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Ultrasonographic studies of rumen in plastic impacted cattle

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Abstract
Single use plastic became ubiquitous and part of human life. Stray cattle with their voracious and indiscriminate feeding behaviour, feed on the garbage materials present in plastic bags and gradually stock the plastics in rumen in the form of big entangled rolls. No modalities to diagnose plastic impaction in cattle are present till date, however, history and careful examination could aid in diagnosis. Six animals suffering from plastic impaction were selected for this study and the rumen was sonographed to observe the echogenicity of its contents and plastic contents. The entangled plastic bundles appeared as hyperechoic zones beneath rumen wall and mostly observed at ventro-lateral aspect of 12th ICS and lower left paralumbar fossa. Rumen wall thickness and distance of rumen wall from abdomen were measured at dorsal sac, transverse groove and ventral sac area of rumen on day 0, 3, 5, 7 and 10 post rumenotomy which gave an idea about the alterations in rumen wall and shape and filling of rumen.

Keywords: Cattle, plastic impaction, rumen wall, ultrasonography

Introduction
Impaction of rumen with plastic material in cattle became an important health hazard in India as they feed indiscriminately on kitchen waste packed in plastic covers thrown on to roads (Vanitha *et al*., 2010) [21]. These polythene covers enter the rumen, stay in huge numbers over the years together, entangle and form into huge chunks of plastic rolls. On entering the rumen, the fate of plastics was not studied properly, lest removing it by rumenotomy (Fani *et al*., 2019) [9].

Diagnosis of plastic impaction in animals can be done based on the history of uncontrolled feeding on foods thrown on roads; clinical signs like doughy to hard rumen, reduced rumen motility, alkaline pH and absence of rumen protozoal motility (Boodur *et al*., 2010) [3]. But surprisingly, there is not even a single test in force to confirm that the animal is suffering from plastic impaction, which can be confirmed after rumenotomy only.

Ultrasonography in cattle was mostly limited to verify the defects in heart, reticulum, intestines, ovaries, uterus, *etc*. (Braun *et al*., 2013) [6]. But, scanning of rumen was not being practiced owing to its voluminous size and presence of gas cap. However, few studies were conducted pertaining to sonographic analysis of rumen and its contents in healthy cattle (Tschuor and Clauss, 2008; Imran *et al*., 2011) [19, 12]. But no reports are on record pertaining to scanning the rumen for its contents and their echogenicity that can aid in the diagnosis of the plastic impaction.

Materials and Methods
The present study was carried out among six cows presented to large animal surgery facility, Dept. of Veterinary Surgery and Radiology, Veterinary College, Hebbal, Bengaluru, Karnataka, India. Rumen of all cows were subjected to two-dimensional, grey scale, B-mode real time ultrasonography using Honda Electronics HS-2000 Vet ultrasound machine equipped with 3.5-5.0 MHz curvilinear transducer. The study was carried out to assess the echogenicity of the rumen contents especially when plastics are present inside. Clinical ultrasonography was carried out before surgery and on 3rd, 5th, 7th and 10th day post-surgery.

The horizontal area from 12th intercostal space to caudal left paralumbar fossa at tuber coxae; vertically from transverse process of left lumbar vertebrae to stifle fold or subcutaneous mammary vein were shaved and made grease free by cleaning with soap water (Fig. 1). The animal was restrained in a travis in standing position.

Fig 1: Photograph showing the site prepared for scanning.

Rumen was scanned as per the procedure described by Braun *et al*. (2013) [6]. The area to be scanned was applied with sufficient coupling gel and transducer head was placed vertically with pointer upside. Whole prepared area was scanned dorsal to ventral and from left to right in sliding motion to find out for any hyper echoic zones inside rumen. Rumen wall thickness at dorsal sac, transverse groove and ventral sac were measured. Distance of rumen wall from left flank was also measured at different intervals of time.

5. Results and Discussion

Rumen is a capacious organ occupying majority of space in the abdomen (Dyce *et al*., 2010) [8]. It always contains gas which will be continuously produced by the microbial fermentation (Randall, 2002) [17]. Ultrasonography of digestive tract (Braun, 2003) [6] and rumen and reticulum (Imran *et al*., 2011) [12] had been studied earlier. But, owing to the huge capacity and presence of gas, scanning of the rumen has been neglected, however, very few studies were on record (Tschuor and Clauss, 2008; Kandeel *et al*., 2009) [19, 13]. Tiwari (2012) [18] conducted *in-vitro* studies to assess the rumen wall layers and their echogenicity. In our study, the rumen was scanned for diagnosing the presence of plastics and to assess the filling of rumen by measuring the rumen wall thickness. Anatomically, dorsal sac, transverse groove and ventral sac cloud be visualized clearly in all the cows.

A curvilinear probe of 3.5-5.0 MHz frequency was employed for this purpose which was also used by many authors (Tschuor and Clauss, 2008; Dabas *et al*., 2010; Tiwari, 2012; Braun and Gautschi, 2013 and Abdelaal and El-Maghawry, 2014) [6, 19, 7, 18, 1]. However, Pitroda *et al*. (2010) [16] used 7.5 MHz transducer in a goat to identify plastics.

Grease free and hair free field is compulsory for better visualization and avoid artefacts while scanning (Athar *et al*., 2010; Gautschi, 2010; Imran *et al*., 2011) [2, 12]. The area horizontally from 12th intercostal space to caudal left paralumbar fossa at tuber coxae; vertically from transverse process of left lumbar vertebrae to stifle fold or subcutaneous mammary vein was selected for sonography. This made the scanning procedure easy, comfortable and avoided artefacts. Standing position was recommended for large animals to scan region wise (Braun, 2003) [6]. Abdomen was scanned as per the indications of Imran *et al*. (2011) [12] and Braun *et al*. (2013) [6].

The skin, muscles and rumen wall were visible clearly as hyperechoic, mixed echoic and hyperechoic layers respectively (Fig. 2). Transverse groove could be identified as V shaped notch (Fig. 3). Stratification of ingesta was not clearly visible in all the plastic impaction cases, but was clear in animals with mild bloat, where, the demarcation from gas to ingesta phase was conspicuous because of reverberation artefact created by gas layer (Fig. 4). However, the transition from fibre mat to fluid layer was not clear in all the cases.

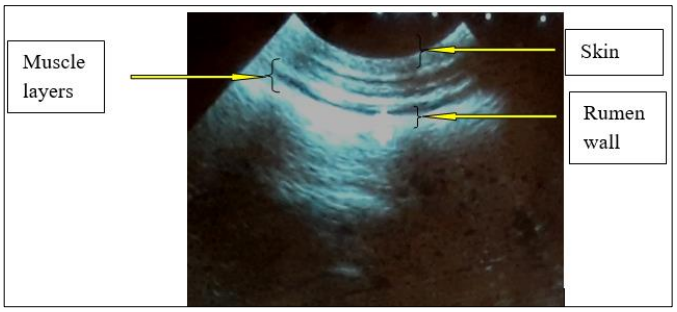

Fig 2: Ultrasonogram showing different layers at paralumbar fossa

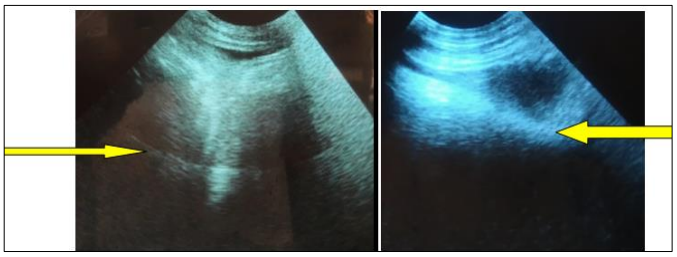

Fig 3: Ultrasonogram showing 'V' shaped notch visible at transverse groove

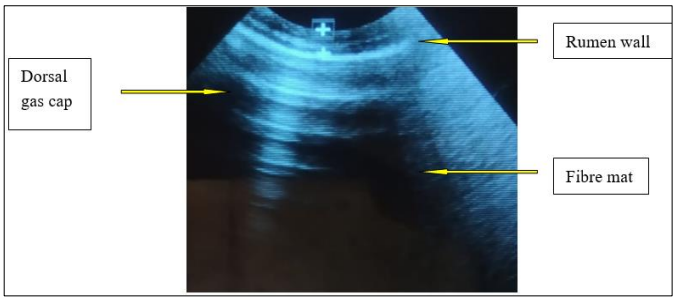

Plate 21: Ultrasonogram showing reverberation artefact and transition from dorsal gas cap to fibre mat

It was presumed that in any plastic impaction case, on prolonged ingestion of plastic bags and other indigestible materials, the churning movements of rumen make them to wound themselves and gets knotted making them impossible to pass into next chambers of forestomach (Omer, 2018) [15]. This dense material might be represented as hyperechoic zones (Fig. 5 to 10) on ultrasonography at most convex parts of the abdomen and areas of rumen close to the skin like 12th ICS and lower left paralumbar fossa (Tschuor and Clauss, 2008) [19]. In our study, most of the times, the plastics were identified at the ventro-lateral aspect of 12th ICS and lower left paralumbar fossa (Fig. 11). Pitroda *et al*. (2010) [16] scanned rumen of a goat and found uniformly distributed diffuse echogenic mass later identified as plastics by rumenotomy.

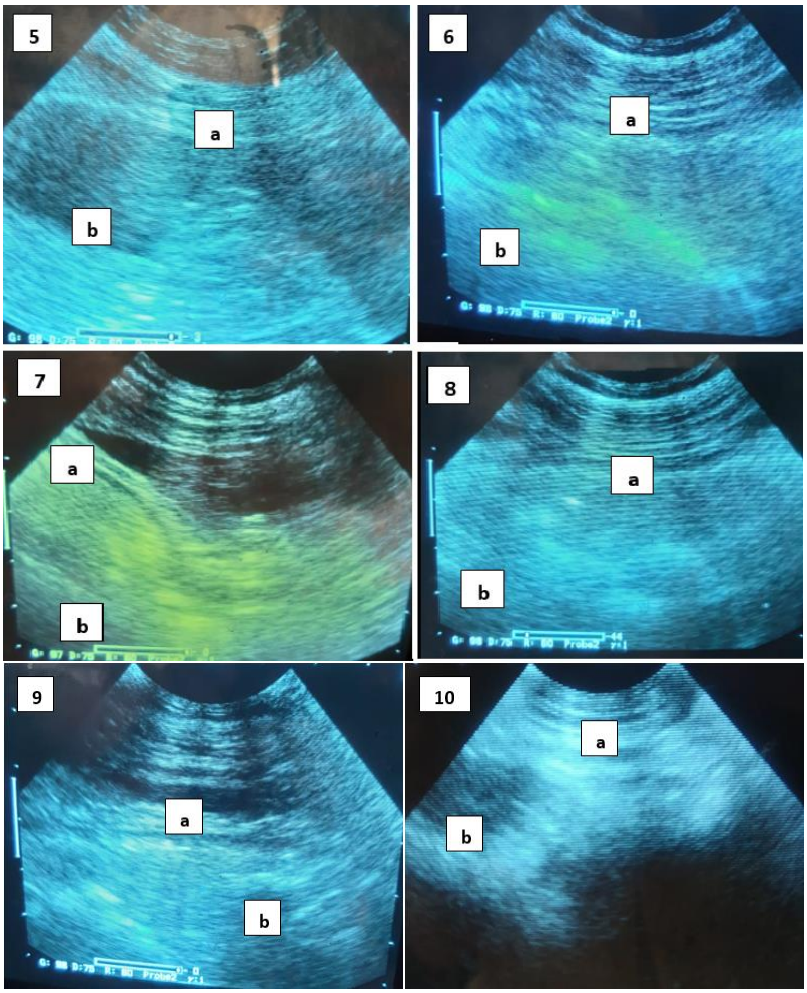

Fig 5-10: Ultrasonogram showing plastics in rumen as hyper echoic zones; (a) rumen wall, (b) hard masses of plastic

Fig 11: Region of identifying hyperechoic zones indicated by yellow circles

The dorsal gas cap followed by fibre mat and fluid phase could be seen in normal animals (Tschuor and Clauss, 2008) [19]. Unclear or discrete stratification of rumen ingesta was another important character found in our study; nevertheless, the gas cap could be identified as reverberation artifact followed by unclear fibre mat in two animals with recurrent bloat (Braun *et al*., 2013) [6].

Assessing the rumen wall thickness gave an idea about the filling of rumen and changes in rumen wall due to the presence of plastics. Few works regarding trans-abdominal ruminal scanning were published earlier to investigate stratification of ruminal contents (Tschuor and Clauss, 2008) [19] and to diagnose ruminal acidosis in cattle (Neubauer *et al*., 2018 and Fiore *et al*., 2020) [10]. But, no studies were available pertaining to this parameter in rumen impacted animals with plastics and its variations post-surgery. Rumen wall was thin in animals with bloaty rumen and normal in impacted animals. Pre and post-surgery, the wall thickness gradually increased as it reaches ventral sac (2.68±0.21 to 3.33±0.18 mm to 3.65±0.41 to 4.23±0.40 mm) (Table 1). Because of gas, the dorsal cap was full always dilating rumen maximally and hence, the wall was thin. Post-surgery, by day 5th, the thickness gradually increased indicating the partial filling of the rumen. As the animal recovers and restores rumen function, the rumen wall thickness again decreased by the end of study period. Braun *et al*. (2013) [6] also reported similar results pertaining to wall thickness *viz*., 0.3±0.07 cm and 0.3±0.08 cm at 12th ICS and flank region respectively. Similarly, Braun (2003) [5] also reported the thickness of rumen wall ranging from 3.0±0.6 mm to 3.0±0.8 mm at 11th ICS to caudal left flank region in healthy cows.

Distance of rumen wall from exterior was measured to assess the filling of rumen and post-operative recovery. Before and after surgery, the distance of rumen wall from skin varied significantly when measured at dorsal paralumbar fossa, transverse groove and near ventral sac as 9.95±3.49 to 18.55±8.91 mm, 9.36±2.11 to 17.83±5.20 mm and 11.83±1.66 mm respectively. No standard reference was found to discuss our work. As the animal start recovering from surgery and taking feed orally, rumen was being filled

and restore its function, the distance gradually reduced and stabilized by the end of day 10th. Braun (2003) [5] recorded the distance from rumen wall to skin ranging from 44.0±2.74 mm to 20.0±2.12 mm at 11th ICS and caudal, flank respectively.

Table 1: Rumen wall thickness (cm) and distance of rumen wall from skin (cm) recorded in bovines diagnosed with plastic impaction

Parameter	Placement of probe	Day 0	Day 3	Day 5	Day 7	Day 10
Rumen wall thickness	Dorsal Paralumbar fossa	2.68±0.21 a	3.11±0.28 a	3.13±0.25 a	3.13±0.28 a	3.33±0.18 a
	Transverse groove	3.41±0.45 a	3.93±0.51 a	3.58±0.23 a	3.08±0.12 a	3.85±0.48 a
	Ventral sac	3.65±0.41a	3.80±0.32 a	4.23±0.40 a	3.93±0.25 a	3.81±0.38 a
Distance of rumen wall from skin	Dorsal Paralumbar fossa	9.95±3.49 a	15.96±5.46 b	16.11±5.21 b	14.98±5.18 b	18.55±8.91 b
	Transverse groove	9.36±2.11 a	16.03±2.61 b	17.08±3.27 b	18.73±5.20 b	17.88±5.76 b
	Ventral sac	17.40±4.92 ab	18.86±2.88 ab	19.11±4.12 ab	21.10±4.04 c	11.83±1.66 a

Superscripts bearing different alphabets vary significantly @ $p< 0.05$

Apart from assessing recovery, scanning also provided information regarding the live motility of rumen (Tiwari, 2012) [18]. Peritonitis in one case showing thin fibrinous material near ventral sac could also be diagnosed based on scanning only, as was also reported by Udheiya (2007) [20].

Conclusion

Further studies have to be conducted regarding the fate of plastics in rumen of the impacted animals. It is concluded that ultrasonography is a best non-invasive method that could be a useful tool in diagnosing severe plastic impaction in ruminants.

References

1. Abdelaal AM, El-Maghawry S. Selected studies on foreign body impaction in goats with special reference to ultrasonography. Veterinary World. 2014;7(7):522-527.
2. Athar H, Mohindroo J, Singh K, Singh T. Clinical, haemato biochemical, radiographic and ultrasonographic findings in bovines with rumen impaction. Intas. Polivet, 2010;11(2):180-183.
3. Boodur P. Study on chronic rumen impaction due to plastic materials in cattle and buffaloes. M. V. Sc. thesis. Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka, India; c2008.
4. Braun U, Schweizer A and Trosch L. Ultrasonography of the rumen of the dairy cows. BMC Veterinary Research. 2013;9:44
5. Braun U. Ultrasonography in gastrointestinal disease in cattle. The Veterinary Journal. 2003;166:112-124.
6. Braun U, Gautschi A. Ultrasonographic examination of the forestomachs and the abomasum in ruminal drinker calves. Acta Veterinaria Scandinavia. 2013;55:1.
7. Dabas VS, Derashri HJ, Gohil JA. Accidental ingestion of gold necklace and its extraction from a Surti buffalo. Intas Polivet. 2010;11(2):196.
8. Dyce KM, Sack WO, Wensing VJG. The abdomen of the ruminant. In: Textbook of Veterinary Anatomy, Edn. 2nd., Saunders Elsevier, St. Louis, Missouri; c2010. p 677.
9. Fani F, Thorat MG, Upadhye SV, Kuralkar SV, Waghmare SP, Dhore RN, *et al*. Clinico-physiological and haemato-biochemical alterations in non-penetrating foreign body syndrome with reference to the percentage of plastic in cattle. International Journal of Science and Environment and Technology. 2019;8(4):882-895.
10. Fiore E, Faillace V, Morgante M, Armato L, Gianesella M. A retrospective study on transabdominal ultrasound measurements of the rumen wall thickness to evaluate chronic rumen acidosis in beef cattle. BMC Veterinary Research. 2020;16:337.
11. Gautschi A. Sonographische Untersuchungen an Haube, Pansen, Psalter und Labmagen von 30 Kälbern. University of Zurich: Dr Med Vet Thesis; c2010.
12. Imran S, Kumar A, Tyagi SP, Kumar A, Sharma S. Ultrasonographic examination of the rumen in healthy cows. Veterinary Medicine International; c2011. p. 840629.
13. Kandeel AE, Omar MSA, Mekkawy NHM, El-Seddawy FD, Gomaa M. Anatomical and ultrasonographic study of the stomach and liver in sheep and goats. Iraqi Journal of Veterinary Science. 2009;23(2):181-191.
14. Neubauer V, Humer E, Kroger I, Meibl A, Reisinger N, Zebeli Q. Changes in rumen mucosa thickness measured by transabdominal ultrasound as a non-invasive method to diagnose subacute rumen acidosis in dairy cows. Journal of Dairy Science. 2018;101:2650-2654.
15. Omer AM. Ingestion of foreign bodies in rumen and reticulum of shoats in Hargeisa, Somalia: Prevalence and associated risk factors. Journal of Dairy Veterinary and Animal Research. 2018;7(3):67-71.
16. Pitroda AH, Tiwari DK, Ud Din DM, Patil DB, Parikh PV. Ultrasonographic diagnosis and treatment of rumen impaction in a goat. Intas Polivet. 2010;11(2):251-252.
17. Randall D, Burggren W, French K. Eckert animal physiology: Mechanisms and adaptations. Edn. 5th. W.H. Freeman and Company, New York; c2002. p. 78-93.
18. Tiwari DK. Ultrasonographic diagnosis of gastrointestinal tract surgical disorders in bovines. Ph. D. thesis. Anand Agricultural University, Anand, Gujarat; c2012.
19. Tschuor A, Clauss M. Investigations on the stratification of forestomach contents in ruminants: An ultrasonographic approach. European Journal of Wildlife Research. 2007;54:627–633.
20. Udheiya RK. Evaluation of ultrasonography as a diagnostic tool for reticulo-omasal disorders in bovines. M.V.Sc. Thesis. Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India; c2007.
21. Vanitha V, Chandra GS, Nambi AP. Polychlorinated biphenyles in milk and rumen liquor of stray cattle in Chennai. Tamil Nadu Journal of Veterinary and Animal Sciences. 2010;6(2):71-74.