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Evaluation of the efficacy of an oral magnet administration for the treatment of traumatic reticuloperitonitis in cattle

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ABSTRACT

Magnets were administered orally in 42 cows diagnosed with traumatic reticuloperitonitis (TRP) with radiographic evidence of sharp foreign bodies in their reticulum, and without any prior administration of atropine sulphate. Upon radiologic investigation, magnets were observed within the reticulum in 40 cases and foreign bodies were attached to the magnet in 24 cases. In 8 cases, though foreign bodies were dislodged but their attachment could not be clearly discerned. Foreign bodies were not attached to the magnet in 4 cows due to the presence of non-ferromagnetic foreign bodies and in 2 cows because the foreign bodies were penetrating deep through the wall of the reticulum. In 2 cases, the foreign body was unattached to magnet and located close to magnet probably in the magnetic field. The radiological findings of foreign body attachment, non-attachment or displacement were confirmed in 14 animals by rumenotomy. It was concluded that magnet therapy is effective and radiological diagnosis is a reliable tool in making decision about surgical intervention in cases of TRP following administration of magnet.

Key words: Cattle, Magnet administration, Radiography, Rumenotomy, Traumatic reticuloperitonitis

Traumatic reticuloperitonitis (TRP), a commonly encountered condition in developing world, has seen a tremendous rise during recent years, due to changing farm practices including mechanization of dairy farm operations. Management of TRP is challenging and involves immobilization or confinement of animals, elevation of the forelimbs, antibiotic therapy to control the infection, and surgical approach in the vast majority of cases (Braun 2005). Oral administration of a magnet was recommended for the prevention of the disease (Carroll 1956) but not all farms follow this recommendation. A study in a slaughterhouse revealed presence of magnet in reticulo-rumen in only 10% of cattle (Cramers *et al.* 2005). The disease continues to be prevalent in many parts of the world (Sharma *et al.* 2015b). The use of a magnet for the treatment of TRP was limited, and to the author's knowledge only a few studies investigated the use of a magnet in combination with radiography to diagnose the disease. Furthermore, no attempts were made to correlate and confirm the radiological findings of foreign body attachment or non-attachment to the magnet with rumenotomy findings. As a routine practice, preventative administration of a magnet in healthy cattle is usually preceded by subcutaneous atropine sulphate injection, and lowering of forequarters so as to avoid regurgitation, and to facilitate magnet settlement (Schneider 1982, Braun *et al.* 2003). This practice, in our experience seemed unnecessary due to invariable presence of signs of reticulo-ruminal stasis. In the present study, efficacy of magnet therapy in cases of TRP by radiography, and/or rumenotomy was evaluated without administration of atropine sulphate.

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MATERIALS AND METHODS

Cattle (42) referred to university teaching hospital with clinical manifestations of TRP were selected. Clinical examination was performed including general and systemic examination, and special examination of gastrointestinal system along with rectal palpation. Jugular venipuncture was done and blood samples collected in EDTA for complete blood cell count, and in heparin for total plasma protein and fibrinogen concentrations. Peritoneal fluid was collected aseptically with a cranial approach by tapping post xiphoid region with a 16 gauge needle. Samples were placed in EDTA as well as sterile tubes. Results of a cytological and microbiological examination of the peritoneal fluid samples were consistent with peritonitis in 31 out of 42 cases. The animals were subjected to radiography of the reticulum and the presence of sharp foreign bodies was confirmed in all 42 cases. Subsequently, a cylindrical bar magnet of 70 mm length, rounded at both ends was administered orally to each of the animal by depositing on base of the tongue behind torus linguae either with the help of balling gun or through non collapsible flexible tube (of 2 feet length and 1 inch diameter, approximately), without any premedication with atropine and without lowering their forequarters. All cows were administered a combination of broad spectrum antibiotics for 7 days along with parenteral

fluids and crystalloids as needed. Animals were again subjected to radiography within 1–3 days of magnet administration. One to five days after administration of the magnet, all cows with radiographic evidence of non attachment of foreign bodies to the magnet, and 5 randomly selected animals with attachment of foreign body to the magnet underwent rumenotomy. Magnets were searched through the rumenotomy incision without disturbing the reticulo-ruminal contents in order to prevent relocation.

RESULTS AND DISCUSSION

Pre-treatment observations: Nails, pieces of wires, pins, screws and needles were the most common sharp foreign bodies identified on radiographs, while in some animals sharp unidentifiable metallic pieces were seen within the reticulum. The majority (31) of foreign bodies measured more than 3 cm in length based on radiographs. The simultaneous presence of significant amounts of radio-opaque debris was recorded in 17 cases. Sharp foreign bodies in 12 cases appeared to have contact with the reticular wall (Figs 1a, 2a) and 2 appeared perforated. Multiple sharp foreign bodies (Figs 1a, 2a) as many as 7 in 1 case were visible on radiographs of 19 animals (Table 1). Radiologic evidence of peri-reticular lesions (such as indentation of contour of reticular wall, abnormal position and size of reticulum etc.) was observed in 17 cases (Figs 2a, b); fluid interface/density around the lower third of the diaphragm along with peri-reticular lesions in 3 cases, clear diaphragmatic line in 9 cases, while there was insufficient evidence to establish such diagnosis in rest of the animals.

Radiographic findings post-magnet therapy: Upon radiologic study of the reticular area of all cows, attachment of penetrating foreign bodies to the magnet was observed in 32 of 42 animals. Of these, the outline of the foreign bodies with magnet was clearly appreciable in 24 animals (Fig. 1b) but not so clear in the other 8 where foreign bodies were dislodged and absent from their original location. In 2 cases, magnets as well as foreign bodies were not visible in the reticulum (Table 1). Position of sharp foreign body in 5 cases remained unchanged in reticular radiographs of pre and post-magnet therapy, with complete non-attachment of sharp foreign bodies to magnet, which included a sharp piece of wire in 2 cases, a nail (Fig. 3b) in one, a linear metallic piece in one (Fig. 2b), 3 nail like pegs in one, while in one more case, sharp foreign body visible in first radiograph got attached to magnet and a new sharp foreign body (not visible in first radiograph), unattached to magnet, appeared in second radiograph (Fig. 4b). In 2 cases, foreign

Table 1. Radiographic evaluation:pre and post-magnet therapy

Pre-treatment observation	Number of animals
Sharp foreign body (of considerable size)	
Multiple	19 (2^a+3^b+2^c+12^d)
Single	23 (3^a+1^b+2^c+17^d)
Presence of significant amount of radiopaque debris	17
Post-magnet therapy	
Foreign body attached and discernible on magnet	24
Foreign body not discernible on magnet	8
Magnet as well as foreign body not visible	2
Foreign body unattached to magnet	6
Foreign body unattached to magnet but appreciably displaced	2

a, Minimum of one foreign body appeared to have contact with reticular wall with no other lesions; b, Foreign body and evidence of peri-reticular lesions with no other lesions; c, Foreign body and clear diaphragmatic line with no other lesions; d, Others and with more than one lesion.

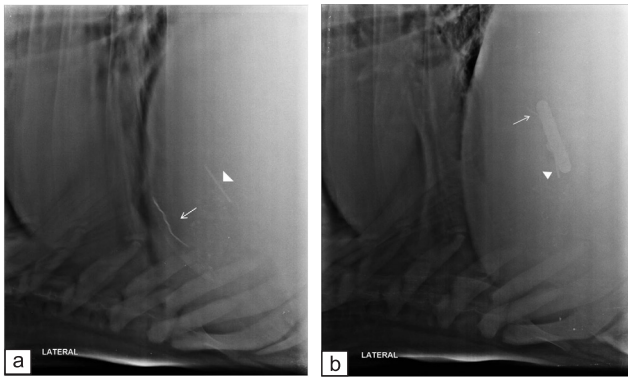

Fig. 1. Lateral radiographic view of reticulum of cow at level of diaphragm (a) before oral administration of magnet showing nail (arrow head) and a piece of wire (arrow) (placed on floor) in reticulum. Note unclear diaphragmatic line and evidence of perireticular lesions. (b) Successful treatment and attachment of wire (arrow) and nail (arrowhead) discernible (along horizontal axis and projecting outwards) to administered magnet.

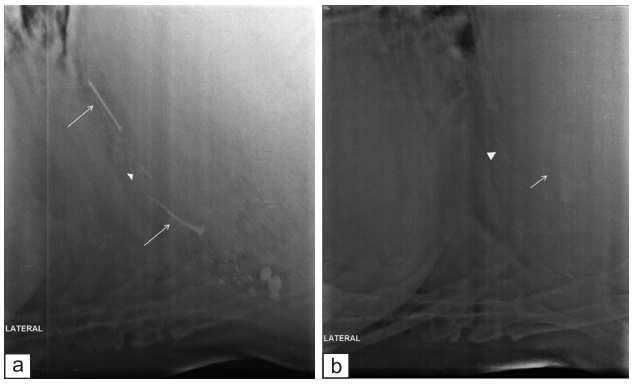

Fig. 2. Lateral radiographic view of reticulum of cow at level of diaphragm (a) before oral administration of magnet showing presence of two nails (arrow) and one sharp foreign body (arrowhead) and some radiopaque debris in the reticulum. Note unclear diaphragmatic line and evidence of perireticular lesions. (b) Partial successful treatment and attachment of nails discernible to administered magnet (arrow) but non-attachment of one of sharp foreign body (arrowhead). Note non-displacement of sharp foreign body from its position and on rumenotomy it was perforated 3/4th of length through anteroventral wall of reticulum.

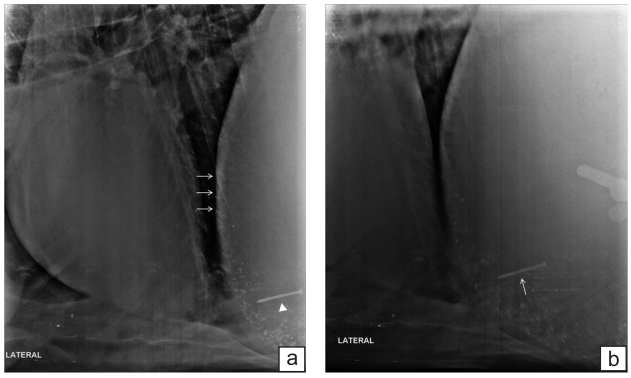

Fig. 3. Lateral radiographic view of reticulum of cow at level of diaphragm (a) before oral administration of magnet showing presence of sharp nail (arrowhead) and radiopaque debris in reticulum. Diaphragmatic line (arrows) is clearly demarked. (b) Unsuccessful treatment and non-attachment of nail to administered magnet. Note non-displacement of nail (arrow), and on rumenotomy it was found embedded inside left wall of reticulum with only head protruding inside through mucosa.

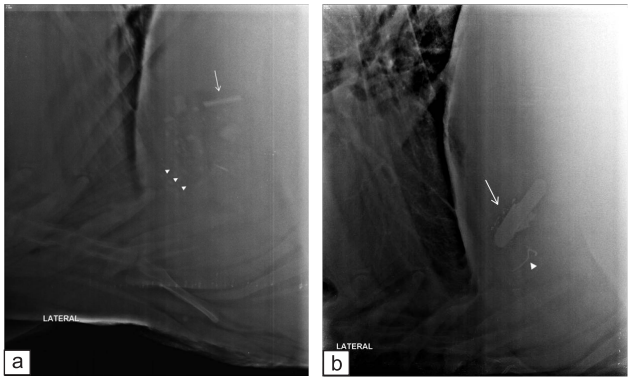

Fig. 4. Lateral radiographic view of reticulum of cow at level of diaphragm (a) before oral administration of magnet showing presence of sharp foreign body (arrow) and some radiopaque debris (arrowheads) in the reticulum. Note clear diaphragmatic line. (b) Attachment of sharp foreign body (arrow) discernible to administered magnet (along long axis) and one new sharp piece of wire (arrowhead), not visible in first radiograph, is seen unattached to magnet.

body was unattached to magnet but appreciably displaced from their position (Fig. 5b) and oriented and placed close to magnet as if in its magnetic field.

Most magnets appeared in the antero-ventral part of the reticulum (Fig. 4a) in 25 of 42 cases, in reticular body in 11 cases, and in the caudal aspect of the reticulum by the reticuloruminal fold in 4 cases.

Rumenotomy findings: Surgical intervention was performed in all the animals with radiographic evidence of magnet-foreign body non-attachment, 5 randomly selected animals with magnet-foreign body attachment, and in one animal in which the magnet was not visible in the second radiographic evaluation. The rumenotomy in cases of unattached foreign body to the magnet revealed, an aluminum wire (5 cm) perforating the ventral third of the cranial reticular wall, a copper wire (>4 cm) lodged on the ventromedial reticular floor, and 3 non-ferromagnetic aluminum like pegs

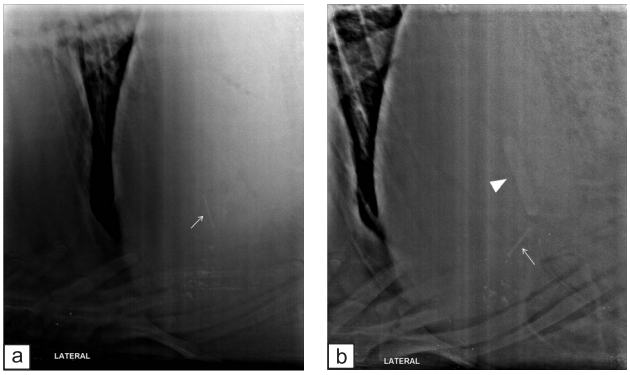

Fig. 5. Lateral radiographic view of reticulum of cow at level of diaphragm (a) before oral administration of magnet showing presence of nail (arrow) in the reticulum. Note unclear diaphragmatic line. (b) Magnet (arrowhead) along with approaching nail (arrow) which is displaced from its previous position and oriented towards magnet as if in its magnetic field, and was found attached on rumenotomy.

(4 cm each) lying free in the reticulum. In one case, a sharp copper wire was found in the second radiographic evaluation but not in the first radiologic study. An entire ferromagnetic nail was embedded inside the left wall of reticulum with only the head protruding through mucosa in one case (Fig. 3a). A linear piece of iron wire perforating 3/4th of its length through the antero-ventral reticular wall (with other two nails attached) was cause of non attachment in another case. Two cows with radiographic evidence of displaced foreign body (a finding from the second study) had a sharp needle and a screw nail attached to the magnet. All ferromagnetic foreign bodies in 5 randomly selected animals were found attached to the magnets, with one case showing a 4 cm sharp wire perforating 1/3rd the reticular wall of the rumino-reticular groove area. The majority (9/14) of the magnets were recovered near the ventromedial floor of the reticulum. A magnet with attached foreign bodies was recovered close to the reticulo-ruminal groove in 1 of 2 cases. In these cases the magnets were not visible in the second radiographic study.

Three magnets had additional nails, pins and sharp wires (>3cm in length) which were observed upon radiographic evaluation. Reticulophrenic adhesions were confirmed in 4 cases by rumenotomy, 2 of which were suspected based on radiographic evaluation. A small fluid pocket was noticed in the ventral reticulo-phrenic area in 1 case, and a fibrous mass was seen in the cranial reticular wall in another case, which was not revealed by prior radiographic examination.

Outcome of cases: There was disappearance of clinical signs and restoration of normal appetite in the majority (23) of the animals within 4–7 days. Three animals recovered within 10 days after magnet and antibiotic therapy. Two animals did not improve by 7th day therefore they were administered a different antibiotic for an additional 5 days after which they resumed moderate appetite. Eleven of 14 animals undergoing rumenotomy recovered their nomal appetite within 4–6 days, whereas 3 cows recovered faster in less than 4 days. A follow up of the cows enrolled in the

study was done. Twenty three animals recovered its expected milk yield within 15–35 days, while only two animals performed sub-optimally.

Magnet therapy was successful in 35 of 42 (83%) cases in this study. Magnets were effective in attaching nearly all ferromagnetic foreign bodies (of considerable size) but deep penetrated ones. Non-ferromagnetic foreign bodies were the other major reason for non-attachment (3/5). Such foreign bodies although not common, but unusual or bizarre types of foreign bodies had been incriminated with TRP from different regions (Harwood 2004, Sharma *et al*. 2015a). Dislocated, dislodged or non-discernible foreign bodies in post-magnet radiographs, were attached to magnet, and corroborated upon rumenotomy in 14 cases. Oral administration of magnet has been used as a standard treatment of TRP in cattle for many years but there are only a few studies on the subject with efficacy varying from 54 to 97% (Schneider 1982, Braun *et al.* 2003). In those studies as well, mere clinical improvement was taken as index of recovery, and causes of unsuccessful treatment were not determined. We confirmed the magnet-foreign body attachment by radiography and further determined the causes of non-attachment by rumenotomy. Hence, the results of present study are more convincing. Confirmation of attachment of foreign body to magnet by radiography was carried out in a sole study (Braun *et al.* 2003), in which relatively low (54%) success of magnet therapy had been reported. The possible reason for higher success rate in the present study could probably be attributed to less number of animals with perforated foreign bodies. Moreover, position of foreign body within the reticulum has been reported to significantly influence outcome of therapy. Success rates of as high as 92% for free foreign bodies on reticular floor and as low as 32% for clearly perforated foreign bodies in reticular wall were observed (Braun *et al.* 2003). The nature of foreign bodies, depending upon husbandry practices, in different settings could be different. In this study, non-ferromagnetic foreign bodies, not reported previously in literature, were found in four animals upon rumenotomy.

The radiographic findings of attachment or non-attachment were fairly well in agreement with observation on rumenotomy. Therefore, the use of radiography following magnet administration is helpful in making decision about rumenotomy in the refractory cases. In another study, radiography could provide evidence of perireticular adhesions in some cases (Partington and Biller 1991).

None of the animal in this study was injected with atropine before oral administration of magnet. Inspite of this, in 40 of 42 animals radiographic findings indicated that magnets were in the reticulum. Usually, atropine is injected before magnet administration in healthy animals to prevent its regurgitation due to reticulo-ruminal motility. However, in cases of TRP gut stasis develops due to pain, inflammation, adhesions, endotoxemia or hypokalemia and hypocalcemia associated with prolonged anorexia (Huber *et al*. 1981, Duranton and Bueno 1984, Braun 2009). In our view, in absence of reticulo-ruminal motility, gravity principle seemed to govern the position of magnet in the reticulum as majority (9/14) of magnets were recovered from lower most medial position on reticular floor. Probability of magnets directly entering into reticulum therefore is high in cases with decreased reticulo-ruminal motility as compared to healthy animals in which ingested foreign bodies first enter into rumen (Smith 2002). Therefore administration of atropine before magnet therapy appears irrelevant.

Overall, magnet therapy is an effective first line of treatment in cases of TRP and radiography should be used before making decision about surgical intervention in refractory animals.

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