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Case Report

Recurrent small colon obstructions in a foal age 7 weeks affected by a mandibular fracture

L. J. SMITH AND T. S. MAIR*

Bell Equine Veterinary Clinic, Mereworth, Maidstone, Kent ME18 5GS, UK.

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This report describes a colt foal age 7 weeks presented for evaluation of colic of 3 days' duration. Exploratory laparotomy revealed a small colon obstruction by a phytoconglobate composed of undigested food material. The foal had sustained a mandibular fracture 3 weeks earlier, and this may have predisposed to the intestinal obstruction.

Introduction

Compared with other regions of the intestinal tract, obstructions of the small colon occur relatively infrequently, being reported in 3.5–4.2% of surgical colic cases in mature horses (White and Lessard 1986; Edwards 1992). In a study of 102 horses with small colon diseases, 78.4% had intraluminal obstructions (Dart *et al.* 1992). Simple (nonstrangulating) intraluminal obstructions occur most frequently, and include impaction with ingesta and focal intraluminal obstruction by faecaliths, enteroliths, phytobezoars, trichobezoars and foreign bodies (Boles and Kohn 1977; Gay *et al.* 1979; Edwards 1992, 1997; Schumacher and Mair 2002). In the newborn foal, meconium impaction of the rectum and small colon is a common cause of colic, especially in male foals (Cohen and Chaffin 1994; Cable *et al.* 1997; Edwards 1997). Small colon impactions and faecalith, conglobate and bezoar obstructions have also been recognised in older foals presenting with colic (Crook 1967; McClure *et al.* 1992; Yvorchuk-St. Jean *et al.* 1993), and an increased incidence of small colon disease in foals age less than 6 months (unassociated with meconium impaction) has been reported (Reeves *et al.* 1989). In one study, 23 (34%) of 67 foals aged less than 150 days that underwent surgical exploration of the abdomen for colic had obstruction of the small colon by feed material (Vatistas *et al.* 1996). In another study, 5 (25%) of 20 neonatal foals (less than age 2 weeks) with surgical colic had small colon obstruction (Adams *et al.* 1988).

Predisposing factors for the development of small colon impactions include decreased water intake, poor quality roughage, and inadequate mastication (Edwards 1997). Shetland ponies and American Miniature Horses appear to be particularly prone to small colon impaction (Tennant 1975; Ragle *et al.* 1992), and faecalith obstruction has been reported as a common cause of unresponsive colic in miniature foals (McClure *et al.* 1992). The relatively high incidence of such obstructions in young animals is believed to be associated with their inquisitive nature and less discriminate eating habits.

*Author to whom correspondence should be addressed.

Case details

History

The 7-week-old Thoroughbred colt foal was presented with a history of intermittent abdominal pain of 2 days' duration. Occasional rolling was first noticed in the stable 48 h previously; however, the foal appeared otherwise bright and alert, remaining keen to suck and eat. The following day there was no improvement in the colt's condition and the veterinary surgeon was therefore called. Sedation and analgesia (detomidine hydrochloride 0.05 mg/kg bwt and carprofen 0.1 mg/kg bwt i.v.), oral anti-ulcer medication (sucralphate 20 mg/kg bwt and cimetidine 20 mg/kg bwt *per os*) and 250 ml liquid paraffin via nasogastric tube were administered. The colt continued to exhibit signs of intermittent pain and was seen to strain frequently, as if trying to urinate; but was seen to pass urine normally with no problems the following morning. A small amount of normal faeces was passed early on the day of referral, but subsequently no more were passed. As no improvement was seen in the colt's condition, referral to a surgical facility was recommended.

The colt had sustained a kick from its dam to the mandible 3 weeks prior to presentation. An open fracture of the left mandibular diastema was diagnosed. Swelling followed by callus formation was evident; however, because the colt had continued to suck vigorously, no further treatment was pursued.

Clinical examination

On initial examination the colt's vital parameters were all within normal limits; however, the mucous membranes were slightly

Fig 1: Intraoperative view of the small colon at the first surgery. There is generalised distension of the small colon and severe serosal congestion, especially along the antimesenteric band.

Fig 2: Intraoperative view of the first surgery, showing the intraluminal mass after exteriorisation from the abdomen.

Fig 3: Removal of the faecalith via a colotomy incision through the antimesenteric band of the small colon during the first surgery.

Fig 4: Intraoperative view during the second surgery, showing fibrin deposition on the bowel and severe serosal inflammation due to peritonitis.

congested and dry, with a capillary refill time of 2 secs. The colt appeared slightly depressed and displayed signs of intermittent low-grade abdominal discomfort. A purulent discharge was evident from the fracture site at the left mandible. Good gut sounds were present in all 4 quadrants of the abdomen and no abdominal distension was evident. Gastroscopy revealed no evidence of ulceration of the gastric mucosa. Transcutaneous abdominal ultrasonography showed some moderately distended loops of small intestine in the caudal abdomen; however, motility of the small intestinal wall was evident. Digital rectal examination was unremarkable.

Routine haematology and serum biochemistry revealed a mild leucocytosis (WBC count 15.8 x 10^9/l; normal range 5.0–10.0 x 10^9/l). In view of the intermittent but persistent pain, poor response to analgesia and reduced faecal output, a simple or partial intestinal obstruction was suspected. The decision was made to explore the abdomen surgically.

Surgery

A long-stay, over-the-wire i.v. catheter was placed in the left jugular vein, and gentamicin (6.6 mg/kg bwt i.v. s.i.d.), sodium benzylpenicillin (10 mg/kg bwt i.v. b.i.d.) and flunixin meglumine (1.1 mg/kg bwt i.v.) were administered. The foal was anaesthetised with romifidine (0.1 mg/kg bwt i.v.), followed by diazepam (0.03 mg/kg bwt i.v.) and ketamine hydrochloride (2.2 mg/kg bwt i.v.). The colt was intubated and maintained on isoflurane in oxygen using a semiclosed circuit. A routine exploratory laparotomy was performed via a midline incision. This revealed caecal tympany and distension of the large and small colons by ingesta, fluid and gas. Severe congestion of the serosal surface and antimesenteric band of the small colon was present (**Fig 1**). An intraluminal mass was palpable obstructing the distal small colon at its junction with the rectum at the level of the pelvic inlet. This mass was gently milked proximad until it could safely be exteriorised (**Fig 2**), at which point it was removed via a colotomy incision through the antimesenteric band (**Fig 3**). The mass was found to be a phytoconglobate/faecalith composed of undigested straw and cereal husks. The colotomy incision was closed using a single continuous Cushing suture of 2 metric polydioxanone. Exploration of the rest of the abdomen revealed impaction of the right dorsal colon by more fibrous material. The large colon wall was extremely congested and friable, and tearing of the serosa of the right dorsal colon occurred as it was exteriorised. One tear was opened to the lumen in an attempt to remove some of the fibrous food

material; however, this proved impossible to achieve without causing further serious trauma to the bowel wall and peritoneal contamination. The colotomy was closed with a double-layer Cushing suture of 2 metric polydioxanone. The abdomen was lavaged with normal saline, which was then aspirated prior to routine closure of the body wall and skin.

The colt recovered uneventfully from the surgery and was maintained on i.v. antibiotics and fluid therapy (compound sodium lactate). One litre of plasma was given i.v. post operatively. Within 2 h of recovering from surgery, the colt was significantly brighter and sucking vigorously from the mare. However, over the following 12 h the foal became increasingly depressed, losing all interest in sucking and displaying signs of abdominal discomfort, including flank watching and laying in lateral recumbency for the majority of the time.

Repeat abdominal ultrasonography revealed multiple mildly distended loops of small intestine; however, some motility was evident. A nasogastric tube was passed and 3 l net reflux obtained. Over the next 24 h, between 3 and 5 l gastric reflux were obtained every 4 h. Throughout this time the colt became progressively more uncomfortable, flank-watching and displaying bruxism. Heart rate rose to 100 from 72 beats/min, and mucous membranes became more injected with a prolonged capillary refill time (3 secs). Due to the deterioration in condition, the decision was made to return to surgery.

A second routine exploratory laparotomy was performed through the original wound. This revealed a diffuse peritonitis (**Fig 4**) and severe congestion of the serosa of the small colon. There was a further obstruction of the proximal small colon by another phytoconglobate/faecalith. This was removed via a colotomy along the antimesenteric band, as described previously. In addition there was marked distension of the proximal 2/3 of the small intestine, proximal to a short (10 cm) ischaemic segment of distal jejunum. The mesenteric blood vessels were thrombosed at this site. This segment of jejunum was resected, and an end-to-end anastomosis performed using a single layer Cushing suture of 2 metric polydioxanone. The small intestine was then decompressed by milking its contents into the caecum, and the abdomen was lavaged and closed routinely.

The colt recovered uneventfully from the second surgery, and was continued on i.v. antibiotics and i.v. fluid therapy. In addition to the previous therapy, ranitidine was administered *per os*. Initially the colt appeared bright and was keen to suck and searching for hard feed. A nasogastric tube was passed, but no net reflux was obtained until 12 h after surgery. At this time, the colt's condition began to deteriorate and signs of abdominal discomfort were evident once more. The majority of time was spent laying in either lateral or dorsal recumbency and reluctance to rise and loss of all interest in feed were evident. At this time euthanasia was performed on humane grounds, due to the extremely poor prognosis for recovery.

Pathology

A *post mortem* examination was performed within 30 mins of death. This revealed a diffuse septic peritonitis. A sample of peritoneal fluid showed total nucleated cell count 112 x 10^9/l with 98% neutrophils, and numerous bacteria, both free and phagocytosed. Bacteriological culture of the fluid was not performed. Multiple fibrinous adhesions were present throughout the abdomen, and several areas of the small colon had undergone focal necrosis. Further obstruction by food material and another faecalith were present in the small colon. The colotomy wounds appeared healthy, with no evidence of leakage. The small intestine and intestinal anastomosis appeared healthy. A large amount of poorly masticated fibrous food material was still present within the right dorsal and transverse colons.

Discussion

Although it is impossible to be certain that the mandibular fracture predisposed to the small colon obstructions in this foal, it seems likely that this was the case. After the initial injury to jaw, the colt had remained bright, appearing to eat well. However, it was evident from the nature of the ingesta in the colon that significant quantities of roughage (straw and corn husks) had been consumed but not properly masticated. This material had accumulated in the right dorsal colon from where it was slowly passing into the small colon, causing multiple simple obstructions. The abrasive nature of the material may have caused damage to the mucosal surface of both the large and small colon. In addition, the intestinal distension caused by the bulky ingesta may have exerted pressure necrosis of the intestinal wall. Ultimately, these processes resulted in the multifocal areas of ischaemia and infarction. The extent of the damage was too great for treatment to be effective.

Faecaliths, phytoconglobates and bezoars develop within the intestinal tract but behave like foreign bodies, and commonly obstruct the small colon because of its reduced luminal diameter (Schumacher and Mair 2002). Faecaliths are discrete concretions of inspissated faecal material and are most commonly seen in ponies in late autumn when the grass is coarse and the weather cool, reducing water intake (Meagher and Bugreef 1989). Faecalith impaction has been recorded as a common cause of nonresponsive colic in American Miniature Horse foals (Ragle *et al.* 1992). Phytoconglobates are concretions of matted plant residues formed into balls, and bezoars are a combination of magnesium ammonium phosphate crystals and plant fibre (phytobezoars) or hair (trichobezoars) (Schumacher and Mair 2002). Improper mastication and dietary abnormalities (excessive coarse fibrous material and inadequate water intake) are believed to be predisposing factors for all of these conditions (McClure *et al.* 1992; Yvorchuk-St. Jean *et al.* 1993). Phytobezoars are also recognised in children, where predisposing factors include delayed gastric transit and prior gastric surgery, improper mastication and ingestion of persimmons (Choi and Kang 1988). The inquisitive nature and poor discriminatory eating habits of foals are also likely to be important factors that predispose them to such obstructions. Indeed, foreign body obstruction by material from halters, haynets or twine is most commonly seen in young horses age less than 3 years (Boles and Kohn 1977; Gay *et al.* 1979; Edwards 1997).

This case highlights the difficulty of diagnosing the exact cause of abdominal discomfort in foals, and in determining the

need for surgery. Although pain is a primary indication for surgery (as in older horses), the colt had remained bright and displayed a good appetite, showing only intermittent signs of abdominal discomfort. Similarly, the colt was passing small quantities of faeces up to a few hours prior to referral; this was a confusing finding that would not be suggestive of an obstructive lesion in the small or large colon. Rectal palpation, often an essential tool in the evaluation of colic in mature horses, is not a feasible technique in foals and a different set of diagnostic modalities must be used (Bernard 1992; Cable *et al*. 1997). The physical, laboratory, radiographic and ultrasonographic findings, as well as clinical judgement, must be relied upon (Cable *et al.* 1997). Abdominal radiography has been used successfully to diagnose certain types of gastrointestinal obstruction in foals (Donawick and Orsini 1985; Fischer and Yarbrough 1995). In a review of surgical colic in foals age less than 150 days, plain lateral radiographs consistently revealed colonic and occasionally jejunal distension in foals with small colon impaction (Vatistas *et al.* 1996). Retrograde contrast radiography has also proved valuable in evaluating the distal intestinal tract in young foals (up to age 30 days: Fischer and Yarbrough 1995), and might have been helpful in this case. However, the decision to perform surgery had already been made in the foal based on the history and clinical findings; radiography would therefore not have provided any further useful information. In addition, retrograde contrast radiography is technically more difficult to perform in a foal age >30 days.

Small colon impaction or obstruction was the commonest lesion in one series of surgical colics in foals age <150 days (Vatistas *et al.* 1996) and the second commonest in another series of younger foals age <14 days (Adams *et al.* 1988). However, in 2 other reviews of abdominal surgery in young horses age <1 year, small colon obstructions were rarely encountered, apart from meconium impactions in the newborn (Cable *et al.* 1997; Singer and Livesey 1997). The reasons for this apparent difference in incidence of small colon obstructions are difficult to identify, but may partly reflect breed differences at the different centres. Small colon obstructions in mature horses have been reported as being most commonly seen in American Miniature Horses by some authors (Vatistas *et al.* 1996) and in Thoroughbreds by others (Ruggles and Ross 1991).

Peritonitis was present at the second laparotomy in the foal. This was assumed to have been the result of contamination of the abdomen during the first surgery, when both the small colon and large colon were opened to permit removal of intestinal contents. The foal undergoing colic surgery is generally believed to be predisposed to complications involving infection because of its poor immunological status (Adams *et al.* 1988; Hunt 1988). Foals are essentially immune competent at birth, but depend on passive immunity derived from the colostrum to protect them during the first month *post partum* (Sellon 2000). This foal, being age 7 weeks, would have been capable of mounting an effective immune response, but the rate and magnitude of the response was probably poor because of immaturity of the immune system. Therefore, the abdominal contamination with intestinal flora was sufficient to overwhelm the foal's immune system, and septic peritonitis resulted. In addition, ischaemia-reperfusion injury is known to occur in the small colon (Faleiros *et al.* 2002) and this could predispose to the development of several complications, including peritonitis, endotoxaemia and adhesions. The use of saline rather than lactated Ringer's solution to lavage the abdomen at the completion of the first surgery might also have predisposed the foal to septic peritonitis. Saline is potentially more irritating in the abdominal cavity, and this could have resulted in an increased risk of infection in the foal with compromised intestine. However, saline has been used routinely at our clinic for abdominal lavage at the completion of abdominal surgery in both mature horses and foals with no obvious deleterious effects.

Extensive intra-abdominal adhesions were identified *post mortem*. There is a commonly held belief that post operative adhesions have a greater tendency to form in foals than in mature horses (Baxter 1991; Lundin *et al.* 1989; Embertson 1993; Southwood and Baxter 1997), and this is one reason why long-term survival rates following colic surgery in foals have in the past appeared to be lower than in mature horses (Pascoe *et al.* 1983). However, recent studies have given conflicting results about the incidence of post operative adhesions and survival rates (Vatistas *et al.* 1996; Cable *et al.* 1997; Singer and Livesey 1997).

At both surgeries, a large quantity of coarse, fibrous ingesta was identified in the right dorsal colon. This was the source of the material that caused repeated obstructions in the small colon. In retrospect, it would have been wise to remove this material at the first surgery, possibly by lavage or retrograde flushing into the left colon. However, at the time of the initial surgery, even very careful handling of the distended colon resulted in serosal tearing, and it was felt that continued manipulation of the colon would predispose the foal to peritoneal contamination and serious post operative adhesions and scarring. The risk of bowel rupture was considered to be high in view of the apparent friability of the colonic wall. For these reasons, the decision was made not to evacuate the colon. The reason for performing the second laparotomy was the continued clinical deterioration of the foal. Neither peritonitis nor the area of jejunal ischaemia were suspected prior to this surgery, and the cause of the small intestinal ischaemia was not determined.

Necrosis of focal areas of the wall of the small colon was found *post mortem*. This appears to be a common event in intraluminal obstructions of this segment of the bowel in the horse, and there have been several reports of devitalisation of the wall (with or without rupture) of the small colon at the obstruction site (Blue 1979; Gay *et al.* 1979; Ruggles and Ross 1991; Hassel *et al.* 1999; Rhoads *et al.* 1999). In a study of 900 cases of enterolithiasis, intestinal rupture occurred in 131 horses, and 71% of these involved the small colon (Hassel *et al.* 1999). Devitalisation of the wall is believed to occur as a result of mural compression caused by intraluminal distension. Recently, ischaemia of the equine small colon wall due to reduced microvascular perfusion has been demonstrated in an experimental model of intraluminal distension (Faleiros *et al.* 2002). Intraluminal obstruction is believed to stimulate the intestinal wall, which contracts in a spastic manner, provoking a

pressure increase which ultimately leads to ischaemia and necrosis (Blue 1979; Faleiros *et al.* 2002). The slow development of clinical signs, often over several days (Rhoads *et al.* 1999; Schumacher and Mair 2002), and the resulting delay in surgical treatment is another potential reason why devitalisation of the small colon wall is commonly seen in cases of intraluminal obstruction.

Careful dietary management of foals and other horses at particular risk of developing small colon obstructions (such as Shetland ponies and Miniature Horses) is indicated in animals that have impaired masticatory function. In this case, a mandibular fracture appeared to predispose the foal to colonic impaction and phytoconglobate/faecalith obstruction. However, dental diseases and other traumatic lesions to the mouth should also be considered as potential predisposing factors. Avoidance of high fibre/low digestibility rations is appropriate in such cases. The foal described here appeared to have eaten significant quantities of straw, and the use of an inedible bedding material would also be indicated. Although foals sometimes consume other bedding materials, including shavings, it is unlikely that a foal would ingest similar quantities to the amount of straw consumed by the foal described here. If a foal or miniature horse with known masticatory dysfunction is observed to be eating bedding material, removal of all bedding would appear to be a sensible preventive measure.

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