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Partial gastrectomy and total splenectomy for the treatment of a gastric mass in a horse

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Summary

A nine-year-old cob mare with a history of recurrent colic presented during an acute colic episode. Ultrasonography revealed a mass emanating from the greater curvature of the stomach and was tightly adhered to the cranial edge of the spleen. Partial gastrectomy and total splenectomy were performed via a midline celiotomy incision. The mass was subsequently confirmed to be granulomatous inflammation, postulated to be secondary to a penetrating injury to the stomach. Postoperatively, the mare had episodes of recurrent colic that were successfully managed with optimisation of the horse's diet and feeding regime. At ten months postoperatively the mare was managed on full turn out, with no evidence of colic and had returned to the previous level of ridden work. The horse then presented 14 months postoperatively with severe colic due to a large colon impaction and displacement and was euthanased. This is the first report to describe successful partial gastrectomy as a treatment option for a gastric mass in the horse.

Introduction

Gastric masses are infrequently reported in the horse, with neoplastic disease described most commonly. Neoplastic masses affecting the equine stomach include squamous cell carcinoma (Taylor *et al.*, 2009; McKenzie *et al.*, 1997; Tennant *et al.*, 1982; Mair *et al.*, 2010; Olsen, 1992; Meagher *et al.*, 1974), adenocarcinoma (Taylor *et al.*, 2009; Patton *et al.*, 2006), mesothelioma (Taylor *et al.*, 2009), leiomyoma (Taylor *et al.*, 2009), leiomyosarcoma (Boy *et al.*, 1992), gastrointestinal stromal cell tumours (GIST) (Del Piero *et al.*, 2001; Haga *et al.*, 2008), and lymphoma (Taylor *et al.*, 2009). Benign adenomatous polyps are also described (Morse and Richardson, 1988; Marley *et al.*, 2016; Furness *et al.*, 2013), and rarely, gastric abscesses are also reported (Arnold and Chaffin, 2012).

Horses diagnosed with gastric masses often have non-specific clinical signs, including colic, weight loss, inappetence, lethargy (McKenzie *et al.*, 1997), and hypersalivation (Taylor *et al.*, 2009). Clinical signs are often not evident until late in the course of disease, and survival time is often short after identification of gastric masses (Tennant *et al.* 1982; McKenzie *et al.* 1997; Taylor *et al.* 2009). Most reports have focused on neoplastic disease, which has a high incidence of metastasis (up to 78% in one study (Taylor *et al.*, 2009)), or benign polyps that have resulted in fatal gastric outflow tract obstruction (Morse and Richardson, 1988; Furness *et al.*, 2013). For this reason, gastric masses are of significant concern when identified in equine patients.

Treatment options are often limited, and inaccessibility via a midline celiotomy incision has hampered gastric surgery in the horse. Transendoscopic surgical removal of a small gastric adenomatous polyp has been reported (Marley *et al.*, 2016), and gastrectomy has been used to successfully treat gastric masses in other veterinary species (Gardhouse *et al.*, 2016; Lee *et al.*, 2014; Walter *et al.*, 1985). To date, there are no reports of surgical removal of large or infiltrative gastric masses in the adult

horse. This report describes a horse presented with recurrent colic, in which a mass was identified emanating from the stomach, and was tightly adhered to the spleen. The mass was subsequently confirmed to be granulomatous inflammation, which was considered likely to be secondary to a penetrating gastric injury. This was treated surgically, necessitating splenectomy and partial gastrectomy. Short and long term complications (mild colic) were responsive to management changes and oral phenylbutazone and hyoscine butylbromide. The mare had four colic free months and returned to ridden exercise, but was euthanased 14 months later following development of colic (due to a right dorsal displacement) refractory to analgesia.

Case History

A nine-year-old Cob mare was referred to the Weipers Centre Equine Hospital for evaluation of acute colic that was unresponsive to treatment. The horse had a history of recurrent colic of two and a half years' duration, which had been successfully treated medically on multiple occasions. The colic episodes had occurred with varying frequency, and at their most frequent occurred weekly. Investigation prior to referral led to an initial diagnosis of inflammatory bowel disease (based on a clinical improvement following treatment with corticosteroids) and hepatitis (due to increased serum bile acids) that was treated with trimethoprim sulfadiazine. One week prior to referral the horse was noted to have increased acute phase protein concentrations (fibrinogen 7.8 g/l, reference <4; serum amyloid A 578 mg/l, reference <5.4).

Clinical findings at presentation

The horse was in good general body condition (BCS 3/5, 517 kg), and was quiet, alert, and responsive. Heart rate was 48 beats/minute, respiratory rate was 8 breaths/minute, and rectal temperature was 37.8°C. Mucous membranes were pale pink, with a capillary refill time of two seconds. Borborygmi were reduced in the right dorsal quadrant. General clinical examination was otherwise unremarkable.

Transabdominal ultrasound was performed, revealing the stomach to be distended with fluid content. There was an increased volume of anechoic peritoneal fluid. A nasogastric tube was passed, and 13 litres net reflux was obtained. Rectal palpation revealed a large gas distended viscus in the right dorsal abdomen. Abdominocentesis was performed, and fluid analysis was within normal limits.

A tentative diagnosis of right dorsal colon displacement was made, and the horse was treated conservatively. A jugular catheter was placed, and a bolus of Hartmann's solution (Vetivex 11¹ 10 ml/kg) was administered. No further nasogastric reflux was obtained. Food was withheld overnight, and no colic signs were observed. Reassessment the following day confirmed resolution of the abnormalities on rectal palpation.

Transabdominal ultrasonography

Repeat abdominal ultrasonography was performed; the gastric contour was small, with no fluid distension. An elliptical structure was visible extending from left intercostal space 8 to 14 (**Fig. 1**). The structure was tubular, following the contour of the greater curvature of the stomach and cranial edge of the spleen, and heterogeneous with a multiloculated appearance. Hypoechoic regions were interspersed with multiple hyperechoic areas, consistent with gas or mineralised material. It was not clear whether the mass arose from the stomach or the spleen.

Gastroscopy

Gastroscopy revealed a convex appearance to the squamous mucosa (**Fig. 2**), consistent with external compression. The proximal duodenum was visualised endoscopically, and was flattened, consistent with extraluminal compression. The visible gastric mucosa was otherwise normal.

Percutaneous fine needle aspirate

An ultrasound guided aspirate of the fluid within the mass was obtained under sedation (detomidine 0.01 mg/kg i.v.; butorphanol 0.02 mg/kg i.v.) and local anaesthesia. A total of 150 ml of serosanguinous fluid was aspirated. Cytological analysis revealed a high proportion of neutrophils (77%) and macrophages (22%). Sparse cultures of *Fusobacterium* and *Prevotella* spp. were identified.

Surgery

Due to the history of chronic colic and risk of gastric rupture secondary to pyloric outflow obstruction an exploratory abdominal celiotomy was performed to further investigate the mass.

Procaine benzylpenicillin (Depocillin² 20 mg/kg bwt i.m.), gentamicin sulphate (Gentaequine¹ 6.6 mg/kg i.v.), and flunixin meglumine (Meflosyl³ 1.1 mg/kg i.v.) were administered prior to induction of anaesthesia.

The horse was positioned in dorsal recumbency and prepared for aseptic surgery in routine fashion. A 47cm ventral midline abdominal celiotomy incision, extending from the umbilicus cranially, was performed which allowed visualisation of the mass. The mass was 20 cm x 10 cm x 7 cm and was tightly adhered to the cranial edge of the spleen and the caudoventral portion of the stomach. The decision to perform a total splenectomy was made due to the inability to ascertain the degree of splenic invasion, and the concern that the mass may have been neoplastic. The dorsal portion, and apex of the spleen was grasped and the spleen was elevated towards the incision allowing the nephrosplenic ligament to be visualised and transected, exposing the splenic artery and vein which were triple ligated with encircling ligatures of 3.5 metric polydioxanone (PDS 11) and with the use of electrocautery (Ligasure-US surgical). The artery was ligated prior to the vein in an attempt to reduce the blood volume of the spleen. Following ligation of the vascular supply a posterior resection of the remaining portion of the nephrosplenic ligament and phrenicosplenic ligament were

performed at depth, under visualisation with careful retraction near the hilus. This allowed complete exteriorisation of the spleen, and the partial exteriorisation of the mass where it was attached to the gastric wall. Further exploration confirmed that the mass was intimately associated with the stomach and a decision was made to perform a partial gastrectomy. The surgical site was isolated using moistened laparotomy sponges and impervious drapes. Four large Doyen bowel clamps were placed across the stomach isolating the mass and sharp dissection was used to incise the gastric wall, removing the affected portion of the stomach, associated mass and the spleen. The stomach was closed with a combination of inverting suture patterns (Parker-Kerr, Cushing and Lembert). Thorough abdominal lavage with 25 litres of Hartmann's solution was performed and the laparotomy incision was closed in a routine manner. A stent was placed and removed 48 hours post-surgery.

Postoperative Progression

Postoperatively the horse received intravenous Hartmann's solution for 48 hours (50 ml/kg/day). Due to the potential contamination of the abdominal cavity with gastric contents during surgery and risk of septic peritonitis, antimicrobial therapy was continued for seven days with penicillin, gentamicin, and metronidazole (Metronidazole⁶ 15 mg/kg bwt p.o. q8 hours). Clinical signs of endotoxaemia developed within five hours of surgery. The horse was pyrexia, tachycardia, and had congested mucous membranes. Flunixin was administered (1.1 mg/kg i.v.) but the horse progressed to develop colic signs (bruxism and pawing) eight hours postoperatively. A nasogastric tube was passed yielding two litres of haemorrhagic reflux. Morphine (Morphine Sulfate Injection⁷ 0.1 mg/kg i.m. q6 hours) was administered on three occasions as pain was refractory to analgesia with flunixin and sedation with detomidine, and the signs of colic resolved. Twelve hours after surgery the horse was bright, alert, and showed no signs of abdominal pain.

Prophylactic cryotherapy was applied to all four feet for 48 hours to minimise the risk of laminitis, and a hernia belt⁸ was applied for the duration of hospitalisation. A moderate amount of serosanguinous fluid drained from the incision for the first 12 hours postoperatively, after which no further incisional complications were noted.

Treatment with omeprazole (Gastrogard⁹ 4 mg/kg p.o. q12 hours for two doses, decreasing to q24 hours thereafter) and sucralfate (Sucrabest¹⁰ 20 mg/kg p.o. q6 hours) was started after surgery. Gradual oral water reintroduction began 16 hours postoperatively. Food was reintroduced 24 hours after surgery, with small volume wet fibre mashes (250g fibre nuts with one litre warm water) offered initially. This was incrementally increased until ad lib water was offered and short walks to grass were introduced 48 hours after surgery. As feed volume was increased the horse became dull and tachycardic, consequently feed was maintained at 50% of required daily ration for five days. On two occasions the horse showed signs of mild discomfort, and food material was lavaged from the stomach via nasogastric tube. Small haynets were added to the ration one week post operatively, and the horse showed no signs of colic when trickle fed small volumes. The ration was increased incrementally over an eight day period until the mare was receiving a diet of 2% bwt soaked hay.

Gross evaluation of the mass

After excision, two discharging tracts were noted; one leading to the resected portion of margo plicatus, and one at the glandular mucosa. Grossly the mass was tightly adhered to the cranial edge of the spleen (**Fig. 3**), was well encapsulated, contained sheets of tissue, and a large amount of foul smelling, tan coloured necrotic material. The contents of the mass were explored for evidence of a foreign body, but nothing was identified. The mass and spleen were radiographed, but no evidence of a metallic foreign body was found.

Histopathology

Histopathological evaluation of the of the mass (contents, capsule, and connection to stomach/spleen) revealed the contents of this structure to consists of sheets of necrotic round cells, however, due to the extensive necrosis the cell type could not be ascertained. The wall of the mass contained a layer of granulation tissue, amongst which moderate to large numbers of inflammatory cells were seen. The cell population was mostly heterogenous. Focally a more monomorphic lymphocyte population was present. Immunohistochemistry (using antibodies for CD3, CD79a, Pax5, MUM1, MAC387, MHCII and CD20) was performed to further explore this lymphocytic population. Results were inconclusive due to inconsistent staining of the suspicious population with the markers applied. Further examination of the sections by two boarded pathologists favoured the presence of a chronic inflammatory process over a neoplastic process (lymphoma).

Diagnosis

A large, well encapsulated, chronic inflammatory gastric mass causing extra-luminal gastric outflow obstruction. Given the location the most probable aetiology was considered to be a chronic inflammatory response to a previous penetrating gastric injury.

Discharge

The horse was discharged from the clinic 17 days after surgery. Prophylactic treatment with omeprazole was continued for 11 days after discharge (1 mg/kg PO q24 hours). The owner was advised to feed a daily ration of 2% bwt dry weight hay soaked for 30 minutes, divided into several nets throughout the day. The horse received three feeds a day consisting of 500g soaked fibre nuts with a feed balancer, and was grazed in hand for ten minutes three times daily.

The horse completed a further four weeks of box rest, and was initially walked twice daily in hand for five minutes, increasing to 20 minutes twice daily by week four.

Turnout was then reintroduced, at first in a 10m² paddock for six weeks, followed by normal turn out to pasture.

Case progression

Five weeks post-discharge the mare had gained 23kg bodyweight. Mild self-limiting colic episodes, associated with small alterations in diet and often preceded by mild diarrhoea were reported, occurring up to once a week.

Clinical examination and repeat blood biochemistry were unremarkable. On gastroscopic evaluation after 16 hour feed withdrawal there was still a small, soft mass of feed within the stomach. Repeat gastroscopy the following day revealed that the glandular mucosa was 'puckered' in appearance, and had not significantly remodelled. There was no visible structural obstruction to the gastric outflow tract. There was no gastric impaction present on repeat gastroscopy four months later.

The period of time spent at grass was increased gradually; and at ten months postoperatively the horse was managed at pasture and had returned to the previous level of ridden work successfully.

Fourteen months postoperatively the horse re-presented to the Weipers Centre Equine Hospital for colic signs of 6 days duration following a change from pasture to 24 hour stabling. On arrival the mare was refractory to analgesia (flunixin 1.1mg/kg i.v.; morphine 0.1mg/kg i.v.; detomidine 0.02mg/kg). The examination was consistent with a large colon impaction and displacement. The owner declined surgical intervention and the horse was euthanased.

Post mortem examination

Post mortem examination revealed a right dorsal displacement of the large colon, and a substantial large colon impaction, with approximately 75% of the large colon lumen full of impacted ingesta. The gastrectomy site was examined, and fibrinous tags were

noted on the serosal surface of the stomach, in addition to a focal fibrinous adhesion between the stomach and the diaphragm.

Discussion

Partial gastrectomy has not been reported in the equine literature. Partial gastrectomy may offer treatment for horses diagnosed with well demarcated gastric masses in a surgically accessible position with no evidence of metastasis.

In the case described here, the horse's initial recurrent colic episodes were likely due to compression of the gastric outflow tract which resulted in accumulation of gastric contents and increased intraluminal pressure. The horse was considered to be a good candidate for surgery due to the risk of fatal gastric rupture, the accessibility of the mass via a midline abdominal celiotomy incision, the well circumscribed nature of the mass, and the lack of any identifiable metastases.

There is a paucity of information regarding surgical access to the stomach in horses; with access to the equine cranial abdomen proving challenging due to the size and depth of the abdomen, and the position of the abdominal viscera. Gastric surgery via a laparoscopic approach has not been described but offers a potential approach for the future. Gastrotomy has been used to successfully treat gastric impactions (Parker *et al.* 2011), and a single case report describes transendoscopic removal of a gastric polyp from the lumen of the stomach (Marley *et al.*, 2016). In foals, gastrojejunostomy, or gastroduodenostomy have been described for the treatment of gastric outflow obstruction (Zedler *et al.*, 2009), however, to the authors' knowledge there are no reports of surgical treatment of gastric masses or partial gastrectomy in the adult horse. The use of surgical stapling devices was considered during the treatment of the case described here, however, the thickness of the gastric wall, and limited space available for manoeuvring the stapler precluded this approach.

The extent to which the equine stomach can remodel is unknown. It is intuitive that resecting glandular mucosa may predispose affected horses to severe squamous ulceration, which may have lifelong consequences if the glandular portion is unable to remodel to accommodate a larger volume of gastric content. However, on repeated gastroscopic evaluations of this horse no gastric ulceration was present. There was evidence that gastric emptying was delayed initially, which is likely to have been a contributing factor to the episodes of postoperative colic. Meal size and composition are known to affect gastric emptying in healthy horses, and smaller, low starch feeds with a higher fibre content empty faster than high starch feeds (Métayer *et al.*, 2004). In this case reducing meal size of a high fibre, low starch meal was associated with reduced frequency of colic episodes. In dogs and humans, gastric emptying following distal gastrectomy is dependent on the viscosity of food material ingested and on small intestinal contractility, which is influenced by the gastroenterotomy technique used (Ehrlein *et al.*, 1987). There are no studies in the horse describing motor function of any section of the alimentary tract following resection, but disruption to intestinal motor activity has been reported in dogs following distal intestinal resection (Quigley and Thompson, 1993). Conversely, humans undergoing sleeve gastrectomy have been shown to have accelerated gastric motility when assessed scintigraphically (Melissas *et al.*, 2013). In this case, it is possible that adhesion formation between the stomach and diaphragm contributed to the postoperative episodes of recurrent colic, but altered motility cannot be ruled out as a contributing factor. It is most likely that the final colic episode of colic was precipitated by management change rather than being directly related to the previous surgery.

A number of approaches have been described for splenectomy in the horse (Dennig and Brocklesby, 1965; Witzel and Mullenax, 1964). These include splenectomy approached from the left side of the horse, with the horse standing and sedated or in right lateral recumbency, with or without resection of the 16th, 17th and/or 18th rib

(Roberts and Groenendyk, 1978), laparoscopic assisted splenectomy (Ortved et al., 2008; Gracia-Calvo et al., 2015), and transthoracic splenectomy (Rigg et al., 1987).

In this case, splenic involvement had not been anticipated prior to surgery, and it was only after exploration of the abdomen that the extent of the mass and involvement of the splenic capsule and body were identified. The intimate relationship between the mass, spleen and gastric wall greatly restricted the options for splenectomy using the previously described techniques and consequently the decision was made to remove the spleen, mass, and affected portion of the stomach as described through a ventral midline celiotomy incision. Involvement of the spleen in abdominal masses has previously been described (Nyack et al., 1984), and with retraction from an assistant, illumination, and the use of long handled instruments and electro-surgery, it is possible to remove all, or a portion, of the spleen via a ventral midline approach (personal communication PJP). Exteriorisation of the spleen can be facilitated and improved, by grasping the apex of the spleen and systematically sectioning the nephrosplenic, phrenicosplenic and gastrosplenic ligaments as the spleen is pulled towards the incision. In this case the decision to remove the spleen in its entirety was made due to the involvement of the gastric wall, making dissection and manipulation difficult, and concern that the mass may have been neoplastic.

In conclusion, this report describes a case with an unusual reason for recurrent colic, and suggests that partial gastrectomy may be considered as a treatment for some gastric masses in the horse depending on their configuration and position. Postoperative complications are likely to include colic, which may be successfully managed by dietary adjustment. The likelihood of a successful outcome following gastric resection needs to be assessed on a case by case basis, with thorough discussion of the risks and potential aftercare requirements with the client beforehand.

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Author's declaration of interests

None declared.

Ethical animal research

This report describes a case that was admitted to the Weipers Centre Equine Hospital for investigation and treatment. The decision to publish the case was made retrospectively, and clinical decision making was not affected by the publication of this report.

Authorship

The case was diagnosed and treated pre- and postoperatively by A.G. Raftery and S.J. Voss. Surgery was performed by P.J. Pollock and F. Barceló Oliver. A. Rupp was responsible for histopathological diagnosis. S.J. Voss primarily prepared the manuscript; all authors contributed to and approved the manuscript.

Manufacturers' addresses

¹ Dechra Veterinary Products, Shrewsbury, Shropshire, UK.

² MSD Animal Health, Milton Keynes, Buckinghamshire, UK.

³ Zoetis UK Ltd., Tadworth, Surrey, UK.

⁴ Ethicon, Johnson and Johnson Medical Ltd, Livingston, West Lothian, UK.

⁵ Medtronic Ltd, Minneapolis, Minnesota, USA.

⁶ Crescent Pharma Ltd., Overton, Hampshire, UK.

⁷ Martindale Pharmaceuticals, Romford, Essex, UK.

⁸ CM™ Equine Products, Norco, California, USA.

⁹ Merial Ltd., Duluth, Georgia, USA.

¹⁰ Grovet, Utrecht, The Netherlands.

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Figure 1: Transabdominal ultrasound image showing an elliptical structure (white arrow) located between the spleen and stomach. Multiple hypoechoic areas are visible, interspersed with focal echodense regions, denoting either gas or mineralised material

Figure 2: Gastroscopic image showing the squamous mucosa of the greater curvature of the stomach. This shows a large indentation in the stomach wall, but the mucosa was unaffected.

Figure 3: Photograph post-excision showing the mass (blue arrow) intimately associated with the spleen after excision