Case Report

Caecal lipomatosis as a cause of colic in a 9-year-old gelding

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Summary
Lipomatosis is an uncommon cause of colic. This case report details the pre- and intraoperative findings of a 9-year-old gelding, presented with acute abdominal pain. Exploratory laparotomy revealed a massive fatty infiltrate involving an extensive portion of the base and mid-body of the caecum. To the authors’ knowledge, this is the first report of an infiltrative lipomatous lesion of the equine caecum.

Introduction
Benign lipomatous lesions of the intestine may present as either encapsulated single or multiple lipomas, or alternatively as diffuse and discrete nonencapsulated lobules of adipose tissue (Sandhu et al. 2011). Single or multiple abdominal lipomata are commonly seen in horses, both as incidental findings at laparotomy or necropsy and as a cause of colic. Originating from the mesenteric fat, they have a tendency to become pedunculated, wrapping around the intestine and associated mesentery, resulting in intestinal strangulation and ischaemia (Blikslager et al. 1992). In contrast, infiltrative intestinal lipomatosis is an uncommon neoplasm, with limited published reports in the human literature and only 3 previously reported cases in horses (Henry and Yamini 1995; Riley et al. 2007; Linnenkohl et al. 2012). Although considered benign histologically, lipomatosis often results in massive tissue infiltration and expansion, with this type of growth mimicking malignancy (Sandhu et al. 2011). Histologically, adipose proliferation may be confined to the submucosa or may extend to the mesenteric and serosal layers, while the muscularis mucosa is usually unaffected (Shenoy et al. 2003). The invasive adipocytes can destroy the muscularis externa layer of the intestine, which may result in weakening of the affected areas, impeding peristaltic function and resulting in an obstruction (Henry and Yamini 1995). In man, colonic lipomatosis is categorised in 2 forms: segmental lipomatosis in which mature unencapsulated adipose tissue lies in clumps in the submucosa of the colon; and diffuse lipomatosis, where lobules of adipose tissue are present throughout the submucosa of the entire colon (Catania et al. 1995).

Invasive adipose infiltration of the transverse and descending colons (Henry and Yamini 1995; Riley et al. 2007) and the mesojejunum (Linnenkohl et al. 2012) has been reported as a cause of colic in the horse. This report describes a case of caecal lipomatosis that resulted in a nonstrangulating intestinal obstruction and clinical signs of acute abdominal pain. To the authors’ knowledge, this is the first case of equine caecal lipomatosis reported.

Case details

Case history
A 9-year-old Sports Horse gelding presented with an approximately 12 h history of colic. There had been no history of recurrent colic or weight loss. Initial examination by the referring veterinary surgeon revealed a heart rate of 40 beats/min with a respiratory rate of 12 breaths/min and a normal rectal temperature. Increased intestinal borborygmi were auscultated in all quadrants. Rectal examination revealed the presence of a taut colonic taenial band, along with a mild colonic impaction. No reflux was obtained and the gelding received 5 l of oral fluids via nasogastric tube. In addition, phenylbutazone (Equipalazone 2.2 mg/kg bwt i.v.)1 and hyoscine butylbromide (Buscopan, 150 mg i.v.)2 were administered. These failed to provide sufficient analgesia, and romifidine (Sedivet, 15 mg i.v) and 20 mg i.m.2 and butorphanol (Torbugesic, 30 mg i.v.)3 were administered immediately prior to referral.

Clinical findings
On presentation, the gelding was quiet and appeared slightly sedated. He was in lean condition, weighing 525 kg and had a body condition score of 2/5 (Carroll and Huntington 1988). His heart rate was 40 beats/min with a respiratory rate of 12 breaths/min and rectal temperature of 37.6°C. His mucous membranes were pink and moist with a capillary refill time of <2 s. The gelding appeared cardiovascularly stable, with packed cell volume of 0.27 l/l (reference range [rr] for our laboratory 0.31–0.43 l/l), total protein of 64 g/l [rr 53–73 g/l] and systemic lactate of 1.2 mmol/l [rr <2 mmol/l]. Intestinal borborygmi were moderately reduced in all quadrants. There was no evidence of abdominal distension and no reflux was obtained on nasogastric intubation. Rectal examination revealed a large distended bladder, with no other significant abnormalities detected. Ultrasonography of the ventral midline and inguinal regions was unremarkable. Abdominoencestesis yielded a sample of grossly normal looking peritoneal fluid, with a total protein of 12 g/l [rr 1–20 g/l] and lactate <0.8 mmol/l (rr <2 mmol/l). Due to the lack of specific clinical findings, the gelding was placed in a stable under observation, where he urinated normally. However, within minutes he started to show repeated signs of marked abdominal pain. Repeat rectal examination was once again unremarkable. Due to the persistent signs of colic, an exploratory laparotomy was undertaken.

Surgical findings
The horse received preoperative procaine penicillin G (Depocillin, 12 mg/kg bwt i.m.)4, xylazine (Virbaxyl, 0.6 mg/kg
bwt i.v.)\(^5\) and morphine sulphate (0.2 mg/kg bwt i.v.)\(^6\) prior to induction of anaesthesia with ketamine (Narketan-10, 2.2 mg/kg bwt i.v.)\(^7\) and diazepam (0.05 mg/kg bwt i.v.)\(^8\). Following orotracheal intubation (35 mm internal diameter), anaesthesia was maintained with sevoflurane (SevoFlo)\(^9\), delivered in oxygen (O\(_2\) flow 6 l/min) at an end tidal concentration of 1.8–2.0%, via a large animal circle breathing system. The horse was placed in dorsal recumbency and a standard midline laparotomy incision was performed. Initial exploration of the abdomen revealed mild gaseous distension of the caecum, with mild distension of the jejunum throughout its entire length with fluid and gas. The ileocaecal junction was palpably normal. Extensive accumulations of adipose tissue were evident on the serosa of the mid-body of the caecum. A firm mass was palpable within the lumen of the caecum, similar to palpation of either a caecocolic or caecocaecal intussusception. No abnormalities of either the ascending or descending colons were evident and both the mesojejunum and mesocolon were free of excessive fat deposits. There was no evidence of involvement of any other abdominal organs and the peritoneal lining was smooth on palpation. A typhlotomy was performed and massive accumulation of apparent adipose tissue was identified within the caecal lumen. Several diverticula were also present, with abnormal masses located in the proximity of both the caecocolic orifice and ileocaecal valve. The extent of the infiltration made complete resection of the mass impossible. The possibility of performing an ileocolic anastomosis in order to bypass the caecum was debated but would have meant leaving the infiltrative caecal mass in situ, with potential for further growth and infiltration into surrounding tissues. In consultation with the owners, the decision was made to subject the gelding to euthanasia on humane grounds.

**Post mortem**

Necropsy was performed within 8 h of death. The caecal wall was massively thickened, resulting in almost complete obstruction of the caecal lumen. A pale, cream-coloured fatty infiltrate was seen to extend from the base of the caecum to within 15 cm of the apex (Fig 1), composed of multifocal to coalescing, raised (finger-like) fatty masses, ranging from 1 to 20 cm in size and involving both the serosal and mucosal lining (Fig 2). Multifocal diverticula present on the mucosal surface contained firm impacted ingesta and the fatty infiltrate extended across almost the entire mucosal surface. The lumen contained a small amount of watery red-green fibrous digesta. Both ileocaecal and caecocolic junctions appeared normal, with no gross evidence of infiltration. Once empty, the caecum weighed 35 kg. No further gross abnormalities were detected.

**Histopathology**

Histopathology of the caecum revealed a moderate, multifocal infiltrate of lymphocytes, plasma cells and lower numbers of eosinophils within the lamina propria (chronic, moderate, multifocal lymphoplasmacytic typhlitis). The grossly normal appearing caecal tip contained a layer of well-differentiated adipocytes within the submucosa, of similar thickness to the mucosa. There was a clearly demarcated, abrupt transition to a nodular expansion of this adipose tissue within the rest of the caecum, where the entire caecal wall was expanded by the adipocyte infiltrate, from within the submucosa to the muscularis externa and subserosally (Figs 3 and 4). The ileum directly adjacent to the ileocaecal junction was normal. Further orad, the ileum contained low to

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**Fig 1:** The caecum at necropsy, following removal from the abdomen. Note the diffuse undulating lipomatous infiltrate on the serosal surface extending from the base (B) of the caecum towards the apex (A). White asterisk denotes right ventral colon.

**Fig 2:** Cross section of caecal wall towards the caecal apex, demonstrating the transition from normal wall to an extensive lipomatous infiltrate beneath the mucosal surface (arrow). Bar = 10 mm.

**Fig 3:** Photomicrograph highlighting overview of transition zone between the grossly normal appearing caecal tissue (white arrow), to a nodular expansion of adipose tissue in the submucosal layer (black arrow). Black asterisk indicates muscularis externa. White asterisk indicates caecal mucosa. H&E staining x40.
moderate numbers of lymphocytes and plasma cells in the lamina propria (chronic, mild, multifocal lymphoplasmacytic ileitis) and an irregular layer of well differentiated adipocytes within the submucosa, not exceeding the approximate thickness of the mucosa. The large colon contained low to moderate numbers of lymphocytes and eosinophils within the lamina propria and mild multifocal haemorrhage in the mucosal epithelium. There was moderate diffuse submucosal oedema and a mild infiltrate of adipose tissue within the colonic submucosa.

Discussion
This report describes a highly unusual case of caecal lipomatosis, along with some histological evidence of lipomatous infiltrate of both the ileum and the large colon. In the 2 previously reported cases of colonic lipomatosis in horses, architectural distortion of the wall by diverticula, along with the presence of coalescing multinodular masses accounted for the functional and physical intestinal obstruction observed (Henry and Yamini 1995; Riley et al. 2007). Numerous multifocal-to-coalescing, raised and globoid to cauliflower-like fatty accumulations ranging in size from 1 to 30 cm were identified along the antimesenteric border of the transverse and descending colons in those cases, similar to the caecal lesions seen in the present report (Henry and Yamini 1995). It is likely that diverticula and the presence of lipomatous masses resulted in a physical obstruction within the caecum, and subsequent development of colic. Reduced caecal function due to compromise of the muscular and neural structures of the caecal wall and subsequent small intestinal dilatation may have further contributed to the abdominal pain. However, there was no evidence of a caecal impaction indicating that caecal function was not completely impaired.

In man, lipomatosis of the intestine causing an intestinal obstruction is extremely rare and of unknown aetiology (Catania et al. 1995; Shenoy et al. 2003). These infiltrative lesions usually occur in the small intestine or colon and may be associated with diverticulosis (Brouland et al. 2000). Submucosal lipohyperplasia of the ileocaecal valve, although rarely encountered clinically in man, is a reasonably common autopsy finding, where even marked lipohyperplasia has remained subclinical (Tawfik and McGregor 1992). The fatty infiltrate remains asymptomatic until an intestinal obstruction occurs, resulting in abdominal pain (Smith and Fenton 2000). Infiltrative lipomatosis affecting the small intestine has been associated with secondary intussusception and volvulus (Tani et al. 1998; Shenoy et al. 2003). In our case, the lesion immediately adjacent to the ileocaecal junction was grossly normal, and although an irregular layer of well differentiated adipocytes within the submucosa was identified further orad, it is unlikely that this was contributing to the clinical signs seen in this horse.

This gelding did not have a history of chronic or recurrent colic, which is perhaps surprising taking into account the extent of the lesion. This is similar to the clinical presentation in 2 previous reports of colonic lipomatosis (Henry and Yamini 1995; Riley et al. 2007). However, several episodes of mild recurrent colic were observed in the mare with mesojejunal lipomatosis (Linnenkohl et al. 2012). There was also a lack of specific clinical findings in the presurgical evaluation, with clinical signs and findings considered to be consistent with a nonstrangulating intestinal lesion. Our limited specific presurgical ultrasonographic examination was unremarkable, whereas a complete abdominal ultrasonographic examination may have allowed us to identify an abnormal appearance to the caecal base. However, given the lack of abnormal findings on rectal examination, it is unlikely that this would have altered our decision to carry out an exploratory laparotomy on the basis of continued signs of abdominal pain.

Due to the extensive nature of the caecal infiltration in our case, a viable attempt at surgical resolution would have required complete caecal amputation. This would have necessitated repositioning the horse into lateral recumbency and attempting complete amputation through a right-sided approach including rib resection (Huskamp and Kopf 1978). Complete surgical resection of the mass by partial caecal resection would have been impossible to achieve in situ. The option of performing a caecal bypass, by either a jeuno or ileocolostomy was considered. This is usually indicated in horses undergoing surgical treatment for caecal impactions and has a fair overall prognosis (Smith et al. 2010). In the present case, however, the sheer weight of the caecum may have resulted in future episodes of colic due to tension on the dorsal mesenteric attachments, together with the potential for external obstruction of other portions of the gastrointestinal tract, due to continued expansion of the lipomatous tissue. The empty tissue weight of the stomach, small and large intestines is approximately 5% of the horse’s total bodyweight (Meyer et al. 1993). Of this, the caecum and colon collectively account for approximately 64% of the empty weight of the horse’s digestive tract (Meyer et al. 1993). The empty caecum alone weighed 35 kg in this case, whereas the total empty weight of the caecum and colon combined in a horse of this bodyweight should be approximately 17 kg.

From the limited reports in equine literature, it is not possible to determine an age, gender or breed disposition for intestinal lipomatosis. Our case was noted to be within normal weight limits for size and type. Previous equine cases reported one affected 7-year-old Quarter Horse gelding to be in good bodily condition (522 kg), while a 2-year-old Tennessee
Walking Horse mare was slightly thin [Henry and Yamini 1995; Riley et al. 2007]. The case of infiltrative lipomatosis of the mesojejunum was reported in a 25-year-old mare (Linnenkohl et al. 2012). In man, the degree of lipohyperplasia has been correlated statistically with increased patient weight and the degree of pancreatic and cardiac right ventricular fatty infiltration (Tawfik and McGregor 1992). Mesenteric lipomas (often associated with the small intestine and small colon) are more likely to occur in older horses (Blikslager et al. 1992; Edwards and Proudmun 1994; Freeman and Schaeffer 2001), but it is unclear if there is any correlation between the occurrence of lipomas and a higher body condition score (Blikslager et al. 1992). In contrast to this, extra-abdominal infiltrating lipomas of the myocardium (Baker and Kreeger 1987), extensor tendon sheath (Hammer et al. 2002), flank (Lepage et al. 1993), thoracic wall and stifle (Bristol and Fubini 1984), neck (Blackwell 1972; Dunkerley et al. 1997) and back (Rebsamen et al. 2010) have been reported only in horses up to and including age 2 years. Although intestinal lipomatosis has been previously reported in horses involving the ascending colon, the descending colon and the mesojejunum, this is the first report of infiltrative lipomatosis involving the ascending colon, the mesojejunum was reported in a 25-year-old mare (Linnenkohl et al. 2012). The case of infiltrative lipomatosis of the equine mesojejunum. The case of infiltrative lipomatosis of the equine mesojejunum.

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Authors’ declaration of interests

No conflicts of interest have been declared.

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9Abbott Laboratories Ltd, Maidenhead, Berkshire, UK.

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