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Large bowel obstruction by enteroliths and/or foreign bodies in domestic equids: retrospective study of cases seen from January 2003 to March 2020

[*Obstrução do intestino grosso por enterólitos e / ou por corpos estranhos em equídeos domésticos: estudo retrospectivo de casos observados de janeiro de 2003 a março de 2020*]

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ABSTRACT

This retrospective study was based on data extracted from medical records of 48 horses with intestinal obstruction caused by enteroliths and/or foreign bodies seen over the course of 17 years. Data analysis was aimed at describing the major features of this type of colic. Obstructions caused by enteroliths, foreign bodies or both accounted for 40 (83.34%), 6 (12.50%) and 2 (4.16%) cases in this sample respectively. Affected horses were aged 1 to 32 years (mean age 9.5 years) and 14 horses were fed alfalfa. Alfalfa is thought to contribute to enterolith formation. Foreign bodies and enteroliths were found in the transverse (12 cases, 25%), the large or the small colon (10 cases, 20.83% respectively). Concurrent obstruction of different intestinal segments was also recorded. These involved the small and the large colon in 10 cases (20.83%), the transverse and the large colon in 4 cases (8.33%), the small and the transverse colon in 1 case (2.08%) and the transition from the large to the transverse colon in one case (2.08%). Short term survival was 77.08% overall and 87.50% when only patients submitted to postoperative treatment were accounted for. Survival data are consistent with survival rates of 91% reported in literature.

Keywords: Equine; intestine; obstruction; enterolithiasis; foreign body.

RESUMO

Este estudo retrospectivo foi baseado em dados extraídos de prontuários de 48 cavalos com obstrução intestinal causada por enterólitos e / ou corpos estranhos observados ao longo de 17 anos. A análise dos dados teve como objetivo descrever as principais características desse tipo de cólica. Obstruções provocadas por enterólitos, corpos estranhos ou ambos foram responsáveis por 40 (83,34%), seis (12,50%) e dois (4,16%) casos nesta amostra, respectivamente. Os cavalos afetados tinham entre um e 32 anos (idade média de 9,5 anos), e 14 cavalos foram alimentados com alfafa. Acredita-se que a alfafa contribua para a formação de enterólitos. Corpos estranhos e enterólitos foram encontrados no cólon transverso (12 casos, 25%), maior ou menor (10 casos, 20,83%, respectivamente). A obstrução simultânea de diferentes segmentos intestinais também foi registrada. Estes envolveram o cólon menor e o cólon maior em 10 casos (20,83%), o cólon transverso e o cólon maior em quatro casos (8,33%), o cólon menor e o transverso em um caso (2,08%) e a transição do cólon maior para o cólon transverso em um caso (2,08%). A sobrevida em curto prazo foi de 77,08%, em geral, e de 87,50% quando contabilizados apenas os pacientes submetidos ao tratamento pós-operatório. Os dados de sobrevivência são consistentes com as taxas de sobrevivência de 91% relatadas na literatura.

Palavras-chave: equino, intestino, obstrução, enterolitíase, corpo estranho

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INTRODUCTION

Intraluminal intestinal obstruction by desiccated intestinal contents, sand, or intestinal calculi (enterolithiasis) are common causes of intestinal transit disruption and may lead to regional or diffuse motility abnormalities in horses (Thomassian, 2005).

Enteroliths are thought to form in the right dorsal colon and may cause partial or complete obstruction of the dorsal, the transverse or the descending colon (House and Warren, 2016). Enteroliths consist primarily of struvite, but may also contain nitrogen, phosphorus, and magnesium. Excessively dietary levels of these elements combined with the alkaline colonic environment contribute to struvite formation. Struvite may then be deposited in concentric layers around a nidus, giving rise to enteroliths (Blue and Wittkopp, 1981).

Several factors may be implicated in enterolithiasis, including the availability of potential niduses, high dietary protein, calcium and magnesium content, high intestinal pH, type of soil and breed. Arabian horses and ponies seem to be more prone to enterolithiasis (Vervuert and Coenen, 2004). As to dietary factors, alfalfa is rich in nitrogen and magnesium and promotes the alkalinization of colonic contents. Also, these elements combine with phosphorus to form struvite, the primary component of enteroliths. Hence the direct relationship between alfalfa consumption and enterolith formation (Hassel *et al.*, 2008). Horses fed diets containing more than 70% of alfalfa consume considerably more minerals and have significantly higher colonic pH and are more likely to form enteroliths relative to horses fed different diets (Santos *et al.*, 2017, Turek *et al.*, 2019).

In cases of intraluminal obstruction by enteroliths, the mounting pressure exerted by the calculus on the intestinal wall leads to congestion and potential necrosis, with high risk of bowel perforation and peritonitis, particularly in bowel segments with small lumen diameter, such as the small colon (Oliveira *et al.*, 2015). Hence, early diagnosis is vital for timely surgical intervention. Investigation of predisposing factors is also important for implementation of preventive measures.

Enterolithiasis may be diagnosed using abdominal radiography, during exploratory laparotomy or *postmortem* examination or by rectal palpation (Hassel, 2002). Digital radiography is deemed a highly sensitive and specific imaging modality for enterolithiasis diagnosis in horses and may be used to support surgical treatment indication (Terek *et al.*, 2019). The diagnosis of enterolithiasis using computed tomography in a 18-year-old pony has also been reported (Nakamae *et al.*, 2018). Sensitive diagnostic imaging modalities are increasingly being developed in an effort to allow earlier and more accurate diagnosis in cases of suspected enterolithiasis.

Enterolithiasis may have unfavorable outcomes if diagnosis and surgical treatment are delayed. Preventive measures, such as appropriate dietary management, are thought to be extremely important.

This study set out to report on large bowel obstruction by enteroliths and/or foreign bodies in horses and donkeys. Major clinical manifestations and prognosis in surgical cases of this type of colic have been described. The potential impacts of dietary factors on enterolith formation were also discussed.

MATERIAL AND METHOD

This retrospective analysis comprised 327 cases of acute abdomen with surgical indication in horses and donkeys seen at the veterinary hospital of *Faculdade de Medicina Veterinária e Zootecnia* of *Universidade de São Paulo* (FMVZ-USP) between January 2003 and March 2020. Of these, 48 medical records of cases enterolithiasis and intestinal obstruction by foreign bodies were retrieved. These included 44 cases of large bowel obstruction caused by enteroliths, foreign bodies or both (36, 6 and 2 cases respectively) and four additional suspected cases of enterolithiasis in which patients were not operated and the diagnosis confirmed during *postmortem* examination. Records were split between two different investigators (from January 2003 to January 2015 and from February 2015 to March 2020 respectively), manually examined and data of interest extracted. To avoid data collection inconsistencies, data of interest were defined by consensus.

The following variables were analyzed: patient age and sex, use, housing conditions and dietary management, site of intestinal obstruction, surgical approach employed, number and characteristics of enteroliths and clinical and postoperative progression. Variables were expressed as percentages and used for comparisons with findings of prior studies, including a similar study conducted at the same veterinary hospital between January 1993 and January 2003.

Whenever available, enteroliths were radiographed in order to investigate the presence of a radiopaque nidus.

RESULTS

This retrospective analysis comprised 48 cases of intestinal obstruction caused by enteroliths and/or foreign bodies seen over the course of 17 years. In this sample, obstruction was caused by enteroliths in 40 cases (83.34%), foreign bodies in 6 cases (12.50%) and enteroliths and foreign bodies in 2 cases (4.16%).

Patients in this analysis were aged 1 to 32 years (mean age, 9.5 years). Patients aged 1 to 3 years, 4 to 8 years or over 8 years accounted for 18.75, 33.33% and 45.83% of cases respectively. Males were more commonly affected than females (52.08% and 47.90% of cases respectively). Most cases (31.25%) involved mixed breed horses, followed by *Brasileiro de Hipismo* (14.58%) and *Mangalarga* (18.75%) horses. Ponies and American Totters contributed 10.41% of cases each. Remaining cases involved Arabian horses (4.16%) and donkeys, Quarter Horses, Holsteiners, *Crioulos* or Anglo-Arabian horses for (2.08% each).

Horses in this sample were used for the following purposes: pleasure riding (31.25%; 15 out of 48), mounted police operations (10.41%; 5 out of 48), competitive equestrian sports (8.33%; 4 out of 48) and breeding purposes or serum production (2.08%; 1 out of 48 respectively). In two cases (4.16%, 2 out of 48) were not used for any particular activity. Regarding housing conditions, horses were either kept stabled (25%; 12 out of 48), at pasture (6.25; 3 out of 48) or turned out during the day and stabled overnight (54.16%; 26 out of 48).

Intestinal dysmotility, abdominal discomfort lasting longer than 12 hours and heart rate equal to or higher than 60 beats per minute were the most common clinical manifestations of colic (81.25%, 70.83% and 62.50% respectively) reported. Fourteen patients in this sample (29.16%) were fed alfalfa. Of these, one was operated twice for enterolith removal. Other types of foods reported were concentrated feed (75%; 36 out of 48), grass (44.89%; 22 out of 48) and grass hay (43.75%; 21 out of 48).

Intestinal obstruction by enteroliths and/or foreign bodies accounted for 13.45% (44/327) cases of acute abdomen requiring exploratory laparotomy in this study. This caseload excluded 4 cases of enterolithiasis in which laparotomy was not performed and the diagnosis confirmed during *postmortem* examination. In 2 of these cases, patients were submitted to standing flank laparoscopy and euthanized due to findings suggestive of intestinal perforation (food material, fibrin, or brownish fluid in the peritoneal cavity). The third patient was euthanized due to cecal rupture and the fourth died during anesthetic induction. Exploratory laparotomy via the ventral midline with the patient in dorsal recumbency and under general anesthesia was the most common therapeutic intervention in this sample (83.34% of cases). Standing flank laparotomy under sedation and local anesthesia was performed in 2 cases (4.16%), as shown in figure 1. In 2 other cases (4.16%), the ventral midline approach was followed by a left flank approach combined with resection of the 17th rib (Van de Graaf *et al.*, 2007).

Figure 1. Standing flank laparotomy under sedation and local anesthesia for removal of enterolith located in the small colon.

In one remarkable case of enterolithiasis, the patient underwent two laparotomy procedures approximately 2 years and 7 months apart. This case was accounted for twice in this sample. In the first occasion, standing flank laparotomy was performed and revealed an enterolith in the small colon. The second surgical intervention consisted of a ventral midline laparotomy and revealed an enterolith in the right dorsal colon. This horse also returned to the hospital 10 months after the first surgical intervention due to gastric overload, which was successfully resolved with medical management.

One horse in this sample had 8 enteroliths in the large intestine (one in the transverse and 7 in the small colon). Another horse was referred several times due to recurrent episodes of colic. Gastritis was suspected on two occasions and ruled out using gastroscopy. On a third occasion, the patient was submitted to diagnostic laparoscopy and a liver biopsy fragment collected and analyzed, but findings were inconclusive. Five months after the first visit, the horse was referred with severe abdominal discomfort and submitted to exploratory laparotomy, which revealed an enterolith in the right dorsal colon.

In two other remarkable cases, exploratory laparotomy revealed enteroliths in the transverse colon. In these cases, retrograde mobilization towards the right dorsal colon was unsuccessful.

Therefore, the abdominal cavity was approached via left flank laparotomy and the 17th rib resected in an effort to remove the enteroliths lodged in the transverse colon. Successful removal was achieved in one case, but the patient had to be euthanized later due to postoperative complications. In the other case, the enterolith could not be removed despite the alternative surgical approach and the patient euthanized intraoperatively.

Surgical intervention and/or *postmortem* examination revealed a single enterolith in the large intestine in 24 out of 48 cases (50.00%), 2 enteroliths in 6 out of 48 cases (12.50%) and 3 enteroliths in 7 out of 48 cases (14.58%). Patients with larger numbers of enteroliths (4, 5 or 8) accounted for 2.08% of cases in this sample respectively. In two cases, obstruction was caused by foreign bodies (plastic bag and gloves and plastic bag, 2.08% of cases respectively). Linear foreign bodies were found in two cases (4.16%). In one of these cases, obstruction was caused by an enterolith and a linear foreign body. In the other case 2, enteroliths and a linear foreign body consisting of plastic bag and rope was found. In 8.33% (4 out 48) of cases, exploratory laparotomy was not performed and patients either submitted to laparoscopy and euthanized or not operated (2 cases respectively).

In this sample, enteroliths were found in the transverse (12 out of 48 cases, 25%), the small (10 out of 48 cases, 20.83%) or the large colon (10 out of 48 cases, 20.83%). In one case (2.08%) the enterolith was lodged between the large and the transverse colon. Enteroliths were detected at multiple sites in 15 cases. In 10 cases (20.83%), one enterolith was found in the small colon and at least one additional enterolith in the large colon. In 4 cases (8.33%), the site of obstruction was the transverse colon and at least one additional enterolith was found in the large colon. In 1 case (2.08%) both the transverse and the small colon were obstructed.

Necrotic foci were found at the site of obstruction in eight cases (16.66%). Enteroliths were found in the transverse or the small colon and removed via enterotomy. In most cases, necrotic foci were protected using pericardium or omentum (4 and 2 cases respectively) or buried into the healthy intestinal wall (1 case). In one case, multiple necrotic foci were found in the small colon and 1.30 m of bowel were resected.

Peritoneal fluid analysis is an important parameter for assessment of intestinal ischemic injury in cases of colic. In this sample peritoneal fluid data were available in 26 records. The peritoneal fluid was described as yellowish and turbid in twelve cases (46.15%), reddish and turbid in eight cases (30.77%), orange colored and turbid in one case (3.84%) and greenish and turbid in one case (3.84%). In four cases (15.38%), abdominocentesis was unproductive.

Enteroliths retrieved from 19 patients in this sample were available. These were photographed and radiographed. In one specimen, the nidus corresponded to a nail (Fig.2A). Three smooths spherical enteroliths retrieved also contained a radiopaque nidus (Fig.2B) consisting of pebbles surrounded by concentric layers of struvite (Fig.2C). Enteroliths in this sample had either smooth or porous surface and were either spherical, elliptic, nodular, or irregular in shape (Fig.2D).

Thirty-seven horses (77.08%) were discharged from hospital. Eleven patients (22.91%) were euthanized or progressed to death. Of these, 14.58% were euthanized following surgical intervention due to septicemia or laparoscopic diagnosis of intestinal perforation (5 and 2 cases respectively). In two cases (4.16%) enteroliths lodged in the transverse colon could not be removed; these cases were deemed inoperable. One horse (2.08%) died during anesthetic induction and 1 horse (2.08%) was euthanized during the postoperative period for reasons unrelated to the obstruction (rectal tear).

As to postoperative complications, 14 patients developed diarrhea or fever (29.16%) respectively) and 10 patients (20.83%) developed serous, purulent or serosanguineous surgical wound drainage. Laminitis was another, less common complication reported (16.32% of cases).

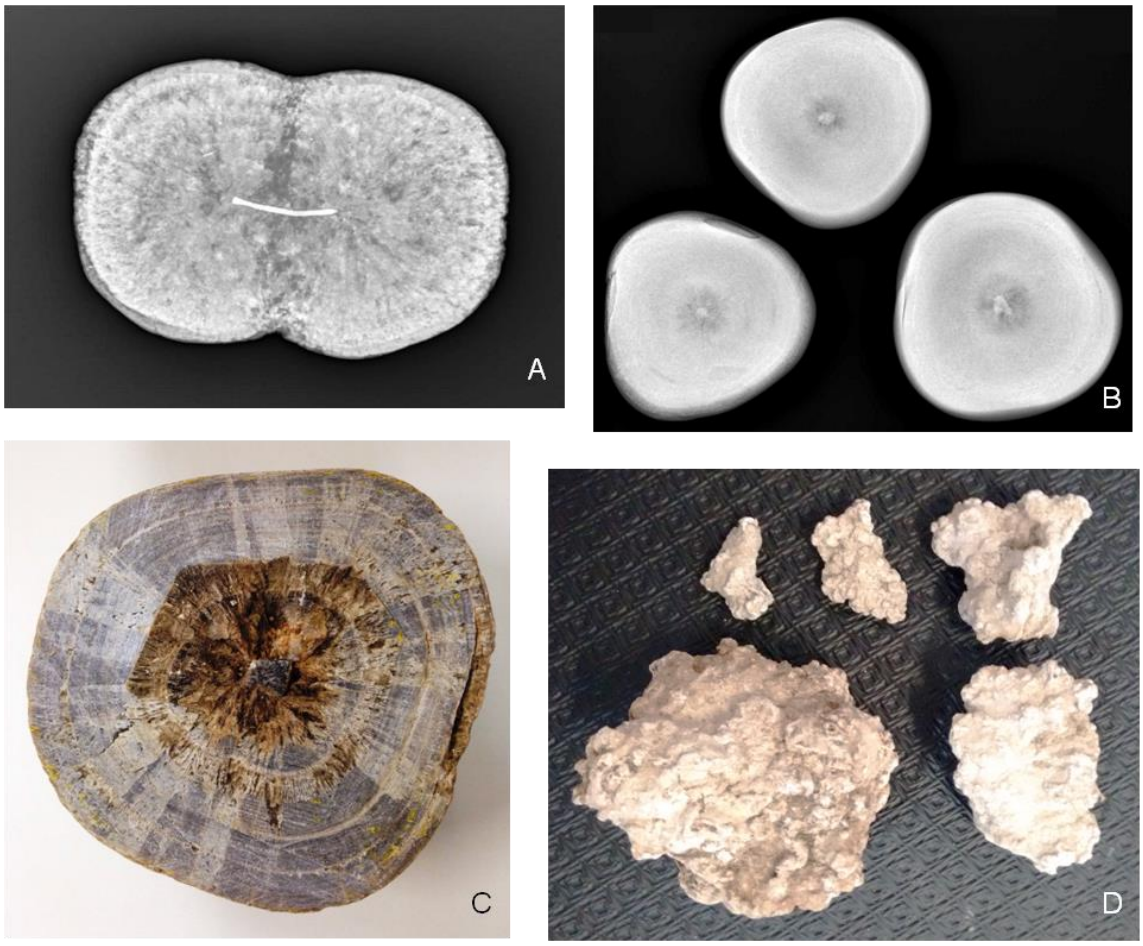

Figure 2. **A –** Enterolith nidus consisting of a nail. **B -** Enteroliths with a radiopaque nidus. **C –** Enterolith nidus consisting of a pebble. **D –** Enteroliths with irregular shape.

DISCUSSION

Arabian horses and ponies are thought to be more prone to enterolith formation (Vervuert and Coenen, 2004). However, mixed breed horses were more commonly affected with enterolithiasis in this sample, followed by *Brasileiro de Hipismo* and *Mangalarga* horses. Smaller numbers of Arabian horses and ponies in this sample may have reflected breed distribution in the region where FMVZ-USP veterinary hospitals located relative to other geographical locations. Likewise, the percentage of *Brasileiro de Hipismo* horses in this sample may be explained by the proximity of the FMVZ-USP veterinary hospital to equestrian centers where horses are fed alfalfa-rich diets and do not have access to pasture (Hassel *et al.*, 2004, 2008, 2009).

Mean age of horses in this sample is consistent with data reported by Corrêa *et al.* (2006), but not with data reported by Kelleher *et al.* (2014). The higher number of horses aged over eight years (47.91%) suggests enteroliths take a long time to form and become large enough to cause partial or complete obstruction of the large intestine.

The number of cases of large intestinal obstruction caused by enteroliths and/or foreign bodies was lower in this relative to prior studies (Corrêa *et al.*, 2006; Pierce *et al.*, 2010). This may have reflected appropriate management (i.e, inclusion of limited amounts of hay in the diet, free access to water, access to pasture and daily exercise). Such management strategies are thought to reduce the chances of enterolith formation (Hassel *et al*, 2004, 2008, 2009). However, more than one-third of horses with enterolithiasis in this sample were fed alfalfa.

According to Cohen *et al* (2000), stabled horses may have impaired large colonic function and may be predisposed to large colon impaction and obstruction by enteroliths, since digestive motility is enhanced by exercise (Orton *et al.*, 1985; Pearson and Merritt, 1991). Also, stabled horses have limited access to pasture and therefore tend to consume more alfalfa (Cohen *et al.*, 2000). In this retrospective study, only three horses had unlimited access to pasture, whereas the vast majority was kept in stables for part of the day. Nevertheless, stabled horses may also be physically active, since they are often used in sport or leisure activities by their owners. More studies are needed to support the hypothesis that stabled horses are more prone to enterolithiasis.

Other important points are the impact of diet on the equine intestinal microbiota and the potential role of dietary imbalances in digestive disorders. For example, starch-rich diets lead to a decline in the large intestinal pH (Clarke *et al.*, 1990), causing to acidosis. In turn, acidosis is a major cause of intestinal dysbiosis, a potential risk factor for colic and laminitis development (Sadet-Bourgeteau and Julliand, 2010). However, changes in gastrointestinal tract pH are not the only factor affecting the gut microbiota. Other dietary factors may also impact intestinal bacterial communities, as well as bacterial metabolism and the ability of bacteria to compete for nutrients (Cipriano-Salazar *et al.*, 2019).

Alfalfa is thought to promote the alkalinization of the colonic environment and hence may contribute to enterolithiasis development. However, research suggests that alfalfa may also enhance the proliferation of beneficial microorganisms in the intestinal tract, as shown by larger counts of pectinolytic microorganisms in the feces of horses fed alfalfa relative to horses fed sunflower meal (Julliand *et al.*, 2018). Interesting as this finding may be, diets containing large amounts of this ingredient have a high protein and magnesium content and may also facilitate the formation of intestinal calculi (Moreau *et al.*, 2014). Several horses in this retrospective study were fed alfalfa, but an equivalent number also consumed grass hay and feed. Given the above mentioned relationships between dietary factors and the intestinal microbiota in horses, care should be taken to provide a healthy and properly balanced diet in order to prevent imbalances that may cause colic, such as gut dysbiosis induced by an acidic intestinal environment or potential enterolith formation due to the alkalinizing effect of elements found in alfalfa (e.g., nitrogen and magnesium).

Different from Maher *et al.* (2011) and Kelleher *et al.* (2014), most enteroliths in this sample were found in the transverse colon, followed by the small and the large colon. The smaller lumen of the transverse and the small colon relative to the large colon may explain this finding. Another potential explanation is enterolith size, given enteroliths which may pass through the large colon may become entrapped in the transverse or the small colon. Similar data have been reported by Corrêa *et al.* (2006). According to Santos *et al.* (2017), intestinal transit promotes the progression of calculi through the intestinal lumen. Therefore, the site of obstruction detected during exploratory laparotomy is not necessarily the site of enterolith formation.

In this sample, obstruction by a single enterolith accounted for 50% of the caseload and 60% of cases of enterolithiasis (i.e., excluding cases of obstruction caused by foreign bodies). In prior studies, intestinal obstruction by a single enterolith accounted for a similar proportion of cases (Maher *et al.*, 2011; Kelleher *et al.*, 2014). The following factors may dictate the number of enteroliths formed: fragmentation of a large enterolith giving rise to several smaller calculi or ingestion of potential niduses that remain in the large intestine, facilitating struvite deposition.

Two horses in this sample were submitted to 2 surgical interventions for enterolith removal. In the first case, both procedures were included in this analysis. That patient was first submitted to flank laparotomy for removal of an enterolith lodged in the small colon, then to ventral midline laparotomy for removal of an enterolith lodged in the large colon. In the first episode of colic, the calculus was diagnosed by rectal palpation and removed via flank laparotomy. Although indicated in selected cases, this surgical approach provides limited access to the abdominal cavity and does not allow comprehensive exploration of the abdominal cavity. It may therefore be argued both calculi were present from the start. In the second case, the first surgical intervention had been included in a prior analysis conducted at the same hospital (Corrêa *et al.*, 2006). Hence, only

the second was accounted for in this sample. Recurrent enterolithiasis may be explained by individual or genetic predisposition to enterolith formation, or by dietary factors (Hassel *et al.*, 2009).

Eight horses in this sample were submitted to conservative treatment in an effort to alleviate the obstruction. In these cases, conservative treatment was attempted before a surgical diagnosis could be obtained. However, intestinal obstructions caused by enteroliths cannot be resolved conservatively and surgery was finally indicated due to recurrent abdominal pain, lack of response to medical management or overall patient deterioration.

In surgical cases of colic, horses must be referred early enough to allow timely intervention. Otherwise, poor outcomes may result. In a recent retrospective study investigating non-infectious gastrointestinal diseases in horses over a 12-year period, enteroliths accounted for 20 out of 114 deaths due to colic-related complications (Bianchi *et al.*, 2020). In that sample, enterolithiasis caused partial or complete obstruction of the right dorsal (9/20) or the transverse colon (9/20 and 4/20 respectively), the small colon and right dorsal colon (3/20), the small colon (2/20) and the rectum and right dorsal colon (2/20). Bowel perforation followed by peritonitis, concurrent colon impaction and secondary gastric dilation were also described (11/20, 6/20 and 5/20 cases respectively) (Bianchi *et al.*, 2020).

Gil *et al.* (2021) conducted an *in vitro* study to determine whether enteroliths could be dissolved using soft drinks (Coca-Cola® and Coca-Cola® Zero) and a solution containing papain and cellulase (Robinson Pharma®, Santa Ana, CA, USA). Although both enzymes were able to boost the dissolution effect of soft drinks on enteroliths, authors of that study emphasized the need for further investigations, given only the successful dissolution of phytobezoars has been reported to date. Therefore, surgery remains the only effective treatment in cases of enterolithiasis so far.

Macroscopic changes in the peritoneal fluid in some horses in this sample (i.e., turbid, bloody fluid) suggested ischemic bowel compromise and the need for surgical intervention. Although peritoneal lactate levels were not recorded in selected medical records, this parameter is a good predictor of ischemic injury (Costa *et al.*, 2020). Postoperative complications such as fever and laminitis may also have been due to endotoxemia. Endotoxemia may result from the translocation of bacteria and/or bacterial cell wall components into the systemic circulation in horses with ischemic intestinal injury caused by long-standing obstruction (Parsons *et al.*, 2007; Moore and Vandenplas, 2014).

One patient in this sample had a history of recurrent episodes of colic and was submitted to exploratory laparotomy for enterolith removal 5 months after the first clinical manifestations. The fact that an enterolith of sufficient size to obstruct the right dorsal colon could hardly have been formed in less than five months suggests the first episode of abdominal discomfort in that case was already caused by an intestinal calculus. Intestinal calculi may cause ischemic injury and abnormal intestinal motility, leading to spasmodic colic. Mild cases of colic with no clear indication for surgical intervention may be further investigated using digital radiography (Maher *et al.*, 2011). Radiographic assessment of the abdominal cavity may be even more important in patients such as ponies and mini horses, in which rectal palpation is often not be feasible.

The left paralumbar approach combined with resection of the 17th rib was used in two cases in this sample. In these cases, the obstruction involved the transverse colon and could not be resolved using the ventral midline approach. The former technique (Van de Graaf *et al.*, 2007) not only provides better visualization, but also allows the exteriorization and manipulation of this intestinal segment, which is attached to the dorsal abdominal wall by a short mesentery. Successful enterolith removal was achieved in one case. However, in the remaining case the affected bowel segment could not be appropriately isolated for safe enterotomy, despite the alternative surgical approach.

Overall short-term survival of 77.08% in this sample suggests intestinal obstructions caused by enteroliths and/or foreign bodies carry a favorable prognosis, as reported by Corrêa *et al.* (2006). When euthanized patients were excluded, short term survival increased to 87.50%. This finding is consistent with survival rates described in a prior study (91%; Pierce *et al.*, 2010).

Missing data in part of medical records in this sample is a major limitation of this study. Ideally, medical records should be properly filled out in order to allow appropriate analysis, discussion of findings and conclusions.

CONCLUSIONS

Foreign bodies and enteroliths are a common cause of large bowel obstruction in horses and donkeys. Although alfalfa is often incriminated in enterolith formation, diets with high magnesium and protein content and intrinsic motility factors are other potential contributing factors. Even so, the judicious inclusion of alfalfa (i.e., in moderate amounts) in the diet may help prevent enterolith formation and potential intestinal obstruction, particularly in stabled horses. However, findings of this study support the premise that alfalfa may play a role in enterolith formation, since some horses that developed enteroliths were fed alfalfa. A clinical diagnosis of enterolithiasis may be obtained, provided the calculus can be accessed by rectal palpation. Otherwise, exploratory laparotomy or *postmortem* examination is required for diagnostic confirmation. Surgical intervention consisting of exploratory laparotomy followed by calculus removal via enterotomy is the only effective treatment for this condition. Intestinal obstructions caused by enteroliths and/or foreign bodies carry a favorable prognosis.

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