

ajava

Asian Journal of Animal and Veterinary Advances



Academic
Journals Inc.

www.academicjournals.com



Research Article

Laboratory, Radiographic and Ultrasonographic Findings of Acute Traumatic Reticuloperitonitis in Buffaloes (*Bubalus bubalis*)

¹Arafat Khalphallah, ²Ashraf M. Abu-Seida, ³Mohammed Abdelhakiem, ⁴Enas Elmeligy and ⁵Usama T. Mahmoud

¹Department of Animal Medicine, Faculty of Veterinary Medicine, Assiut University, 71526 Assiut, Egypt

²Department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Cairo University, P.O. Box 12211, Giza, Egypt

³Department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Assiut University, 71526 Assiut, Egypt

⁴Veterinary Teaching Hospital, Faculty of Veterinary Medicine, Assiut University, 71526 Assiut, Egypt

⁵Department of Animal Hygiene, Faculty of Veterinary Medicine, Assiut University, 71526 Assiut, Egypt

Abstract

Background and Objective: Traumatic reticuloperitonitis (TRP) is one of the most important diseases in buffaloes. The study objective is to describe the clinical, laboratory, radiographic and ultrasonographic findings in buffaloes suffering from acute (TRP). **Methodology:** This study was carried out on 20 apparently normal buffaloes (control group) and 20 buffaloes with acute TRP (diseased group). Full case history was obtained and all animals were subjected to thorough clinical examination, pain tests and electronic metal detector, complete blood pictures, blood serum biochemical analysis, radiographic and ultrasonographic examinations. Rumenotomy was performed in 13 affected buffaloes. **Results:** Diseased buffaloes showed sudden onset of anorexia, sharp drop in milk yield, fever, ruminal atony, constipation, increased respiratory and heart rates. Moreover, the animals were reluctant to lie down or move. Out of 20 diseased buffaloes, 17 had positive pain tests and 14 had positive metal detection. All diseased buffaloes shared marked leucocytosis associated with neutrophilia and shift to the left. A significant increase in the serum level of AST ($p > 0.05$) was the only abnormal serum biochemical analysis. Radiographic examination revealed metallic foreign objects in the reticulum of seven buffaloes, normal sized and shaped heart with clear margins. The main ultrasonographic findings of diseased buffaloes included changes in the shape, contour and contraction of the reticulum. Buffaloes with acute TRP had a reticulum either with its even contour and its half-moon shaped structure ($n = 14$) or slight loss of its shape with slight loss of its contour ($n = 6$). The diseased buffaloes had biphasic reduced reticular contractions ($1.9 \pm 0.6/5$ min). The reticulum was displaced from the diaphragm with a distance of 0.7-3.4 cm in 17 buffaloes. However, reticular abscess was not imaged, peritoneal effusions were imaged in 16 buffaloes. **Conclusion:** Buffaloes with acute TRP show characteristic and complementary clinical, laboratory, radiographic and ultrasonographic findings which are helpful for diagnosis and follow up this disease.

Key words: Buffaloes, hardware disease, reticulum, traumatic reticuloperitonitis, ultrasonography

Received: June 12, 2016

Accepted: September 05, 2016

Published: October 15, 2016

Citation: Arafat Khalphallah, Ashraf M. Abu-Seida, Mohammed Abdelhakiem, Enas Elmeligy and Usama T. Mahmoud, 2016. Laboratory, radiographic and ultrasonographic findings of acute traumatic reticuloperitonitis in buffaloes (*Bubalus bubalis*). Asian J. Anim. Vet. Adv., 11: 675-683.

Corresponding Author: Ashraf M. Abu-Seida, Department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Cairo University, P.O. Box 12211, Giza, Egypt Tel: +201001997359

Copyright: © 2016 Arafat Khalphallah *et al.* This is an open access article distributed under the terms of the creative commons attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Traumatic reticuloperitonitis (TRP) is one of the most important diseases in buffaloes particularly in developing countries resulting in high economic losses. It develops as a consequence of perforation of the reticulum^{1,2}.

Buffaloes commonly ingest foreign objects due to loss of discrimination against metal objects in their feed and incomplete mastication of feed before swallowing. The swallowed metallic objects fall directly or indirectly into reticulum and the honeycomb-like reticular mucosa allows trapping of the sharp foreign objects. Contractions of the reticulum facilitate penetration of the wall by the foreign objects and consequently allow leakage of ingesta and bacteria into the peritoneal cavity resulting in TRP^{3,4}.

Preliminary, diagnosis of digestive disorders in ruminants could be achieved by ordinary diagnostic procedures such as visual inspection, palpation, percussion and auscultation⁵. However, recent advances such as radiography, ultrasonography and laparoscopy have been applied for diagnosis of TRP in cattle and buffaloes⁶.

Radiography is an efficient technique for identifying metal foreign bodies, whereas ultrasonography rarely identifies metallic objects including magnets. Radiography is best suited for the detection of metallic foreign bodies in and outside the reticulum and the position of the foreign body is the most reliable indicator for diagnosing TRP by radiography. In contrast, ultrasonography is the method of choice for detecting fibrinous deposits and abscesses that cannot be detected by using radiography. Although, neither radiography nor ultrasonography alone achieve a complete definitive diagnosis of TRP, the two techniques complement one another well^{7,8}.

On last few years ultrasound has been used successfully for diagnosis of various surgical affections in buffaloes⁹⁻¹². Ultrasonography provided exact information concerning the various sequelae of TRP in cattle and buffaloes¹³. Moreover, ultrasonography made it possible to determine the location and extent of the lesions accurately, the site best suited for abdomino and thoraco-centesis^{1,3}.

Differentiation between acute TRP, Traumatic Pericarditis (TP), other diseases marked by stasis of the gastrointestinal tract, other causes of peritonitis, particularly perforated abomasal ulcers and other acute inflammatory conditions such as nephritis, endocarditis and metritis is a challenge in the veterinary practice. The differential diagnosis of these diseases was based on clinical, hematological, biochemical and ultrasonographic changes in bovine¹⁴.

Several studies have been conducted on chronic TRP^{1,15,16} however, there are scarce studies concerned with acute TRP in buffaloes. Accordingly, the present study aimed to describe the clinical, laboratory, radiographic and ultrasonographic findings in buffaloes suffering from acute TRP.

MATERIALS AND METHODS

Animals: This study was carried out on 40 buffaloes that classified into two groups. These groups included control group (n = 20) and TRP diseased group (n = 20). The control group was selected from healthy non-pregnant females buffaloes belonged to the herd of veterinary teaching hospital and from the neighboring villages around Assiut city, Egypt. The control group had 15 buffaloes with 5-7 years old and 5 heifers with 1-2 years old. The diseased buffaloes were treated in accordance with guidelines established by Faculty of Veterinary Medicine, Assiut University Committee on Animal Care. Legal and ethical requirements have been met with regards to the human treatment of animals described in the study. A complete case history was obtained for all diseased buffaloes.

Clinical examination: All buffaloes underwent a thorough clinical examination described before¹⁷. Pain tests and electronic metal detector were applied in all diseased buffaloes.

Blood sampling: Whole blood and serum samples were collected and all precautions of sample collections and preparation for accurate evaluation of hematological and biochemical indices were taken into consideration as reported before¹⁸.

Complete Blood Count (CBC) assessment: A fully automated blood cell counter machine (Medonic CA620 Vet hematology analyzer-Sweden) was used to determine various hematological parameters. Differential Leukocytic Count (DLC) was determined using four field meander method¹⁹.

Biochemical assays: Spectrophotometric method using Phillips Pye Unicam spectrophotometer (U.V. Visible Mod. 800) was adopted to determine serum concentrations of liver enzymes: Aspartate aminotransferase (AST), γ -glutamyl transferase (GGT) and alkaline phosphatase (AP), serum total protein, serum albumin, cholesterol and triglycerides (TG). Serum globulin was determined by subtraction of albumin from total protein and its value was used to calculate

Albumin/Globulin ratio (A/G ratio). All kits and reagents were obtained from spectrum reagents (Egyptian Company for Biotechnology, Egypt).

Radiographic examination: Radiography was performed in recumbent position according to the method described before²⁰ under the effect of xylazine hydrochloride (Xylaject®, ADWIA-Egypt) at a dose of 0.05 mg kg⁻¹ b.wt. All radiographic examinations were performed using fixed radiographic apparatus (Philips, super 80 CP). The radiographic setting factors included 60-70 kVp, 50-60 mA and 75-90 cm FFD for imaging of the caudal thoracic and cranial abdominal region.

Ultrasonographic examination: All internal organs of diseased and healthy buffaloes were examined ultrasonographically by using a 3.5 MHz sector transducer (FF Sonic, Model UF-4000, Tokyo, Japan) to detect either the normal organs in the control animals or the affected one in diseased buffaloes. The examined organs included heart, reticulum, rumen, abomasum, omasum, spleen, liver, right kidney and intestines⁴.

Rumenotomy: It was performed after radiography and ultrasonography in 13 buffaloes with acute TRP. Rumenotomy was carried out using Weingarh's ring technique²¹.

Statistical analysis: Data were analyzed using statistical software program. All data were presented as Mean±Standard Deviation (SD). Analysis of variance of the obtained data was done and significance level was set at $p \leq 0.05$.

RESULTS

Clinical findings: The mean admission time was 2 ± 0.8 days from the onset of the disease. The diseased buffaloes showed sudden onset of anorexia, sharp drop in milk yield, fever $39 \pm 0.7^\circ\text{C}$ (normal: $38.3 \pm 0.4^\circ\text{C}$), decreased ruminal motility $0.5 \pm 0.2/2$ min (normal: $2.7 \pm 0.5/2$ min), rapid shallow thoracic respiration $35 \pm 1.7 \text{ min}^{-1}$ (normal: $24 \pm 3.1 \text{ min}^{-1}$), increased heart rate $76.4 \pm 6.1 \text{ min}^{-1}$ (normal: $71.5 \pm 3.7 \text{ min}^{-1}$) and emaciation (Fig. 1). Moreover, the animals were reluctant to lie down or move and suffered from constipation. Mucous membranes including conjunctiva were moderately congested or normal and episcleral capillaries were moderately engorged or filled with absence of true jugular pulsation. Out of 20 diseased buffaloes, 17 had positive pain tests and 14 had positive metal detection.

Laboratory findings: All data are collected in Table 1. Blood picture indicated that all buffaloes with acute TRP shared marked leucocytosis associated with neutrophilia and shift to the left (increase population of immature neutrophils). A



Fig. 1 (a-b): (a) About 5-years-old buffalo with acute traumatic reticuloperitonitis showing emaciation and (b) Same animal after rumenotomy

significant increase in the serum level of AST ($p > 0.05$) was the only abnormal serum biochemical analysis.

Radiographic findings: In all control buffaloes, lateral radiographs of the reticulum showed no metal objects inside

Table 1: Mean \pm Standard Deviation (SD) of blood picture and serum biochemical indices in control and diseased buffaloes

Indices	Control group (n = 20)	TRP group (n = 20)
RBCs (T/L) ($\times 10^6$)	7.54 \pm 2.98	6.62 \pm 1.43
PCV (%)	38.00 \pm 3.24	32.93 \pm 3.52
Hb (g L ⁻¹)	118.00 \pm 4.50	133.30 \pm 12.4
TWBCs (g L ⁻¹) ($\times 10^3$)	6.71 \pm 1.63	22.53 \pm 3.76*
Neutrophils (%)	26.40 \pm 9.13	50.50 \pm 3.76*
Lymphocytes (%)	60.80 \pm 7.73	33.75 \pm 4.86*
Monocytes (%)	7.80 \pm 4.63	7.25 \pm 2.50
Eosinophiles (%)	3.60 \pm 2.07	4.75 \pm 1.21
Band cells (%)	1.40 \pm 0.52	3.75 \pm 1.06*
Total proteins (g L ⁻¹)	94.70 \pm 10.7	96.70 \pm 7.40
Albumin (g L ⁻¹)	55.00 \pm 8.40	56.10 \pm 5.90
Globulin (g L ⁻¹)	45.70 \pm 4.60	40.60 \pm 4.60
A/G ratio	1.38 \pm 0.59	1.59 \pm 0.40
GGT (U L ⁻¹)	14.95 \pm 5.23	14.41 \pm 2.33
AP (U L ⁻¹)	36.11 \pm 8.40	41.81 \pm 4.34
AST (U L ⁻¹)	32.92 \pm 4.77	91.20 \pm 8.96*
Cholesterol (mmol L ⁻¹)	106.77 \pm 10.96	89.33 \pm 7.41
TG (mmol L ⁻¹)	3.62 \pm 0.20	3.27 \pm 0.91

*Significant ($p < 0.05$), TRP: Traumatic reticuloperitonitis, RBCs: Total red blood corpuscles, PCV: Packed cell volume, Hb: Haemoglobin concentration, TWBCs: Total white blood cells count, A/G: Albumin/globulin ratio, AST: Aspartate aminotransferase, AP: Alkaline phosphatase, GGT: Gamma-glutamyl transferase and TG: Triglycerides

or outside the reticulum. The diaphragm appeared as a clear well-identified intact line separating radio-opaque abdomen from radiolucent thorax. The heart appeared as radio-opaque soft tissue density within the radiolucent lung gas with clear margins, normal size and a characteristic shape (Fig. 2).

Radiography had a diagnostic significance in seven buffaloes with acute TRP. It usually showed normal sized and shaped heart with clear margins. The reticulum was either free from any metallic foreign bodies (Fig. 3) or containing metal foreign objects (Fig. 4).

Ultrasonographic findings: Ultrasonographic findings in buffaloes with acute TRP were restricted only to the reticulum without extension to any other organ. The reticulum was usually with either its even contour and half-moon shaped structure (n = 14) or slight loss of its shape and contour (n = 6) due to thickening in the reticular serosa with echogenic fibrinous deposits interspersed with hypoechoic pockets of exudates commonly imaged caudoventral to the reticulum and sometimes cranially or laterally (Fig. 5a). The mean reticular thickness was 1.5 ± 0.2 cm (normal: 0.5 ± 0.06 cm).

In buffaloes with acute TRP, the reticulum displaced from the diaphragm and abdominal wall by echogenic fibrinous deposits (Fig. 5b) and by a fibrinous echogenic mass (Fig. 5c) for a distance about 0.7-3.4 cm (2.8 ± 0.6 cm) between the reticulum and abdominal wall. There was a

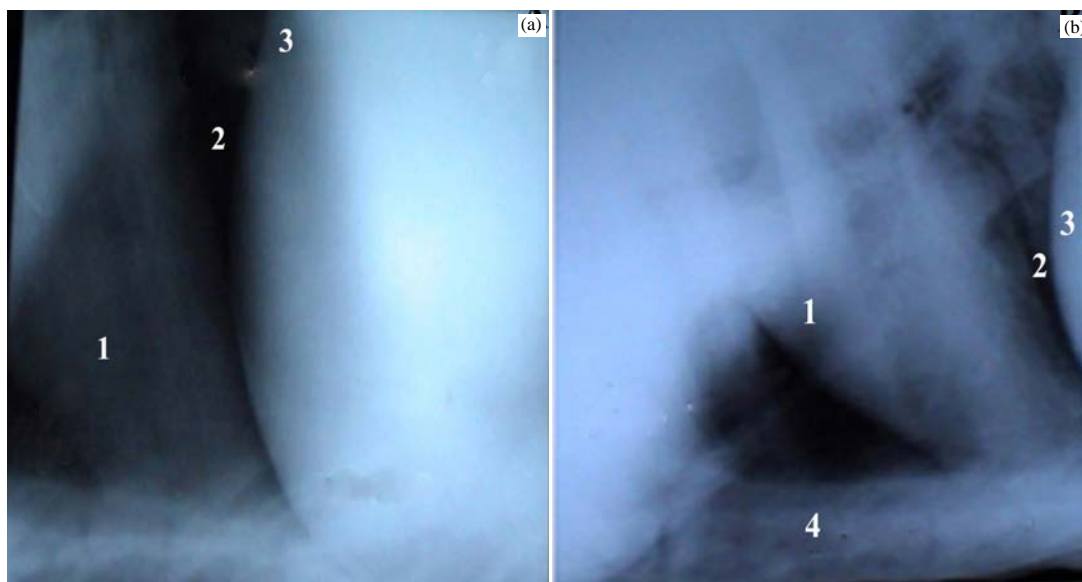


Fig. 2(a-b): (a) Lateral radiographic view of the cranial abdomen, (b) Caudal thorax of a 3-years-old non-pregnant buffalo showing normal radiographic appearance of reticulum, heart and diaphragm, 1: Heart, 2: Diaphragm, 3: Reticulum and 4: Sternum

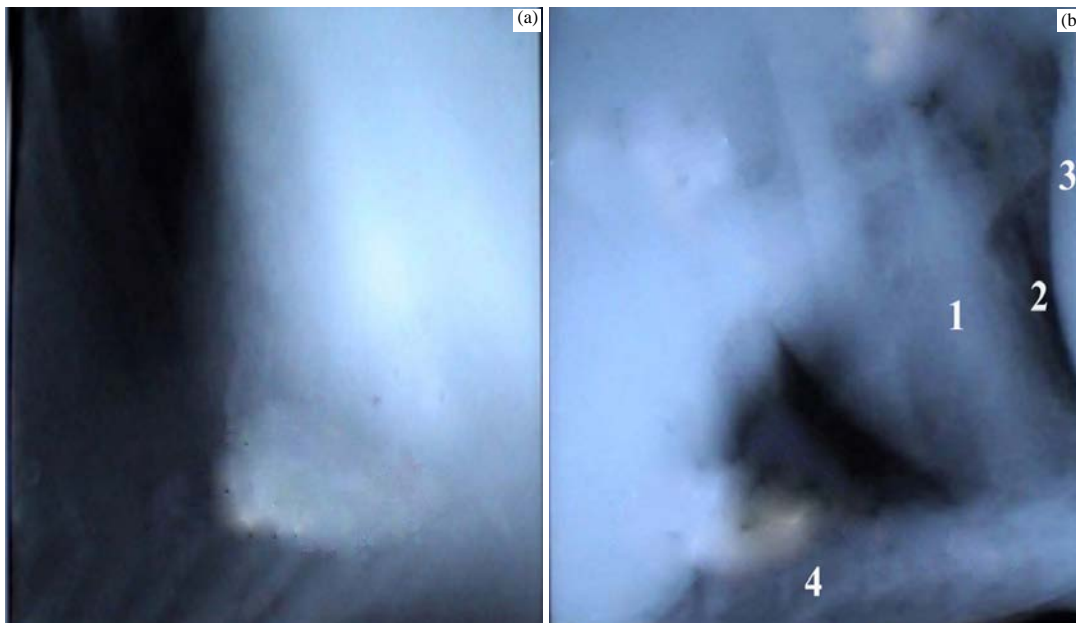


Fig. 3(a-b): (a) Lateral radiographic view of the cranial abdomen, (b) Caudal thorax of a 4-years-old pregnant buffalo with acute TRP showing free reticulum, clear diaphragmatic line, normal sized and shaped radiopaque heart, 1: Heart, 2: Diaphragm, 3: Reticulum and 4: Sternum

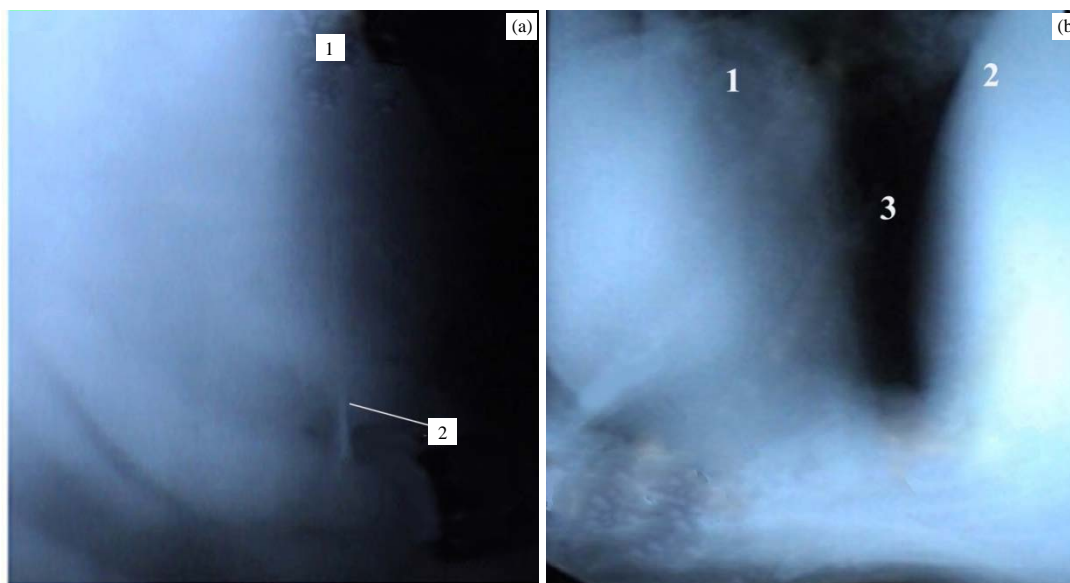


Fig. 4(a-b): (a) Lateral radiographic view of the cranial abdomen of a 2.5-years-old buffalo with acute TRP showing 1: Reticulum with nail (2), (b) Lateral radiographic view of the caudal thorax showing 1: Radio-opaque heart with clear margins and normal size, 2: Reticulum and 3: Diaphragm

significant reduction in the reticular contractions to $1.9 \pm 0.6/5$ min (normal: $4.75 \pm 0.4/5$ min).

All diseased buffaloes had no reticular abscess meanwhile, peritoneal effusions were usually imaged in

16 animals. Peritoneal effusions appeared as accumulation of echogenic fibrinous deposits forming echogenic tree (Fig. 5d) or echogenic band (Fig. 5e) ventrally to the reticulum and dorsally to the ventral abdominal wall

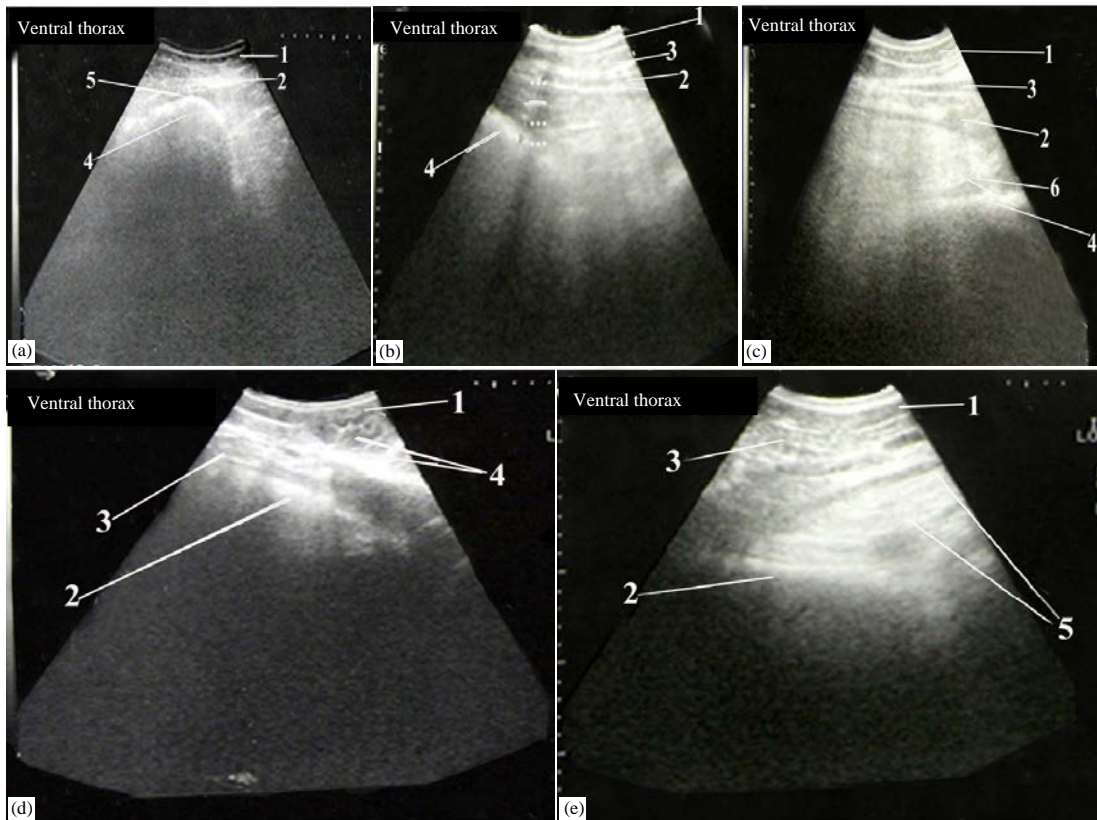


Fig. 5(a-e): (a) Ultrasonograms of buffaloes with acute TRP imaged from the left ventral thorax showing slight thickening and corrugation in the reticular serosa, (b) Loss of even contour and half-moon shaped structure of the reticulum and displaced reticulum due to accumulation of fibrinous deposits and hypoechoic exudates caudoventral and cranial to the reticulum or due to echogenic fibrinous mass between reticulum and diaphragm, (c) 1: Abdominal wall, 2: Diaphragm, 3: Muscophrenic vein, 4: Reticulum, 5: Thickening in the reticular serosa, 6: Echogenic fibrinous mass, (d) Ultrasonogram of a 7-year-old buffalo with acute TRP imaged from the left ventral aspect of the thorax showing uneven reticular serosa with loss of its half-moon shaped structure, displacement of the reticulum with peritoneal effusions in the form of echogenic fibrinous tree (e) Echogenic bands, 1: Abdominal wall, 2: Reticulum, 3: Peritoneal effusions, 4: Echogenic fibrinous tree and 5: Echogenic fibrinous bands

Table 2: Common ultrasonographic findings associated with acute traumatic reticuloperitonitis in buffaloes

Parameters	Ultrasonographic findings
Half-moon shaped of reticulum	Present (n = 14) or slightly lost (n = 6)
Even contour of reticulum	Observed (n = 14) or slightly lost with slight thickening in the reticular serosa (n = 6)
Reticular contraction	1-2/3 min
Reticulum-diaphragm distance	0.7-3.4 cm (Usually not highly displaced)
Reticular abscess	Not imaged
Peritoneal effusions	Usually imaged (n = 16)
Heart	Not involved
Spleen	Not involved
Rumen, omasum and abomasum	Not involved
Liver	Not involved
Intestines	Not involved
Right kidney	Not involved

(extended from reticular serosa to abdominal wall). These findings are summarized in Table 2.

Rumenotomy revealed the presence of ropes, small parts of rubber bags in the rumen, nails, pins and wires in the reticulum. Absence (n = 3) or presence (n = 10) of adhesions between the reticulum and surrounding organs including the diaphragm was also detected in 13 operated buffaloes. No diaphragmatic hernia was recorded in all diseased buffaloes.

DISCUSSION

Foreign body syndrome in buffaloes is still a challenge in veterinary practices all over the world²²⁻²⁴. Hardware disease

synonymously known as TRP or Sharp Foreign Body Syndrome (SFBS) is a common and serious disease in buffaloes particularly in developing countries due to bad management of the animals^{25,26}. Unfortunately, foreign body syndrome is the major problem facing the bovine producers all over Egypt and results in devastating economic losses^{1,13}.

The present study was conducted only on buffaloes with acute TRP. The diagnosis of acute TRP depended mainly upon case history and clinical, laboratory, radiographic and ultrasonographic findings in comparison with normal buffaloes.

The recorded clinical findings in buffaloes with acute TRP agreed with those reported in cattle before⁵. All recorded clinical signs could be attributed to acute inflammatory changes induced by penetration of the reticulum by the sharp foreign body.

In the present study, electronic metal detector could identify metal objects in the reticulum but did not distinguish between perforating and nonperforating foreign bodies. Additionally, it could not detect sharp non metallic foreign objects. Similar findings were also reported before².

Although, not always necessary, laboratory findings may be helpful in the diagnosis of acute TRP. Blood pictures showed marked leucocytosis associated with neutrophilia and shift to the left in buffaloes with acute TRP. This is in agreement with a previous study²⁷.

In buffaloes with acute TRP, there was a significant increase in serum level of AST. In this respect, previous study demonstrated that haematological picture and serum biochemical profiles in cases of TRP showed changes which could be used as a diagnostic tool because it reported highly significant increase in blood globulin and fibrinogen levels and decrease in albumin and plasma protein: Fibrinogen ratio (PP:F)²⁸. However, the blood levels of Total Plasma Protein (TPP) and Plasma Fibrinogen (PF) increase among cattle with TRP and those with other gastrointestinal diseases. Meanwhile, Benjamin²⁹ reported that the changes in hematological and biochemical parameters such as elevation of blood fibrinogen, aspartate aminotransferase and alkaline phosphatase were indicative of inflammatory changes in the body and not restricted only to traumatic reticulo-peritonitis/pericarditis.

Braun *et al.*²⁰ explained the importance of radiography as an aid in the diagnosis of TRP in cattle while Braun *et al.*⁷ compared ultrasonographic and radiographic findings in cows with TRP. In this respect, radiography could be a confirmed tool for diagnosis of acute TRP when visible metallic foreign bodies such as nails, needles and pins, present beyond the border of the reticulum, unattached to the magnet in the

reticulum and positioned off the floor of the reticulum. However, radiography failed to either identify inflammatory changes that occurred on the reticular serosa, reticular abscesses and non metallic sharp objects like glasses, contraction and relaxation of the reticulum. Moreover, the portable radiographic machines unable to penetrate the area of reticulum of the standing adult buffalo therefore, the affected animal may need to be transported to where there is a radiographic unit with sufficient power. During radiographic examination, the animal should not be positioned in dorsal recumbency to avoid the stress on adhesions and diffuse peritonitis due to gravitational spread of infection²⁰.

Ultrasonography should be used simultaneously with radiography for the diagnosis of acute TRP in buffaloes⁷. In this study, there was no case with positive radiography and had negative ultrasonography. Conversely, there were several cases with positive ultrasonography and had negative radiography. The foreign bodies in these cases could be displaced posterior to the reticulum or of non metallic nature.

Ultrasonography is considered as a very beneficial and easy tool for diagnosis of TRP in buffaloes³⁰. The examination is conducted on standing, non-sedated animals for visualization of physiological¹⁵ and pathological conditions of the reticulum in cattle and buffaloes suffered from TRP³¹. The current study also reported that ultrasonography in some cases of acute TRP particularly those of mild degree was diagnostic without the aid of radiography through its ability to detect the reduction in the reticular contractions. Slight peritoneal effusions and moderate disruption in the even contour of the reticulum wall with slight loss of its half-moon shape and thickening in the reticular serosa were also observed. These results relatively agreed with previous studies^{7,20}. Although, other studies^{1,11} recorded metallic foreign bodies by ultrasound, no foreign body could be imaged by ultrasound in this study. This could be attributed to the small number of the examined buffaloes in this study. Ultrasonographically, metallic foreign body appeared as hyper echogenic structures penetrating the wall of reticulum with comet tail artifact^{1,11}.

The acute TRP cases were characterized by certain ultrasonographic findings, mainly restricted to the reticulum including the contour, shape and contraction of the reticulum. This is due to short time between the onset of the disease and the admission of animals for treatment. The loss of shape and contour of reticulum is due to accumulation of fibrinous deposits interspersed with pockets of exudates on the serosa of the reticulum. The displacement of reticulum from diaphragm and abdominal wall is also due to accumulation of fibrinous deposits and masses between the

reticulum, abdominal wall and diaphragm. Reduction of the reticular contraction compared to control animals could be attributed to adhesions. No reticular abscess was imaged in this study. This could be attributed to early admission of the affected buffaloes for treatment. Other ultrasonographic finding is peritoneal effusions which appeared as accumulation of echogenic fibrinous deposits forming echogenic tree or echogenic bands extending from reticular serosa to abdominal wall. Similar findings had been reported in cattle³².

Rumenotomy was carried out in 13 diseased buffaloes for justification of diagnosis and removal of foreign objects. Rumenotomy confirmed all radiographic and ultrasonographic findings. The owners of other diseased buffaloes refused rumenotomy.

There are several sequelae to acute TRP in buffaloes including chronic localized or diffuse TRP, reticular, splenic, hepatic, abdominal and thoracic abscesses, traumatic pericarditis, diaphragmatic hernia, traumatic pleuropneumonia, vegal indigestion and acute haemorrhage with sudden death. Ultrasonography is the most accurate tool for the differential diagnosis of these complications³³.

Several measures have been recommended to prevent TRP in buffaloes including passing feed over magnets, avoiding the use of baling wire, keeping buffaloes away from areas of new construction, removal of old fences and buildings, administration of a rumen magnet and reapplication of a second new magnet four years later in animals at high risk^{4,30}.

CONCLUSION

Buffaloes with acute TRP show characteristic and complementary clinical, laboratory, radiographic and ultrasonographic findings which are helpful for diagnosis and follow up this affection.

ACKNOWLEDGMENTS

The researchers are grateful to the Director of Veterinary Teaching Hospital and Head Department of Animal Surgery at Assiut University for their kind support during conducting this study.

REFERENCES

1. Mostafa, M.B., A.M. Abu-Seida, A.M. Abdelaal, O.S. Al-Abbadi and S.F. Abbas, 2015. Ultrasonographic features of the reticulum in normal and hardware diseased buffaloes. Res. Opin. Anim. Vet. Sci., 5: 165-171.
2. Abu-Seida, A.M. and O.S. Al-Abbadi, 2015. Studies on sharp foreign body syndrome in iraqi buffaloes and its impact on milk production. Asian J. Anim. Sci., 9: 128-133.
3. Abdelaal, A.M., M. Floeck, S. El Maghawry and W. Baumgartner, 2009. Clinical and ultrasonographic differences between cattle and buffaloes with various sequelae of traumatic reticuloperitonitis. Veterinarni Medicina, 54: 399-406.
4. Al-Abbadi, O.S., A.M. Abu-Seida and S.M. Al-Hussainy, 2014. Studies on rumen magnet usage to prevent hardware disease in buffaloes. Vet. World, 7: 408-411.
5. Radostits, O.M., C.C. Gray, K.W. Hinchcliff and P.D. Constable, 2007. Veterinary Medicine: A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs and Goats. 10th Edn., Saunders Elsevier, Philadelphia, USA., pp: 430-432.
6. Abu-Seida, A.M. and O.S. Al-Abbadi, 2016. Recent advances in the management of foreign body syndrome in Cattle and Buffaloes: A review. Pak. Vet. J., (In Press).
7. Braun, U., M. Fluckiger and M. Gotz, 1994. Comparison of ultrasonographic and radiographic findings in cows with traumatic reticuloperitonitis. Vet. Rec., 135: 470-478.
8. Kaske, M., A. Midasch and J. Rehage, 1994. Sonographic investigation of reticular contractions in healthy sheep, cows and goats and in cows with traumatic reticulo-peritonitis. J. Am. Vet. Med. Assoc., 41: 748-756.
9. Abu-Seida, A.M.A., 2012. Ultrasonographic diagnosis of some scrotal swellings in bulls. Pak. Vet. J., 32: 378-381.
10. Kotb, E.E., A.M. Abu-Seida and M.S. Fadel, 2014. The correlation between ultrasonographic and laboratory findings of mastitis in buffaloes (*Bubalus bubalis*). Global Vet., 13: 68-74.
11. Abdelaal, A. and M. Floeck, 2015. Clinical and sonographical findings in buffaloes (*Bubalus bubalis*) with traumatic reticuloperitonitis. Veterinarski Arhiv, 85: 1-9.
12. Abdelaal, A.M., O.S. Al-Abbadi and A.M. Abu-Seida, 2016. Transcutaneous and transrectal ultrasonography in buffalo calves with urine retention. Asian J. Anim. Vet. Adv., 11: 79-88.
13. Khalphallah, A., E. Elmeligy, H.K. Elsayed, S.F. El-Hawari and M.H. Elrashidy, 2016. Diagnostic significance of ultrasonography in complicated traumatic reticuloperitonitis in egyptian buffaloes (*Bubalus bubalis*). Asian J. Anim. Vet. Adv., 11: 319-330.
14. Ghanem, M.M., 2010. A comparative study on traumatic reticuloperitonitis and traumatic pericarditis in Egyptian cattle. Turk. J. Vet. Anim. Sci., 34: 143-153.
15. Abouelnasr, K.S., E. Mosbah, G.I. Karrouf and A.E. Zaghloul, 2012. Comparative ultrasonographic findings of traumatic reticulitis, perireticular abscess and diaphragmatic hernia in buffalo (*Bubalus bubalis*). J. Am. Sci., 8: 590-595.
16. Aref, N.E.M. and M.A.H. Abdel-Hakim, 2013. Clinical and diagnostic methods for evaluation of sharp foreign body syndrome in buffaloes. Vet. World, 6: 586-591.

17. Cockcroft, P.D., 2015. Diagnosis and Clinical Reasoning in Cattle Practice. In: Bovine Medicine, 3rd Edition, Cockcroft, P.D. (Eds.), John Wiley and Sons Ltd., New York, ISBN: 978-1-4443-3643-6, pp: 124-132.
18. Coles, E.H., 1986. Collection of Blood Samples. In: Veterinary Clinical Pathology, 4th Edition, Coles, E.H. (Ed.), W.B. Saunders Company, Philadelphia, ISBN-13: 978-0721618289, pp: 46-47.
19. Kelly, W.R., 1984. Veterinary Clinical Diagnosis. 3rd Edn., Elsevier Health Sciences, London, ISBN-13: 9780721609478, Pages: 430.
20. Braun, U., M. Fluckiger and F. Nageli, 1993. Radiography as an aid in the diagnosis of traumatic reticuloperitonitis in cattle. Vet. Rec., 132: 103-109.
21. Hofmeyr, C.F., 1988. The Digestive System. In: Textbook of Large Animal Surgery, Oehme, F.W. (Ed.). 2nd Edn., Williams and Wilkins, Baltimore, MA., ISBN-13: 9780683066357, pp: 448-448.
22. El-Ashker, M., M. Salama and M. El-Boshy, 2013. Traumatic reticuloperitonitis in water buffalo (*Bubalus bubalis*): Clinical findings and the associated inflammatory response. J. Vet. Med., Vol. 2013. 10.1155/2013/808656.
23. Sileshi, N., V. Ramaswamy, U. Chandrashekar and N. Raja, 2013. Studies on foreign body ingestion and their related complications in ruminants associated with inappropriate solid waste disposal in Gondar Town, North West Ethiopia. Int. J. Anim. Vet. Adv., 5: 67-74.
24. Abu-Seida, A.M. and O.S. Al-Abbadi, 2014. Recurrent rumen tympany caused by trichobezoars in buffaloes (*Bubalus bubalis*): A series report. Thai. J. Vet. Med., 44: 147-151.
25. Sharma, M.C. and P. Kumar, 2006. Foreign body syndrome in buffaloes (*Bubalus bubalis*): An emerging threat. Asian J. Anim. Vet. Adv., 1: 89-98.
26. Semieka, M.A., 2010. Radiography of unusual foreign body in ruminants. Vet. World, 3: 473-475.
27. Latimer, K.S., E.A. Mahaffey and K.W. Prasse, 2003. Duncan and Prasse's Veterinary Laboratory Medicine: Clinical Pathology. 4th Edn., Iowa State Press, Ames, USA., pp: 68-77, 152-160, 166-167.
28. Braun, U., N. Pusterla and H. Anliker, 1998. Ultrasonographic findings in three cows with peritonitis in the left flank region. Vet. Rec., 142: 338-340.
29. Benjamin, M.M., 1985. Outline of Veterinary Clinical Pathology. 3rd Edn., Kalyan Publishers, New Delhi, Pages: 291.
30. Abu-Seida, A.M., 2016. Current status and prospect of ultrasonographic application in buffaloes. Asian J. Anim. Vet. Adv., 11: 144-157.
31. Flock, M., 2006. Ultrasonography of the reticulum-a diagnostic tool for the practitioner. Slovenian Vet. Res., 43: 208-209.
32. Braun, U., G. Schweizer and M. Fluckiger, 2002. Radiographic and ultrasonographic findings in three cows with reticulo-omasal obstruction due to a foreign body. Vet. Rec., 150: 580-581.
33. Abdelaal, A.M., M.B. Mostafa, A.M. Abu-Seida, O.S. Al-Abbadi and S.F. Abbas, 2016. Ultrasonographic findings in hardware diseased Buffaloes (*Babulus babilus*). Res. J. Pharma. Biol. Chem. Sci., 7: 1644-1649.