardware diseased buffaloes

Groups / Reticular features	Control	Local peritonitis	Abdominal abscess	Thoracic abscess	Traumatic Pericarditis	Pleuro-pneumonia
Frequency of reticular contractions (per 5 minutes)	4.95±0.15^{c}	2.09±0.15^{ab}	2.42±0.29^{ab}	1.50±0 .29^{a}	2.40±0.38^{ab}	2.67±0.33^{b}
Thickness of reticulum (cm)	0.45±0.07^{a}	3.01±0.08^{c}	1.72±0.24^{b}	1.83±0.1^{b}	1.85±0.23^{b}	0.80±0.06^{a}
Distance between the reticulum and abdominal wall (cm)	2.08±0.06^{a}	5.15±0.23^{cd}	6.33±0.46^{d}	4.80±0.48^{bc}	3.70±0.29^{b}	3.63±0.63^{b}
Duration of 1st reticular contraction (second)	2.00±0.12^{a}	4.20±0.06^{b}	3.10±0.11^{c}	3.60±0.32^{bc}	2.60±0.14^{ac}	2.20±0.18^{a}
Duration of 2nd reticular contraction (second)	3.90±0.22^{a}	8.10±0.12^{b}	6.70±0.13^{c}	7.30±0.47^{bc}	5.20±0.19^{c}	4.50±0.44^{a}
Total duration of reticular contraction (second)	5.90±0.25^{a}	12.30±0.18^{b}	9.80±0.14^{c}	10.90±0.77^{bc}	7.80±0.19^{c}	6.70±0.5^{a}
Relaxation period of reticulum (second)	60±1.8^{a}	143±12.7^{b}	119±6.4^{b}	128±21.4^{b}	95.2±15^{b}	89±22^{ab}
Amplitude of 1st reticular contraction (cm)	5.46±0.32^{c}	2.50±0.09^{a}	2.83±0.32^{a}	3.10±0.25^{ab}	3.69±0.26^{ab}	4.20±0.26^{bc}
Amplitude of 2st reticular contraction (cm)	17.67±0.32^{c}	9.73±0.29^{a}	8.47±0.58^{a}	9.75±0.75^{a}	8.25±0.24^{a}	12.40±0.31^{b}

Data are presented as Mean ± SEM. Rows with different alphabets are significantly different (P<0.05).

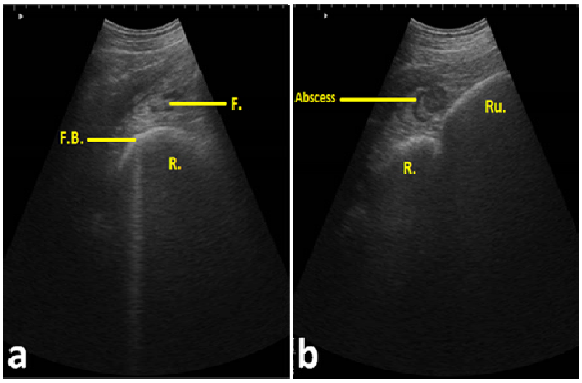

Fig. 1: (a) Representative ultrasonogram of the reticulum (R.) in hardware diseased buffaloes showing metallic foreign body (F.B.) with commit tail artefact and hyperechoic fibrin (F.). (b) Representative ultrasonogram of the reticulum (R.) in hardware diseased buffaloes showing abdominal abscess. Ru; rumen.

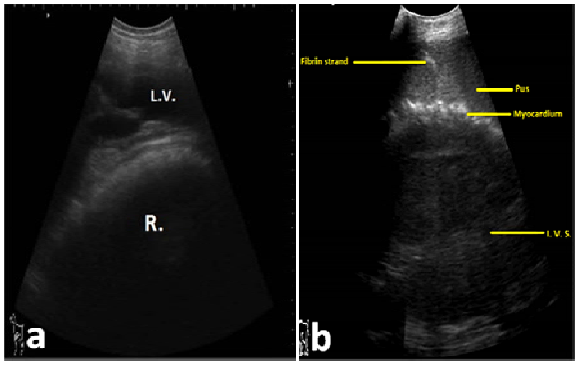

Fig. 2: (a) Representative ultrasonogram of the reticulum (R.) in hardware diseased buffaloes showing diaphragmatic hernia. Notice the close contact between the reticulum and left ventricle. LV; left ventricle. (b) Representative ultrasonogram of a buffalo with traumatic pericarditis. Notice the accumulation of hypoechoic pus and hyperechoic fibrin strands inside the pericardial sac. I.V.S.; interventricular septum

reticular contractions was significantly longer in buffaloes with local peritonitis, traumatic pericarditis, abdominal and thoracic abscesses than normal buffaloes. There was no significant difference in the duration of 2nd and total reticular contractions between healthy buffaloes and buffaloes with pleuroneumonia. There was no significant difference in the duration of 1st, 2nd and total reticular contractions between buffaloes with abdominal and thoracic abscesses and traumatic pericarditis.

There was no significant difference in the duration of 1st and 2nd reticular contraction between buffaloes with local peritonitis and thoracic abscess. Buffaloes with local peritonitis had the longest duration of 1st, 2nd and total reticular contractions.

The effect of hardware disease on the relaxation period of reticulum

The relaxation period of reticulum was significantly longer in buffaloes with local peritonitis, traumatic pericarditis, abdominal and thoracic abscesses than normal buffaloes. There was no significant difference in the relaxation period between healthy buffaloes and buffaloes with pleuropneumonia. There was no significant difference in the relaxation period between all buffaloes with various complications of hardware disease. Buffaloes with local peritonitis had the longest relaxation period of reticulum

The effect of hardware disease on the amplitude of 1st reticular contraction

The amplitude of 1st reticular contraction was significantly lower in buffaloes with local peritonitis, traumatic pericarditis, abdominal and thoracic abscesses than healthy buffaloes.

There was no significant difference in the amplitude of 1st reticular contraction between healthy buffaloes and buffaloes with pleuropneumonia. There was no significant difference in the amplitude of 1st reticular contraction between buffaloes with local peritonitis, traumatic pericarditis abdominal and thoracic abscesses. There was no significant difference

in the amplitude of 1st reticular contraction between buffaloes with thoracic abscess, traumatic pericarditis and pleuropneumonia. Buffaloes with local peritonitis had the lowest amplitude of 1st reticular contraction.

The effect of hardware disease on the amplitude of 2nd reticular contraction

The amplitude of 2nd reticular contraction was significantly lower in buffaloes with all recorded complications of hardware disease than healthy buffaloes. There was a significant difference in the amplitude of 2nd reticular contraction between healthy buffaloes and buffaloes with hardware disease.

There was a significant difference in the amplitude of 2nd reticular contraction between buffaloes with local peritonitis, abdominal and thoracic abscesses, traumatic pericarditis and pleuropneumonia. There was no significant difference in the amplitude of 2nd reticular contraction between buffaloes with local peritonitis, abdomional and thoracic abscesses and traumatic pericarditis. Buffaloes with abdominal abscess had the lowest amplitude of 2nd reticular contraction.

Discussion

Unlike sheep and goat, buffaloes do not use their lips to discriminate between very fibrous feed and metallic objects in feedstuffs (Abu-Seida and Al-Abbadi, 2014). Therefore, hardware disease synonymously called sharp foreign body syndrome (SFBS) or traumatic reticuloperitonitis (TRP) is a relatively common disease in buffaloes (Divers and Peek, 2008).

Although reticulum is the main target organ in the pathogenesis of SFBS in buffaloes, several complications of such syndrome are recorded. The reticulum plays a crucial role in the ruminant digestive tract because the primary cycle of rumen motility usually starts with a reticular contraction (Braun et al., 1998).

Traumatic pericarditis was the most common sequelae of TRP in cows (Radostits et al., 2007), while chronic local traumatic reticuloperitonitis was the most common sequelae in buffaloes. This is because TRP in buffaloes tend to become chronic (Saleh et al., 2008).

In this study, hardware diseased buffaloes had reduced appetite, ruminal atony with scanty faeces and decreased milk production. These findings agree with those reported by Saleh et al. (2008). Additionally, Radostits et al. (2007) stated that the presences of such symptoms are considered as a general signs for indigestion.

Pain tests were positive in all buffaloes with different sequelae of TRP while signs of pain and systemic reactions were not observed in all buffaloes. Therefore, the diagnosis of such conditions was difficult in buffaloes, as mentioned by Saleh et al. (2008). Similarly to the finding of Mohamed and Oikawa (2007) animals with reticular abscesses had no specific signs in the affected buffaloes.

Abnormal heart sounds, distended jugular veins, congested mucous membranes and brisket oedema were detected in all buffaloes with traumatic pericarditis and most animals with pleuropneumonia. This coincided with those reported by Divers and Peek (2008). Furthermore, the same symptoms have been found in 2 buffaloes with thoracic abscesses. Similarly, Radostits et al. (2007) reported that mediastinal abscesses might cause congestive heart failure. Respiratory manifestations including cough, dyspnoea with abnormal lung sounds have been found in all buffaloes with pleuropneumonia, pericarditis and in most cases with thoracic abscesses as well as in few cases with pericarditis. So it is difficult to differentiate the involvement of heart, lung or mediastinal region by clinical findings. Hence it is necessary to use additional diagnostic techniques in diagnosis of such conditions. Ultrasonography considered the first of these diagnostic techniques.

There was a significant rise of body temperature in cases of TRP and its sequelae compared to clinically healthy buffaloes. Similar finding was reported by Ghanem (2010). Bacteria and its endotoxin that lead to release of cytokines are the main cause of this fever (Radostits et al., 2007). There was a significant decrease of body temperature in buffaloes with diaphragmatic hernia. This might be attributed to decrease feed intake that lead to decrease energy and heat production.

Regarding heart rate, there was a significant increase of heart rate in cases of traumatic reticulo pericarditis and it is sequelae than that in healthy animals. These findings agree with that mentioned by Divers and Peek (2008). It could be attributed to rise of blood temperature and fall of the blood pressure resulting from peripheral vasodilatation (Radostits et al., 2007). In contrast, there was a significant decrease of the heart rate in buffaloes suffered from diffuse peritonitis. Similar finding was recorded by Radostits et al. (2007).

Concerning respiratory rate, there was a significant increase in respiratory rate in cases of TRP and thoracic abscess and its sequelae than in healthy animals as reported by Divers and Peek (2008). This is due to the effect of high temperature on the respiratory centre. In addition, there was a significant decrease in respiratory rate in buffaloes with diffuse peritonitis. Also it is within the normal range in cases of diaphragmatic hernia. These findings agree with that reported by Saini et al. (2007).

A significant decrease of the ruminal movement was reported in buffaloes with TRP and its sequelae as reported by Abdelaal et al. (2009) and Ghanem (2010).

This is due to decreased feed intake that leads to decrease chewing movement and feed in reticulum and rumen that originally initiate the primary cycle of contraction. Also a significant decrease of the ruminal movement was noticed in cases of diaphragmatic hernia. This could be attributed to the restricted contraction of the herniated reticulum. This finding disagrees with that mentioned by Saini et al. (2007) who reported that ruminal movement was within the normal range. Abouelnasr et al. (2012) mentioned that foreign body syndrome is the main cause of diaphragmatic hernia in buffaloes, however, other conditions that increased intra-abdominal pressure such as ruminal tympani, violet fall, late pregnancy, chronic cough and straining could act as an exciting cause.

In buffaloes with acute diffuse peritonitis, chronic diarrhoea was reported. It may be due to enteritis, withdrawal of fluid from body to intestine due to gut stasis and/or adhesion between intestines and internal viscera.

Regarding the effect of hardware disease on the frequency of reticular contraction, buffaloes with local peritonitis, abdominal and thoracic abscesses, traumatic pericarditis and pleuropnemonia exhibited significantly lower frequency of reticular contractions than the control animals. This might be attributed to inappetance, pain and the adhesion between the reticulum and surrounding organs.

A significant increase in the reticular thickness was noticed in buffaloes suffered from local peritonitis, traumatic pericarditis, abdominal and thoracic abscesses. This increase in thickness might be attributed to the accumulation of fibrinous tissue interspersed with fluid pockets on the reticular serosa. Similar finding was reported by Abdelaal et al. (2009) and Aboulnasr et al. (2012). Braun et al. (1993) found that the changes in the contour of the reticulum depend on the severity of the inflammatory changes.

The distance between reticulum and abdominal wall was significantly increased in hardware diseased buffaloes. Buffaloes with abdominal abscess showed the highest distance due to the accumulation of pus and inflammatory exudates in between the reticulum and abdominal wall. This is in agreement with that reported by Abouelnasr et al. (2012) who noticed dorsal displacement of the reticulum from the abdominal wall in cases of reticular abscess.

There was a significant increase in the duration of reticular contraction and relaxation between buffaloes with abdominal and thoracic abscesses, local peritonitis and healthy buffaloes. This is due to the adhesions between the reticulum and abdominal wall. Similar findings were recorded by Aboulnasr et al. (2012).

In conclusion, ultrasonography provides exact information concerning the reticular features in the various complications of hardware disease in buffaloes.

References

Abdelaal AM, Floeck M (2015) Clinical and sonographical findings in buffaloes (Bubalus bubalis) with traumatic reticuloperitonitis. Vet Arhiv 85: 1-9.

Abdelaal AM, Floeck M, El Maghawry S, Baumgartner W (2009) Clinical and ultrasono-graphic differences between cattle and buffaloes with various sequelae of traumatic reticulo-peritonitis. Vet Medicina 54: 399-406.

Abouelnasr KS, Mosbah E, Karrouf G, Zaghloul AE (2012) Comparative ultrasonographic findings of traumatic reticulitis, perireticular abscess and diaphragmatic hernia in buffalo (Bubalus Bubalis). J Amer Sci 12: 590-595.

Abu-Seida AM, Al-Abbadi OS (2014) Recurrent rumen tympany caused by trichobezoars in buffaloes (Bubalus bubalis): A series report. Thailand J Vet Med 44: 147-151.

Al-Abbadi OS, Abu-Seida AM, Al-Hussainy SM (2014) Studies on rumen magnet usage to prevent hardware disease in buffaloes. Vet World 7: 408-411.

Aref NM, Abdel-Hakiem M (2013) Clinical and diagnostic methods for evaluation of sharp foreign body syndrome in buffaloes. Vet World 6: 586-591.

Braun U (2003) Ultrasonography in gastrointestinal disease in cattle. Vet J 166: 112-124.

Braun U (2009) Ultrasonography of the liver in cattle. Vet Clin North Amer: Food Anim Prac 25: 591-609.

Braun U, Gotz M (1994) Ultrasonography of the reticulum in cows. Amer J Vet Res 55: 325-332.

Braun U, Götz M, Marmier O (1993) Ultrasonographic findings in cows with traumatic reticuloperitonitis. Vet Record 133: 416-422.

Braun U, Iselin U, Lischer C, Fluri E (1998) Ultrasonographic findings in five cows before and after treatment of reticular abscesses. Vet Record 142:184-189.

Constable PD, Hoffsis GF, Rings DM (1990) The reticulorumen: normal and abnormal motor function. Part I. Primary contraction cycle. Compend Contin Edu Pract Vet 12: 1008-1014.

Divers TJ, Peek SF (2008) Rebhun,s diseases of dairy cattle. 2nd ed. St. Louis, Saunders Elsevier, pp: 141-144.

Ghanem M (2010) A comparative study on traumatic reticuloperitonitis and traumatic pricarditis in Egyptian cattle. Turkish J Vet Anim Sci 34: 143-153.

Kelly WR (1984) Veterinary Clinical Diagnosis. 3rd ed. Baillere, Tindall, London. pp: 122-127.

Mohamed T, Oikawa S (2007) Ultrasonographic characteristics of abdominal ans thoracic abscesses in cattle and buffaloes. J Vet Med A 54: 512-517.

Nugusu S, Velappagounder R, Unakal C, Nagappan R (2013) Studies on foreign body ingestion and their related complications in ruminants associated with inappropriate solid waste disposal in Gondar Town, North West Ethiopia. Inter J Anim Vet Adv 5: 67-74.

Radostits OM, Gay CC, Blood DC, Hinchcliff KW (2000) Veterinary Medicine. 9th Edn Harcout Publishers Ltd, London, pp: 982, 1237, 1471, 1539.

Radostits OM, Gay CC, Hinchcliff KW, Constable PD (2007) Diseases of Spleen and Thymus in Veterinary Medicine. A textbook of the diseases of cattle, horses, sheep, pigs and goats. 10th ed. Philadelphia, PA, Elsevier, pp: 464-466.

Saini NS, Kumar A, Mahajan SK, Sood AC (2007) The use of ultrasonography, radiography and surgery in the successful recovery from diaphragmatic hernia in a cow. Can Vet J 48: 757-759.

Saleh MA, Rateb HZ, Misk NA (2008) Comparison of blood serum protein in water buffaloes with traumatic reticuloperitonitis and squellae. Res Vet Sci 85: 208-213.