

COMPARATIVE EVALUATION OF RETICULAR MORPHOMETRY BY ULTRASONOGRAPHY IN HEALTHY WITH RUMINAL INDIGESTION AND FOREIGN BODY SYNDROME AFFECTED BUFFALOES

**Chaudhari Narshingrao Vijaykumar, Basavannappa Bhagavantappa,* Desai Dilipkumar,
Doddamani Jahangirbasha, Vivek Ramrao Kasaralikal, Prashantkumar Waghe and Venkatgiri**

Received: 08 April 2021

Accepted: 21 March 2025

ABSTRACT

The ultrasonographic study was conducted to evaluate morphometry of reticulum in 32 clinical cases of buffaloes presented to Veterinary College, Bidar. They were divided into three groups, Group 1 (13) healthy buffaloes, Group 2 (13) buffaloes with ruminal indigestion and Group 3 (6) buffaloes with foreign body syndrome. Reticulum sonography was carried out without sedation in standing position at 6th to 8th intercostal space. To know the appearance, contour, motility, wall thickness and distance from abdominal wall to reticulum the four windows were approached. The reticulum is visible at frequency of 3.5 to 4.5 MHz, depth of 14 to 16 cm and gain of 130 to 160 in real time B-mode scanner. In Group 2 buffaloes the appearance of reticulum wall was half moon or crescent shape with smooth contour and significantly decreased reticular motility to $1.30 \pm 0.25/4$ minutes. In Group 3, the appearance of the right lateral reticulum wall revealed irregular shape with uneven contour in 2 buffaloes. The right lateral reticular wall thickness was significantly increased to 0.95 ± 0.13 cm. Reticular motility was significantly decreased to $1.17 \pm 0.15/4$ minutes. Distance between abdominal wall to reticulum on right lateral examination

was 7.09 ± 1.24 cm. Among the forestomach reticulum is the motile organ so better diagnosed by ultrasonography than other imaging modalities. Pathological signs confirmed by ultrasonography scanning are presence of peritoneal fluid, movement of fibrin shreds, adhesions, abscess and hernia of reticulum in buffaloes affected with foreign body syndrome. In ruminal indigestion, nil to reduced reticular motility is the only important sonographic finding.

Keywords: *Bubalus bubalis*, buffaloes, ultrasonography, reticulum, ruminal indigestion, foreign body syndrome

INTRODUCTION

Ultrasonography is a non-invasive and helpful method for the assessment of contour and motility of the reticulum (Braun and Gotz, 1994). Braun (2003); Abouelnasr *et al.* (2014) observed ultrasonographically the normal reticulum appeared half moon or crescent shaped structure with even or smooth contour in cattle and buffalo respectively. The thickness of reticulum wall in healthy buffaloes varied from 0.37 to 0.68 cm

(Makhdoomi *et al.*, 2019). Khalphallah *et al.* (2016a) on ultrasonography observed characteristic three biphasic reticular contractions per 3 minutes in buffaloes. Mostafa *et al.* (2015) observed the distance between reticulum and abdominal wall was 2.08 ± 0.06 cm. Athar *et al.* (2010) on ultrasonography observed the toy of reticulum wall and partial reticular motility in bovines affected with rumen impaction. Khalphallah *et al.* (2016b) observed reticulum with even contour or half-moon shaped structure in 14 buffaloes and slight loss of its shape and contour in 6 buffaloes affected with traumatic reticuloperitonitis (TRP). They also observed the mean reticular wall thickness increased to 1.50 ± 0.20 cm and significant reduction in the reticular contractions to $1.90 \pm 0.60/5$ minutes. Khalphallah *et al.* (2016c) observed reticular contractions were 0/3 min in severely affected buffaloes with TRP. Abu-Seida and Al-Abbadi (2016) observed the distance between reticulum and abdominal wall was significantly increased in cattle and buffaloes affected with TRP.

The importance of present study is ultrasonographic morphometry of reticulum in Indian buffaloes affected with ruminal indigestion and foreign body syndrome as there is a paucity of literature in buffaloes affected with ruminal indigestion. Most of the cases whether they are affected with foreign body syndrome, or any other forestomach disorders the buffaloes primarily come down with signs indicating ruminal indigestion. So, it is very essential to rule out the involvement of reticulum in early stages of buffaloes affected with ruminal indigestion. Here comes the role of ultrasonography in diagnosis of reticular disorders when compared to other imaging modalities along with clinical signs. Thereby it helps with accurate diagnosis and gives proper treatment by therapy or surgical intervention. Therefore, the present study

was carried out with objective of ultrasonographic evaluation of reticulum in health and then compared with buffaloes affected with ruminal indigestion and foreign body syndrome.

MATERIALS AND METHODS

The present clinical case study was approved by Institutional Animal Ethics Committee (No: 04/2020/VCB/VSR dated: 13/03/2020). The study was carried out in 32 clinical cases of buffaloes presented to the Department of Veterinary Surgery and Radiology, Veterinary College, Bidar. 32 buffaloes were divided into three groups. In Group 1 (13) includes apparently healthy buffaloes, Group 2 (13) includes ruminal indigestion and Group 3 (6) includes foreign body syndrome affected buffaloes.

All buffaloes were prepared for ultrasonographic examination by trimming hairs from lateral and ventral abdomen area at 6th to 8th intercostal space. In standing position and without sedation the reticulum was scanned in real time B-mode and B+M mode using CHISON ECO 5 VET ultrasound machine with 2.5 to 5 MHz curvilinear transducer by applying coupling gel at four windows namely right lateral, left lateral, right parasternal and left parasternal as per Braun (2003).

As per the above mentioned windows reticulum wall appearance was evaluated for its physical shape like half moon and crescent shape (Mostafa *et al.*, 2015), the contour of reticulum wall for its smooth and abnormal contour (Braun, 2003), mean thickness of reticulum wall using ultrasonographic callipers in centimeter (Makhdoomi *et al.*, 2019) and reticular contraction with amplitude were recorded for 4 to 5 minutes (Sheikh *et al.*, 2012). For additional information,

reticular sonography was also performed at both right and left parasternal windows for qualitative evaluation. The mean distance between abdominal wall to reticulum wall was recorded on right and left lateral abdomen in centimeter (Abouelnasr *et al.*, 2014). The data obtained in the present study were evaluated by student t-test (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSIONS

The details of group wise reticular morphometry by ultrasonography are given in Table 1. In Group I healthy buffaloes the reticulum wall appeared half moon shape (rainbow like structure) or crescent shape (thick echogenic line with downward curvature at edges) with a smooth contour. On right lateral abdomen examination, along with reticulum diaphragm and liver were observed (Figure 1). On left lateral abdomen examination, along with reticulum diaphragm and spleen were observed (Figure 2). On left parasternal examination, diaphragm, spleen, rumen wall and musculophrenic vein were observed along with reticulum (Figure 3). Similar findings were observed by Sheikh *et al.* (2012). On the right parasternal examination along with reticulum diaphragm was observed (Figure 4). Amplitude of first and second reticular contractions was 3.07 and 3.54 cm respectively (Figure 5). Reticulum wall thickness was 0.73 ± 0.04 cm and 0.96 ± 0.07 cm on right and left lateral reticulum wall respectively whereas Makhdoomi *et al.* (2019) observed the thickness of reticulum wall was 0.37 to 0.68 cm. Reticular motility was $3.96 \pm 0.17/4$ minutes and similar findings were recorded by Khalphallah *et al.* (2016a). Distance between abdominal wall to right lateral reticulum wall was 4.60 ± 0.44 cm

whereas distance between abdominal wall to left lateral reticulum wall was 6.26 ± 0.50 cm. However, Mostafa *et al.* (2015) observed the distance between reticulum and abdominal wall was 2.08 ± 0.06 cm in buffaloes.

The reticulum wall appeared half moon shape on right lateral examination was similar in both Group 1 and 2. There is a paucity of literature on ruminal indigestion in buffaloes to support our findings. However, in Group 3, 3 buffaloes (50%) showed half moon shape, irregular shape (Figure 6) in 2 buffaloes (33%) and crescent shape in 1 buffalo. These findings agreed with Abouelnasr *et al.* (2012) and they observed reticulum wall indentation with fibrinous mass and corrugated appearance due to fibrinous deposits suggestive of TRP.

Majority of the buffaloes of Group 2 and 3 showed a reticulum wall was crescent shape on the left lateral examination when compared to Group 2 buffaloes. These findings agreed with Abouelnasr *et al.* (2012).

In Group 1 and 2 the contour of reticulum wall was smooth on right lateral examination. However, in Group 3, 50% buffaloes were with uneven contour suggestive of changes in the serosal wall of reticulum suggestive of adhesions. In all three groups of buffaloes reticulum showed smooth contour on left lateral examination. However, in Group 3 one buffalo showed uneven contour suggesting changes in the wall of reticulum with adhesions indicating foreign body syndrome of reticulum. These findings were in agreement with Abdelaal *et al.* (2016); Abdelaal *et al.* (2009) and they opined that thickening of reticular serosa with echogenic fibrinous deposits produced uneven contour of reticular wall.

The right lateral reticulum wall thickness was 0.72 ± 0.04 and 0.95 ± 0.13 cm on right lateral

examination in Group 2 and Group 3 buffaloes respectively. Non-significantly decreased and significantly increased ($P \leq 0.05$) reticulum wall thickness (Figure 7A) was observed in Group 2 and 3 buffaloes respectively when compared to Group 1 buffaloes. Similar findings were observed by Khalphallah *et al.* (2016b); Mostafa *et al.* (2015) in buffaloes affected with acute TRP and hardware disease respectively. The left lateral reticulum wall thickness was 0.93 ± 0.05 and 0.88 ± 0.06 cm in Group 2 and 3 respectively. Non-significant decreased reticulum wall thickness was observed on left lateral examination in buffaloes of Group 2 and 3 when compared to Group 1 buffaloes. Whereas Makhdoomi *et al.* (2019) observed increased thickness of reticulum wall on left lateral examination in cows and buffaloes affected with TRP.

Reticular motility was 1.30 ± 0.25 and $1.17 \pm 0.15/4$ min in Group 2 and 3 respectively. Significantly decreased ($P \leq 0.01$) reticular motility was observed in Group 2 and 3 when compared to Group 1 buffaloes suggestive of decreased functional contraction of reticulum both in rate and force of contraction. These findings were in agreement with Athar *et al.* (2010) in bovines affected with rumen impaction and Mostafa *et al.* (2015) in buffaloes affected with hardware disease and they attributed due to pain and adhesions between reticulum and surrounding organs resulted in reduced reticular motility.

Distance between abdominal wall to reticulum wall was 4.46 ± 0.34 and 7.09 ± 1.24 cm on right lateral examination in Group 2 and 3 respectively. Non-significant decreased and significant increased ($P \leq 0.05$) (Figure 7B) distance between abdominal wall to reticulum wall was observed on right lateral examination in Group 2 and 3 when compared to Group 1 buffaloes. These

observations were in agreement with Abdelaal *et al.* (2016) in hardware diseased buffaloes and they opined that accumulation of fibrin interspersed between reticulum and abdominal wall in cattle and buffaloes affected with TRP. Distance between abdominal wall to reticulum on left lateral examination was 6.40 ± 0.39 and 6.95 ± 0.53 cm in Group 2 and 3 buffaloes respectively. Non-significant increased distance between abdominal wall to reticulum on left lateral examination was observed in Group 2 and 3 when compared to Group 1 buffaloes. On contrary, Makhdoomi *et al.* (2019) found decreased distance on left lateral examination in cows and buffaloes affected with TRP.

Amplitude of first and second reticular contraction was 0.98 and 1.58 cm respectively. The amplitude was decreased in Group 2 and 3 buffaloes when compared to Group I buffaloes (Figure 8). Similar findings were observed by Abouelnasr *et al.* (2012) in diaphragmatic hernia buffaloes.

In 2 buffaloes affected with foreign body syndrome, the metallic foreign body was detected ultrasonographically with comet tail artifact (Figure 9A). In Group 3, 2 buffaloes showed crescent shaped reticulum wall (intrathoracic) adjacent to heart with transposition of reticulum from abdomen to thoracic cavity indicating reticular hernia (Figure 9B).

CONCLUSION

All four window approaches are essential to get complete abnormality of the reticulum in buffaloes.

The reticulum is clearly visible with transducer frequency of 3.5 to 4.5 MHz, depth of

Table 1. Ultrasonographic morphometry of reticulum in ruminal indigestion (Group 2) and foreign body syndrome (Group 3) affected buffaloes compared with healthy buffaloes (Group 1).

S1. No	Ultrasonographic parameters	Group 1 (Healthy)	Group 2 (Ruminal indigestion)	Group 3 (Foreign body syndrome)
1	Right lateral reticulum wall thickness (cm)	0.73±0.04	0.72±0.04	0.95±0.13*
2	Left lateral reticulum wall thickness (cm)	0.96±0.07	0.93±0.05	0.88±0.06
3	Reticular motility / 4 minutes	3.96±0.17	1.30±0.25**	1.17±0.15**
4	Distance between abdominal wall to right lateral reticulum wall (cm)	4.60±0.44	4.46±0.34	7.09±1.24*
5	Distance between abdominal wall to left lateral reticulum wall (cm)	6.26±0.50	6.40±0.39	6.95±0.53

Mean ± SE values bearing superscript* differ significantly at (P≤0.05) between the groups.

Mean ± SE values bearing superscript** differ significantly at (P≤0.01) between the groups.

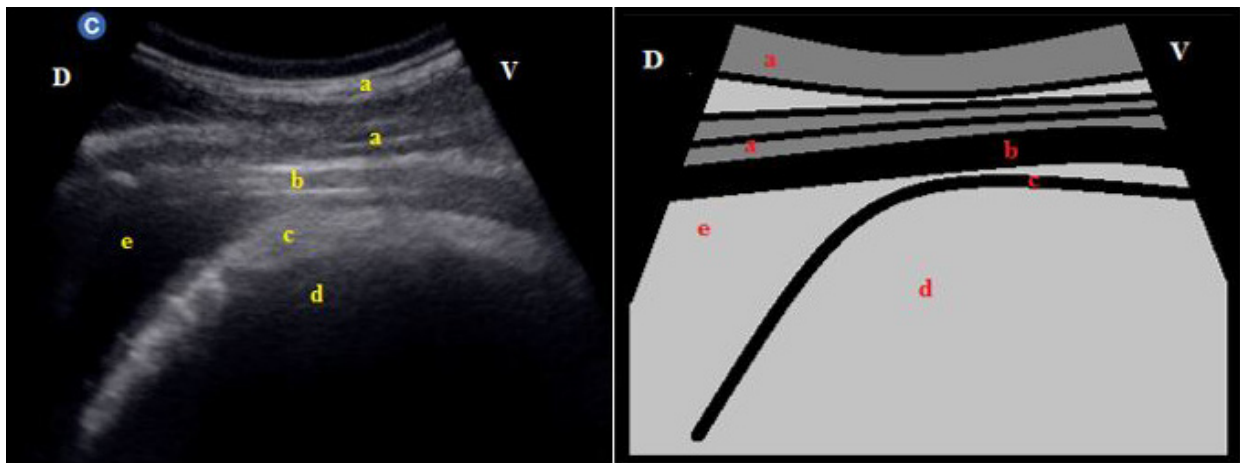


Figure 1. USG image showing reticulum wall appeared half-moon shape at 6th ICS on right lateral examination in a healthy buffalo of Group I. a) Abdominal wall; b) Diaphragm; c) Reticulum wall; d) Reticulum e) Liver. D: Dorsal; V: Ventral.

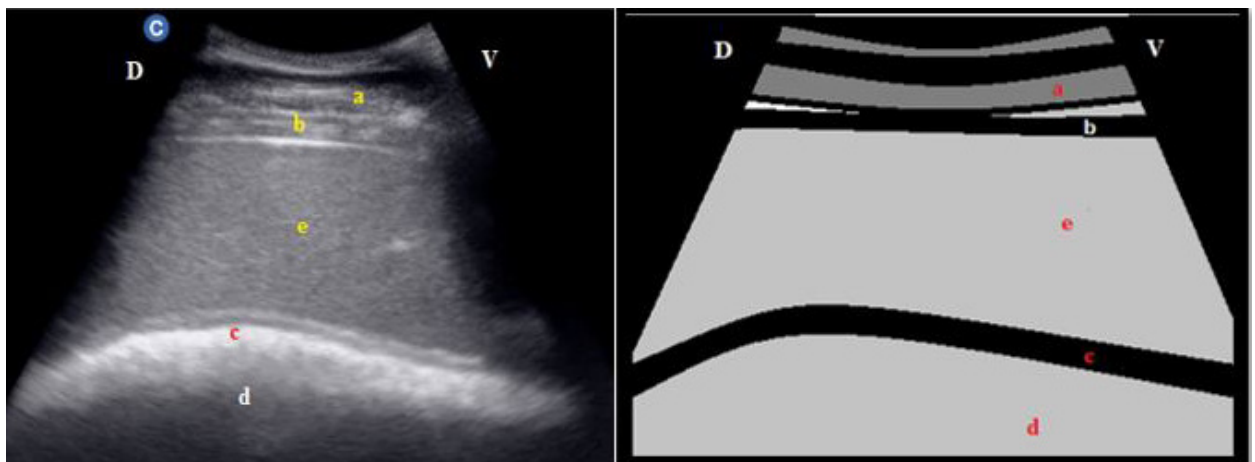


Figure 2. USG image of reticulum wall appeared crescent shape with smooth contour at 7th ICS on left lateral examination in a healthy buffalo of Group I. a) Abdominal wall; b) Diaphragm; c) Reticulum wall; d) Reticulum; e) Spleen. D: Dorsal; V: ventral.

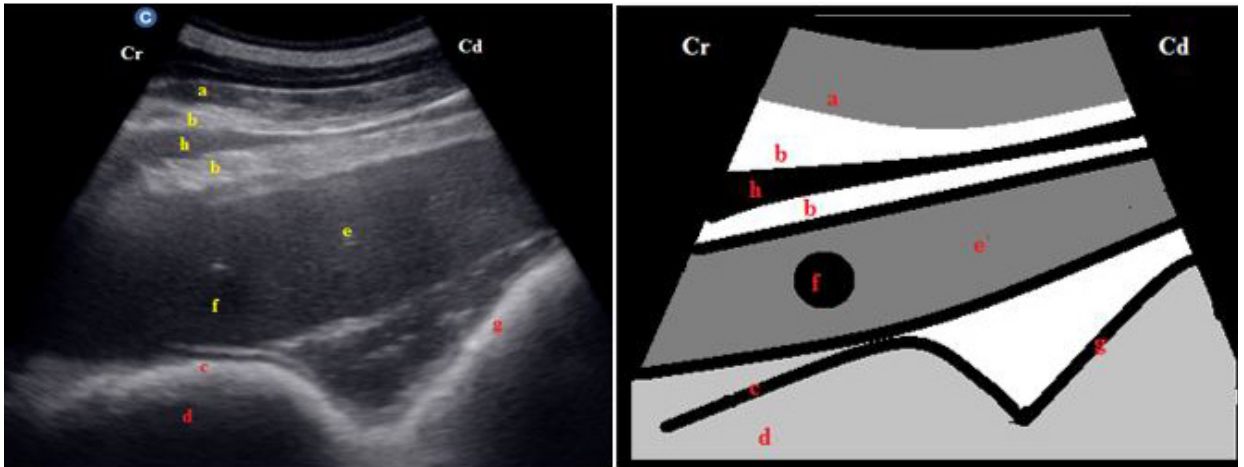


Figure 3. USG image showing B-mode scanned image of reticulum wall appeared half-moon shape at level of 7th ICS on left parasternal examination in healthy buffalo of Group I. a) Abdominal wall; b) Diaphragm; c) Reticulum wall; d) Reticulum; e) Spleen; f) Splenic vein; g) Rumen wall; h) Musculophrenic vein. Cr: Cranial; Cd: Caudal.

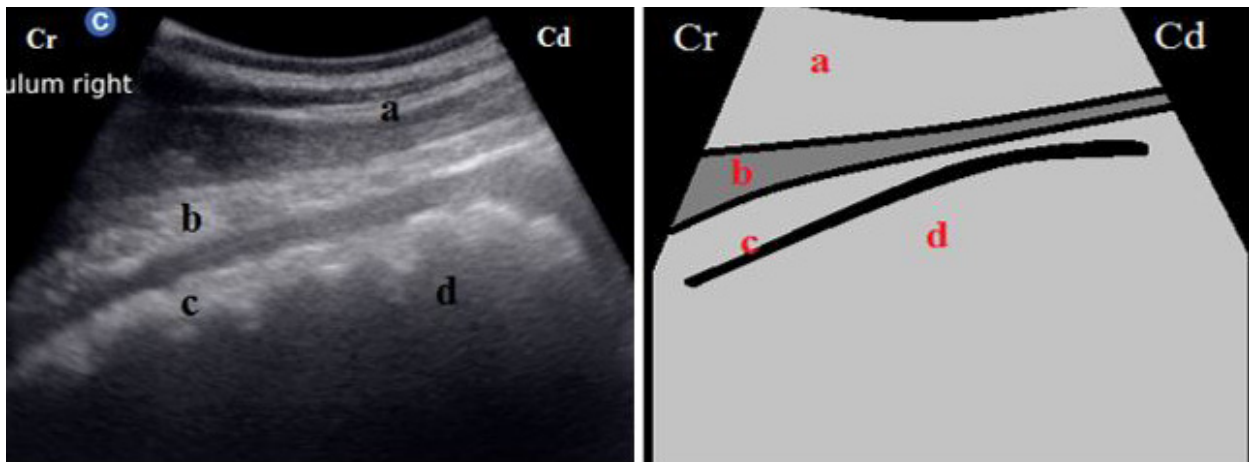


Figure 4. USG image showing B-mode scanned image of reticulum wall appeared crescent shape with honeycomb structures within lumen at level of 6th-7th ICS on right parasternal examination in healthy buffalo of Group I. a) Abdominal wall; b) Diaphragm; c) Reticulum wall; d) Reticulum. Cr: Cranial; Cd: Caudal.

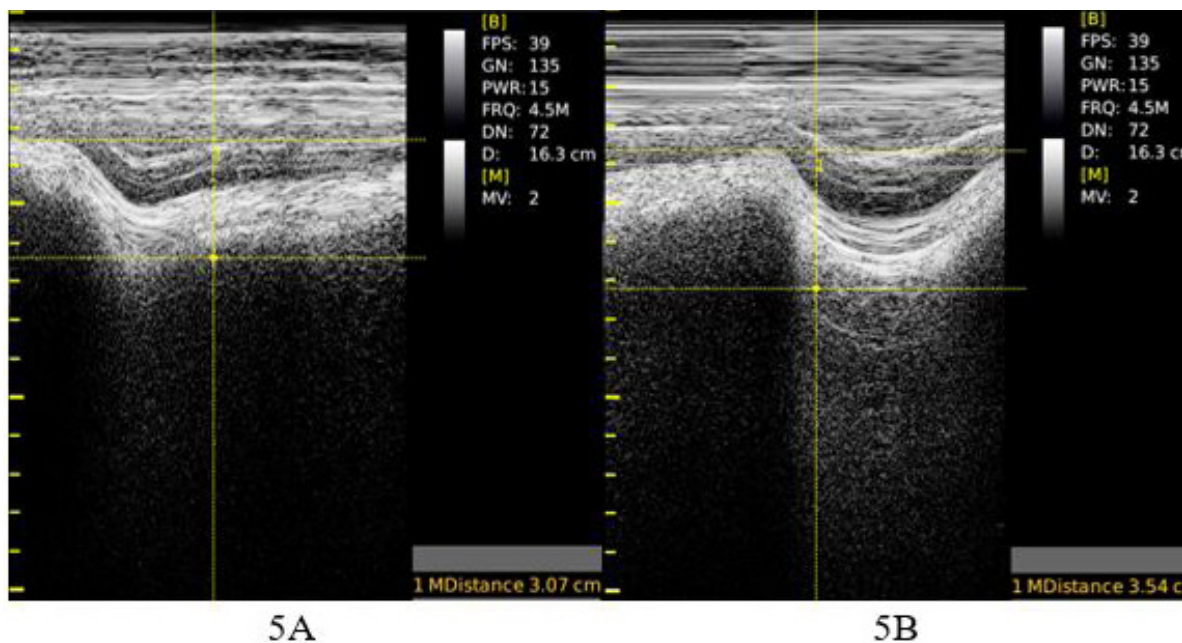


Figure 5. USG image showing B+M mode measured 3.07 cm amplitude of first reticular contraction (5A) and measured 3.54 cm amplitude of second reticular contraction (5B) of biphasic reticular contraction in a healthy buffalo of Group I. Ruminal indigestion and foreign body syndrome affected buffaloes of Group 2 and 3.

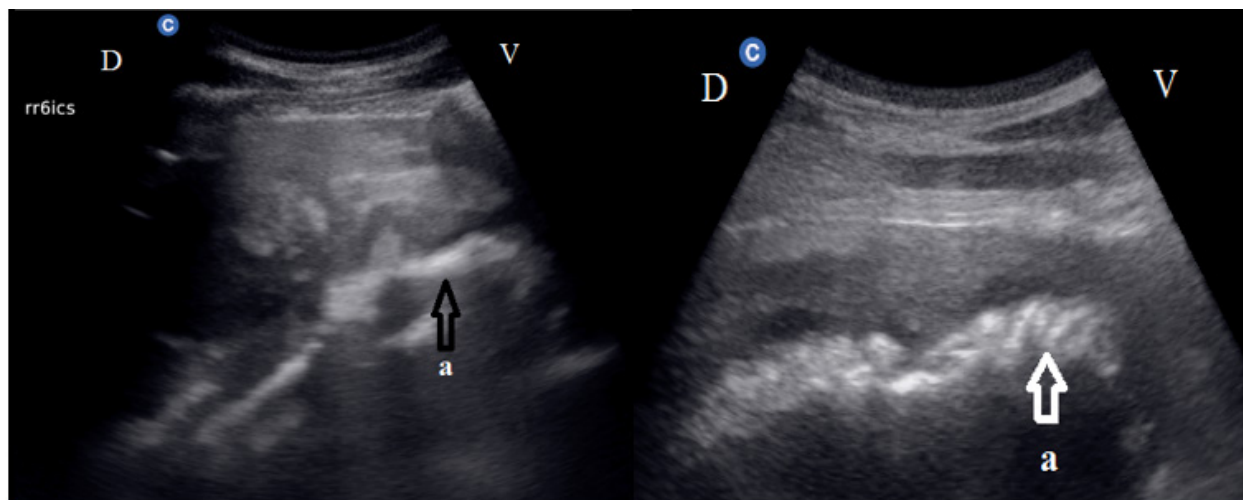
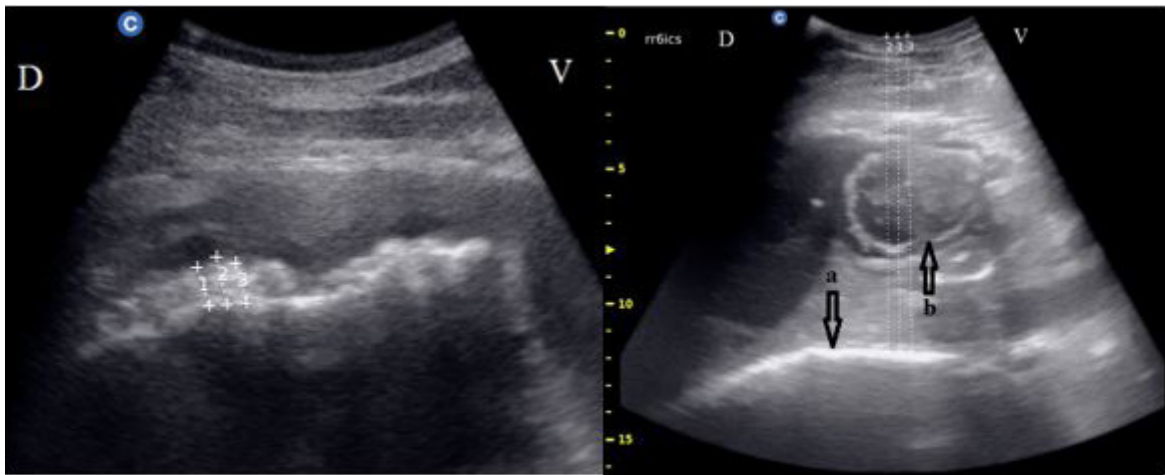


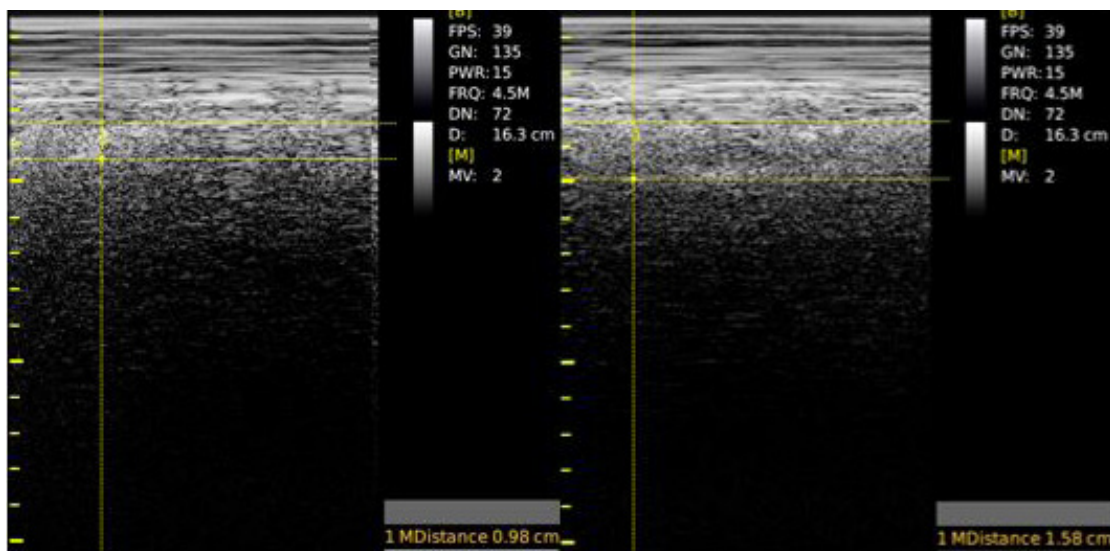
Figure 6. Photograph showing B-mode scanned image of reticulum wall (a) on right lateral examination appeared irregular shape and uneven contour in buffaloes of Group 3 affected with foreign body syndrome. D: Dorsal; V: ventral.



7A

7B

Figure 7. USG image showing (7A) measured three times increased reticulum wall thickness with uneven contour on right lateral examination in Group 3 buffalo, (7B) measured three times increased distance between abdominal wall and reticulum wall on right lateral examination in Group 3 buffalo with liver abscess complication. a) Reticulum wall; b) Liver abscess. D: Dorsal; V: ventral.



8A

8B

Figure 8. USG image showing B+M mode measured 0.98 cm amplitude of first reticular contraction (8A) and 1.58 cm amplitude of second reticular contraction (8B) of biphasic reticular contraction in a buffalo of Group 2 affected with ruminal indigestion. The biphasic contraction was atypical with only turbulence like motility.

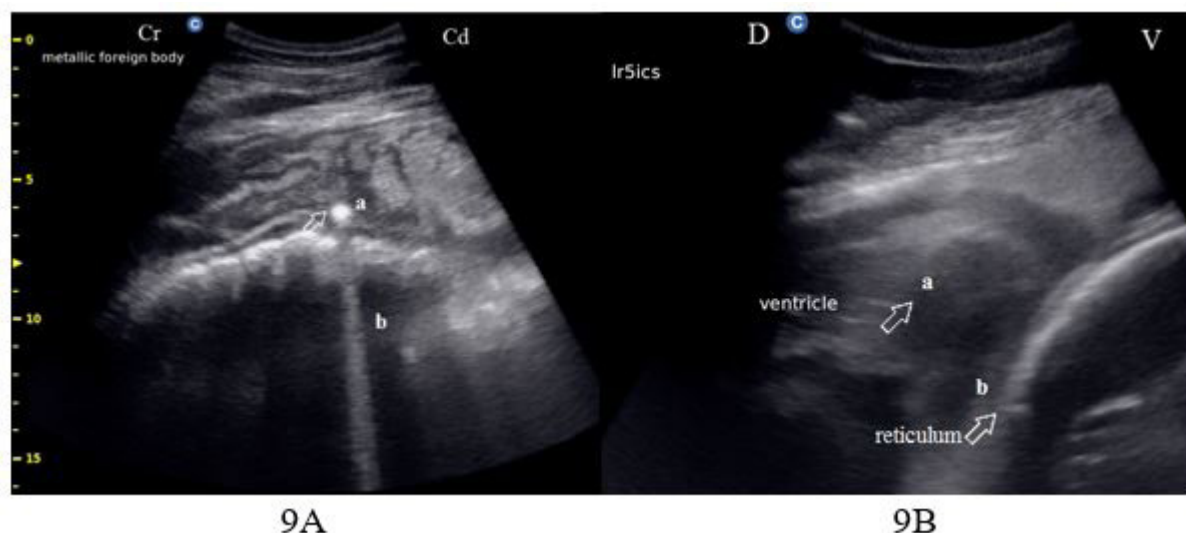


Figure 9. USG image showing B-mode scanned image of parasternal view (9A) metallic body (a) with comet tail artifact (b) in Group 3 buffalo. USG image showing B-mode scanned image (9B) of crescent shape reticulum wall (b) adjacent to ventricle heart (a) on left lateral examination at 5th intercostal space indicates reticular hernia.

14 to 16 cm and gain of 130 to 160 in real time B-mode scanner.

Among the forestomach reticulum is the motile organ so it is better diagnosed by ultrasonography than other imaging modalities.

The appearance and contour of reticulum wall was half moon shape or crescent shape with smooth or even contour in healthy and ruminal indigestion affected buffaloes. Whereas in foreign body syndrome affected buffaloes, irregular shape with uneven contour of reticulum wall was observed.

Reticular motility/4 minutes was significantly decreased in ruminal indigestion and foreign body syndrome affected buffaloes when compared to healthy buffaloes.

The thickness of reticulum wall and distance between abdominal wall to reticulum wall on right lateral examination was significantly increased in foreign body syndrome affected

buffaloes.

Pathological signs confirmed by ultrasonography scanning are presence of peritoneal fluid, movement of fibrin shreds, adhesions, abscess and hernia of reticulum in buffaloes affected with foreign body syndrome.

In ruminal indigestion, nil to reduced reticular motility is the only important ultrasonographic finding that helps in animal therapy.

REFERENCES

- 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. *Vet Med.*, **54**(9): 399-406. DOI:

10.17221/128/2009-VETMED

- 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*). *Research Journal of Pharmaceutical Biological and Chemical Sciences*, **7**(5): 1644-1649. Available on: [https://rjpbcs.com/pdf/2016_7\(5\)/\[210\].pdf](https://rjpbcs.com/pdf/2016_7(5)/[210].pdf)
- 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*). *Journal of American Science*, **8**(8): 590-595. Available on: https://www.jofamericanscience.org/journals/am-sci/am0808/090_8843am0808_590_595.pdf
- Abouelnasr, K.S., E.M. Mosbah, G.I. Karrouf and A.E. Zaghloul. 2014. Ultrasonography of normal reticulum in 30 healthy buffalo (*Bubalus bubalis*). *J. Appl. Anim. Res.*, **42**(2): 153-159. DOI: 10.1080/09712119.2013.823435
- 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.*, **36**(4): 385-393.
- Athar, H., J. Mohindroo, K. Singh and T. Singh. 2010. Clinical, haematobiochemical, radiographic and ultrasonographic findings in bovines with rumen impaction. *Intas Polivet*, **11**(2): 180-183.
- Braun, U. and M. Gotz. 1994. Ultrasonography of the reticulum in cows. *Am. J. Vet. Res.*, **55**(3): 325-332.
- Braun, U. 2003. Ultrasonography in gastrointestinal disease in cattle. *Vet. J.*, **166**(2): 112-124. DOI: 10.1016/s1090-0233(02)00301-5
- Khalphallah, A., H.K. Elsayed, E.N.A.S. Elmeligy and S.F. El-Hawari. 2016a. The ultrasonographic findings of the gastrointestinal tract and spleen in healthy Egyptian buffaloes (*Bubalus bubalis*). *Assiut Veterinary Medical Journal*, **62**(148): 9-47. Available on: https://avmj.journals.ekb.eg/article_169208_e88f5d15dc741d4a308947f1c6a610c5.pdf
- Khalphallah, A., A.M. Abu-Seida, M. Abdelhakiem, E. Elmeligy and U.T. Mahmoud. 2016b. Laboratory, radiographic and ultrasonographic findings of acute traumatic reticuloperitonitis in buffaloes (*Bubalus bubalis*). *Asian J. Anim. Vet. Adv.*, **11**(11): 675-683. DOI: 10.3923/ajava.2016.675.683
- Khalphallah, A., E. Elmeligy, H.K. Elsayed, S.F. El-Hawari and M.H. Elrashidy. 2016c. Diagnostic significance of ultrasonography in complicated traumatic reticuloperitonitis in Egyptian buffaloes (*Bubalus bubalis*). *Asian J. Anim. Vet. Adv.*, **11**: 319-330. DOI: 10.3923/ajava.2016.319.330
- Makhdoomi, S.M., V. Sangwan, A. Kumar, J. Mohindroo and A. Gupta. 2019. Ultrasonographic morphometry of reticulum in cattle and buffaloes suffering from traumatic reticulo-peritonitis. *Buffalo Bull.*, **38**(3): 421-436. Available on: https://kukrdb.lib.ku.ac.th/journal/BuffaloBulletin/search_detail/result/390583
- 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. *Research Opinions in Animal and Veterinary Sciences*, **5**(4): 165-171.
- Sheikh, I., S. Shivali and A.A. Bhat. 2012.

Ultrasonographic imaging of normal reticulum and traumatic reticuloperitonitis in crossbred cows. *Eurasian J. Vet. Sci.*, **28**: 214-219. Available on: <https://scispace.com/pdf/ultrasonographic-imaging-of-normal-reticulum-and-traumatic-38x0e5kb6l.pdf>

Snedecor, G.W. and W.G. Cochran. 1994. *Statistical Methods*, 8th ed. Affiliated East-West Press Pvt Ltd, New Delhi, India. p. 53-58.