A 2-year-old Irish Thoroughbred filly presented to a surgical referral hospital 6 hours after it developed an umbilical enterocutaneous fistula. Since birth, the filly had a reducible umbilical hernia that was 1 cm in diameter. The hernia was believed to incorporate omentum only. The owners reduced the hernia daily for the first year and a half of life despite the recommendation for surgical correction during the filly’s examinations as a foal. No episodes of abdominal pain were reported, and no abnormalities were associated with the umbilical hernia. One month before presentation, the filly experienced intermittent episodes of edematous swelling that was localized around the umbilicus, along with one episode of pyrexia, all of which responded to medical therapy. On the day of referral, the filly had developed a large subcutaneous swelling from which digesta drained from breaks in the skin.

**CLINICAL FINDINGS**

At presentation, the filly had a mildly elevated rectal temperature of 102°F (38.9°C) and normal cardiovascular parameters. The patient was alert, responsive, and extremely sensitive to palpation of its ventral abdomen. A 7 × 12 × 6–cm, oval, irregular, tender swelling was present in the region of the umbilicus. The swelling consisted of a digesta-filled, subcutaneous pocket that spontaneously discharged material from two 1 cm–diameter holes of devitalized skin. The digesta was removed from the subcutaneous pocket, and a 1-cm fistula was palpable in the central portion of the umbilicus. A 7 cm–diameter thickened fibrous ring of abdominal wall was palpable around the perimeter of the pocket. A diagnosis of umbilical enterocutaneous fistula was made.

Transabdominal ultrasonography of the umbilicus revealed a 5 cm–diameter section of adhered viscus with a fistulous communication. Normal-appearing colon surrounded the entire adhered intestine, while the spleen was identified approximately 5 cm to the left of the umbilicus. No ultrasonographic evidence of peritonitis was identified. Rectal
evaluation confirmed the presence of viscus adhered to the ventral umbilicus surrounded by the left colon. The results of a complete blood count were normal, whereas a chemistry screen revealed mild elevations in systemic glucose (130 mg/dl; reference range: 65 to 110 mg/dl) and creatine kinase (792 U/L; reference range: 120 to 470 U/L) levels. Serum electrolytes were not measured.

**TREATMENT AND CLINICAL COURSE**

Broad-spectrum antimicrobial therapy, including potassium penicillin (22,000 U/kg IV q6h), gentamicin sulfate (6 mg/kg IV q24h), and metronidazole (20 mg/kg PO q6h), was initiated. NSAID therapy (flunixin meglumine [2.2 mg/kg IV q12h]) was also instituted.

To reduce the volume of digesta within the intestinal tract before surgery, feed was withheld from the filly for 19 hours. The filly was preoperatively sedated with xylazine (0.55 mg/kg IV). Anesthesia was induced with guaifenesin (40 mg/kg IV) and ketamine hydrochloride (2.2 mg/kg IV) and maintained with halothane in a semiclosed circular rebreathing system. The filly was placed in dorsal recumbency, and all digesta was manually removed from the subcutaneous pocket surrounding the umbilicus. The friable nature of the skin overlying the fistula made closure of the fistulous tracts impossible. The subcutaneous space was thoroughly lavaged with water, disinfected with 2% chlorhexidine, and aseptically packed with sterile laparotomy sponges. The ventral midline was then aseptically prepared and draped for celiotomy.

A sterile laparotomy sponge was secured over the packed subcutaneous pocket with towel clamps, and a 15-cm elliptical incision was made through the skin, starting cranially on the ventral midline, coursing laterally to the hernial sac, and ending on the caudoventral midline. The incision was continued down to the ventral midline and rectus abdominis fascia. To ensure en bloc resection of the fistula, an elliptical incision of the abdominal wall was also made around the periphery of the hernial sac; the linea alba was incised cranially and caudally to the fistula and continuously, with paramedian incisions along both sides. A 5 cm–diameter adhesion involving the umbilicus, omentum, and a parietal (Richter’s) hernia of the distal jejunum was identified when the peritoneal cavity was entered. The hernial sac, umbilicus, and omentum as well as a 42-cm section of distal jejunum were entirely resected without gross contamination. A hand-sewn, end-to-end jejunoileostomy was performed with 2-0 polyglactin 910 in a single-layer Gambee pattern.

Because of the large amount of abdominal wall that required resection, the rectus abdominis could not be closed by conventional procedures. The abdominal wall was primarily closed in a single layer using 18-gauge, stainless-steel wire in an interrupted, horizontal matthess, full-thickness suture pattern as previously described. Hard-rubber, 5⁄8-inch tubing (i.e., standard automotive heater hosing) was used as a stent to prevent the wire from cutting through the skin. All sutures were preplaced and the wires tightened by twisting the ends using a pair of sterilized pliers (Figure 1). The filly recovered uneventfully from anesthesia, and a sterile abdominal bandage was applied as soon as the patient was standing.

After surgery, the filly was intravenously administered a balanced crystalloid solution at a rate that maintained basic fluid requirements for 72 hours. Lidocaine was administered as a prokinetic agent and for the suppression of inhibitory reflexes associated with inflammation; an initial bolus (1.3 mg/kg IV) was given immediately

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**Figure 1.** Intraoperative image of the full-thickness, abdominal wall closure using stainless-steel wires and hard-rubber stents. Cranial is to the left.

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**Key Points**

- An enterocutaneous fistula developed in an Irish Thoroughbred filly that had a small, reducible, umbilical hernia for 2 years.
- A primary, full-thickness, body-wall closure was successfully accomplished using stainless-steel wire and rubber stents.

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after surgery, followed by continuous infusion (0.005 mg/kg/min IV) for 24 hours.2 The antibiotic and anti-inflammatory therapies were maintained as already described. Administration of metronidazole, flunixin meglumine, gentamicin sulfate, and potassium penicillin was discontinued on postoperative days 2, 3, 4, and 5, respectively. On the sixth postoperative day, the filly began receiving trimethoprim–sulfamethoxazole (30 mg/kg PO q12h for 2 weeks).

As expected, pressure necrosis and drainage associated with tracts from the sutures developed and resolved after the sutures were removed. The abdominal incision was treated locally with irrigation, cleaning, and topical application of a neomycin, polymyxin B, and bacitracin ointment when the bandage was changed. The abdominal bandage was changed every 2 to 3 days during the first 2 weeks (Figure 2) and then once per week for the following 4 weeks. Alternate sutures were removed at days 17 and 28 (Figure 3), and the abdominal bandage was discontinued 6½ weeks after surgery. The filly experienced no postoperative complications. The only incisional drainage observed was related to the exposed rectus abdominis muscle, whereas suture-related drainage was associated with tract formation and pressure necrosis of the skin. Peritoneal drainage from the incision was never observed. The filly was allowed restricted turnout 2 months after surgery, followed by full turnout the subsequent month. Nine months after surgery, the filly was in full training as a show jumper with no incisional complications.

DISCUSSION

The reported frequency of umbilical hernias in foals is 0.5% to 2%.3,4 Many of these hernias are reducible and resolve with maturation. Complications associated with umbilical hernias are considered low and include abscess formation, intestinal incarceration, intestinal strangulation, and enterocutaneous fistulation.3–8 Enterocutaneous fistula formation can occur spontaneously, traumatically, or iatrogenically.4,5,8–12 Spontaneous enterocutaneous fistulas frequently develop from chronic strangulation of a Richter’s umbilical hernia, as occurred in this case. Strangulated umbilical hernia can develop in horses of any age. However, in one study,4 this hernia was most frequently observed when horses were 12 months of age or younger. In another study8 of enterocutaneous fistulas, 61% of horses were yearlings or younger, whereas 39% were 2 or 3 years of age. The case reported here represents the less common presentation of enterocutaneous fistula formation in adult horses.

The clinical signs associated with enterocutaneous fistula include colic, severe hypovolemia, acidemia, sepsis, and localized umbilical discomfort, whereas some horses exhibit no clinical signs. A significant consequence of enterocutaneous fistula is large fluid losses from escaping intestinal contents that can produce
severe electrolyte and acid–base imbalances. This consequence depends on the size and duration of the fistula in addition to the segment of bowel involved. Enterocutaneous fistulas have reportedly involved the jejunum, ileum, and large colon.\textsuperscript{4,5,8–11} Horses developing large colon fistulas have few metabolic disturbances and appear to tolerate the condition well.\textsuperscript{4,5,8–11} Conversely, fistulas involving the proximal bowel, particularly the ileum, have been associated with severe acidemia and dehydration, presumably due to the high output of alkaline intestinal contents.\textsuperscript{5,8} These patients frequently present with clinical signs of hypovolemia and shock. The filly in this case developed a localized septic umbilicus that was associated with a small enterocutaneous fistula involving the distal jejunum. The metabolically stable presentation of the patient was likely due to the small size of the fistula, the low volume of fluid loss, and prompt attention.

Full-thickness, abdominal wall closure in horses was first described by Tulleners and Donawick\textsuperscript{1} in 10 cases of infected abdominal incisions. In those cases, stainless-steel sutures were used for secondary closure of incisions 3 to 210 days after initial surgery. To our knowledge, the filly in the case discussed here is the first in which full-thickness sutures have been used for primary closure of the abdominal wall in a noninfected incision. Mesh herniorrhaphy was considered for abdominal closure in this case; however, its use was precluded by contamination of the incision, the risk for adhesion formation, and the inability to place the mesh in a retroperitoneal or subfascial space to minimize serosal abrasions.\textsuperscript{13} In addition, it was believed that an insufficient amount of skin would be available after resection to appropriately cover the mesh implant. Stainless-steel sutures provide the greatest tensile strength of all suture materials and maintain their strength when implanted.\textsuperscript{14} Twisted wire also offers the advantage of postoperative adjustments in tension, if needed.\textsuperscript{1} In the case presented here, stainless-steel sutures provided excellent abdominal closure in the presence of significant tensile stresses originating from a large body-wall defect.

The case presented here reinforces the need for careful evaluation of umbilical hernias beyond the weaning age. Herniorrhaphy is highly recommended in treating reducible umbilical hernias that are 5 cm or more in diameter and do not resolve by the time the horse is 6 to 12 months of age.\textsuperscript{3,6,7} Kawcak and Stashak\textsuperscript{15} recommended surgical intervention for hernias that are 3 cm or more in diameter. Herniorrhaphy is absolutely essential for hernias that are nonreducible, greater than 5 cm in diameter, or complicated by intestinal incarceration, strangulation, or infection.\textsuperscript{3,6,7,15} Untreated reducible umbilical hernias can develop into more severe complications, such as an enterocutaneous fistula, even several years later. Although some enterocutaneous fistulas can resolve with medical therapy alone, they frequently require surgical repair, particularly when a patient has metabolic abnormalities.\textsuperscript{7} The case presented here illustrates the successful surgical treatment of an enterocutaneous fistula and primary, full-thickness closure of a large body-wall defect using stainless-steel sutures.

**ACKNOWLEDGMENTS**

The authors thank Drs. Mary Beth Hamorski and Shari Silberman at Califon Animal Hospital in Califon, New Jersey, for their referral.

**REFERENCES**


