Ileal Impaction in Horses*

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Acute abdominal pain in horses is often caused by abnormal conditions of the small intestine. Simple obstruction, strangulating obstruction, and nonstrangulating obstruction are the general categories of small intestinal disorders that require surgical intervention. Ileal impaction is the most frequently reported cause of small intestinal, nonstrangulating obstruction in adult horses. The condition accounted for 0.5% to 9.3% of total colic cases reported in several surveys, retrospective studies, and individual case reports. In a retrospective report involving surgical diseases of the ileum, ileal impaction accounted for more than 41% of the cases.

ANATOMY

The ileum originates in an aboral direction to the jejunum in the left flank, crosses to the right abdominal quadrant at the level of the third to fourth lumbar vertebrae, and then passes upward to the lesser curvature of the base of the cecum, where it ends at the ileal orifice into the cecum (Figure 1). The ileocecal junction is situated in the right dorsal quadrant of the abdomen, and it is relatively immobile because of the short mesenteric attachments to the cecum and right dorsal colon. The antimesenteric border of the ileum is attached to the dorsal taenia band of the cecum by the ileocecal fold. In adult horses, this fold terminates approximately one meter from the cecum. The ileal orifice is partially inverted into the cecum, which places the orifice in the center of a slight elevation formed by an annular fold of mucous membrane that contains a network of veins. This network together with the muscle coat of the ileum serve as a functional ileal sphincter. The blood supply to the ileum is provided by the ileocolic artery. This artery courses along the terminal portion of the ileum in a retrograde fashion and unites with the terminal jejunal artery. Because of the lack of distinguishing features between the jejunum and ileum, the point of transition from the typical arborization of the jejunal artery to the ileocolic artery is usually considered the start of the ileum. When the ileum is relaxed, it is difficult to distinguish from the jejunum. In contrast, when the ileum is

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contracted it is easily distinguished from the jejunum by its thicker muscular wall and narrower lumen.

**MOTILITY AND DIGESTIVE FUNCTION**

Experimental studies of cannulated isolated loops of the ileum in horses indicated that bidirectional movement of water occurred in the ileum when there was little or no intraluminal pressure. An increase of 25 mm Hg in intraluminal pressure decreases ileal contractions and slows the absorption and secretion of water. Intraluminal pressure has the greatest effect on water absorption. Although the movement of sodium, potassium, bicarbonate, and chloride is minimal in the ileum, an increase in intraluminal pressure decreases the bidirectional movement of water and causes a net secretion of sodium and potassium.

The ileum is highly resistant to changes in intraluminal osmolality, even when challenged with media having one-half or two times the osmolality of a buffered, isotonic solution. Although absorption of water is prevented by increased intraluminal pressure, secretion of water continues. Horses recovering from ileal dysfunction should, therefore, be given water or a low-osmolar solution to drink to maintain intestinal motility, aid absorption, and discourage sequestration of water.

Liquid digesta is rapidly propelled through the ileum into the cecal base, conducted to the cecal apex (where it is mixed with cecal contents), and then transported into the right ventral colon. The myoelectric activity of the ileum has been studied in weanling ponies, and all phases of the migrating myoelectric complex and the migration action potential complex (MAPC) were identified. The MAPC is a prominent myoelectric complex and is a normal event in the equine ileum. The MAPC has not been identified in the jejunum of horses. These motility patterns are stimulated by the presence of liquid digesta and are responsible for the aboral transport of the digesta. Data suggest that the MAPC rather than other migrating myoelectric complexes of the ileum may be responsible for the transit of digesta through the ileum into the cecum and is the only ileal event related to cecal motility patterns.

Although the cranial and caudal cecal bases are capable of generating independent retrograde (base-to-apex) spiking activity, this activity may also be initiated in part by the MAPC of the ileum. Ileal and cecal filling may, therefore, be more important in the regulation of ileocecal motility events than the neural or endocrine stimuli associated with eating. Because the progressive myoelectric activity from the cecum to the right ventral colon is initiated by an electrical pacemaker near the cecal apex, surgically removing or bypassing the ileum does not adversely affect the motility of the large intestine. Bypassing the ileocecal valve, however, disrupts the normal MAPC progression from the ileum to the cecum and right ventral colon and may allow bacterial overgrowth in the small intestine. Bacterial overgrowth in the small intestine can result in mucosal cell damage; therefore, the ileocecal orifice should be preserved if possible.

An overall decrease in ileal migrating myoelectric complex spike activity and an increase in the MAPC frequency occur when *Strongylus vulgaris* larvae penetrate the ileal mucosa and migrate in the submucosa. This resultant increase in MAPC frequency indicates that a relationship may exist between *S. vulgaris* larval infection and spasmodic colic in horses. Most or all of the ileal smooth muscle responses to live, third-stage (L3) larvae may not be due to larval penetration and migration into the wall of the ileum but may be due to elaboration of various larval antigens. Questions concerning mucosal receptor re-
Ileal impactions are most common in the southeastern United States\textsuperscript{5,9,10} and Europe.\textsuperscript{9} Although the cause of ileal impactions is unknown, feeding horses hay with a high-fiber content has been associated with ileal impaction in the United States.\textsuperscript{2,10,11,30}

Coastal Bermuda grass hay, which is commonly fed in the southeastern United States, is often dry, fine, and stemmy. The lignin and crude fiber content of coastal Bermuda grass increases markedly as pastures mature (as seen in tall stands or late-summer cuttings).\textsuperscript{30,31}

When the mature grass is cut and fed as hay, the increase fiber content of such hay can predispose horses to impaction colic when associated with weather changes that limit water consumption.\textsuperscript{11}

This condition for impaction is further aggravated by a combination of heat and stress, limited consumption of digestible roughage, ingestion of pelleted feeds, and limited twice-daily feeding schedules.\textsuperscript{32}

Ileal impaction was documented in four horses within four weeks of changing the hay ration to coastal Bermuda grass.\textsuperscript{2} Incidence of ileal impaction is low in areas of the United States where legume or other hay combinations are the primary sources of roughage. In contrast, ileal impactions reported in Europe were not associated with high-fiber roughage but were primarily idiopathic in nature and had been associated with vascular thrombotic disease.\textsuperscript{5}

Other causes of ileal obstruction include mesenteric vascular thrombotic disease,\textsuperscript{2,4,10,12} ileocecal intussusception associated with \textit{A. perfoliata} infection,\textsuperscript{19} ileal hypertrophy of the mucosa and muscularis,\textsuperscript{2,5,9,33-35} hernias involving the body wall, internal hernias involving mesenteric rents or the epiploic foramen, incarcerated scrotal-inguinal hernias,\textsuperscript{16} and intraabdominal adhesions.\textsuperscript{9} Although rare and difficult to document, impactions associated with mesenteric vascular thrombotic disease are believed to be caused by intestinal dysfunction due to ischemia.\textsuperscript{4} In affected horses, the arterial lesions most often occur in the ileoceocolic branch of the cranial mesenteric artery.\textsuperscript{4,36}

Tapeworms cause edema, ulceration, and formation of granulation tissue at the site of scolex attachment to the mucosa.\textsuperscript{21,37} Tapeworms normally attach to the ileocecal orifice where the diameter of the bowel wall abruptly changes.\textsuperscript{21}

Heavy tapeworm infections\textsuperscript{19} may obstruct the ileocecal orifice and cause fatal colic.\textsuperscript{22}

Hypertrophy of the muscular layer of the ileum results in luminal narrowing and partial obstruction. Muscular hypertrophy occurs in two forms: idiopathic (primary) and compensatory (secondary). With idiopathic muscular hypertrophy, there is no detectable stenosis of the distal intestine to cause hypertrophy of the proximal intestinal muscularis. With compensatory muscular hypertrophy, the muscular layer
of the small intestine hypertrophies in response to chronic distal intestinal stenosis.

The hypertrophied muscle narrows the intestinal lumen, causing partial obstruction and distension of the intestine proximal to the obstruction, all of which result in abdominal pain. Partial anorexia and chronic weight loss of one to six months in duration are common findings in patient histories. Exploratory celiotomy is the only definitive method for diagnosing ileal muscular hypertrophy as a cause of colic. Full-thickness rupture of the ileum with subsequent diffuse septic peritonitis has been reported in horses that have idiopathic muscular hypertrophy.

Trauma to the body wall can result in abdominal-wall hernias in which an ileal impaction can develop subcutaneously. Ileal impactions associated with internal hernias, scrotal-inguinal hernias, and adhesions are usually complicated by the incarceration of small intestine, which requires resection.

**CLINICAL FINDINGS AND DIAGNOSIS**

The initial abdominal pain caused by ileal impaction is due to distention of the small intestine and spasm at the site of impaction. Because fluid loss is minimal, there are few systemic effects during this stage of impaction development. The pain becomes more severe as the intestine proximal to the impaction distends with gas and fluid. On rectal examination, distention of the small intestine is a consistent finding, and the impacted ileum can occasionally be identified if the examination is performed early in the course of the disease.

An increased heart rate (> 60 beats/min), nasogastric reflux, and decreased intestinal sounds are usually present. The packed cell volume, plasma protein, serum albumin gap, and protein concentration in the peritoneal fluid are usually increased. In contrast, the white blood cell count; serum urea nitrogen; and peritoneal fluid white blood cell count as well as sodium, potassium, and chloride levels, are normal. Mild metabolic acidosis is usually present. Significant differences in serum albumin gap and plasma protein concentration have been reported between survivors and nonsurvivors of ileal impaction; values for nonsurvivors are higher. Sequestration of fluids in the intestinal tract can eventually result in hypovolemic shock.

These clinical findings, although they can vary with individual cases, are indicative of a nonstrangulating obstruction of the small intestine. Gastric reflex on nasogastric intubation and the presence of small intestinal distention on rectal examination are consistent with small intestine obstruction or proximal enteritis, although other diseases, such as impaction or torsion of the large colon, can infrequently cause these findings. Peritoneal fluid analysis can usually differentiate simple obstruction from strangulating obstruction of the small intestine. Abnormal findings in the peritoneal fluid appear earlier with strangulating obstruction than with simple obstruction.

Useful indicators to distinguish horses that require surgical intervention for ileal impaction from those that do not are the persistence of abdominal pain after nasogastric decompression and the presence of a very turgid small intestine on rectal examination. The impaction may be palpated medial to the cecum on rectal examination early in the course of the disease (Figure 2); however, this finding was identified in only 18 of 75 and in 0 of 12 cases in two retrospective studies. Small intestinal distention continues as the disease progresses, and the ileal impaction usually is obscured.
TREATMENT

Accurate, early diagnosis can facilitate successful medical treatment of horses with ileal impactions. Medical treatments include intravenous fluid therapy, analgesics, intestinal lubricants, and intestinal stimulants. Although intestinal stimulants have been suggested as possible treatments, they should be used with caution in prolonged ileal impactions because mucosal necrosis, perforation, and secondary gastric rupture can occur. Early recognition of the failure to respond to medical management and of the need for surgical intervention is paramount to successful treatment of ileal impaction.

Surgical intervention is generally indicated if rectal palpation over time reveals persistent impaction of the ileum and distention of the small intestine rather than a softening of the impaction. Retrospective studies have demonstrated that the mean duration of clinical signs before surgery ranges from 13 to 17 hours for survivors and 18 to 25 hours for nonsurvivors. Delays in surgical intervention result in a decrease in survival rate because of continuing deterioration of circulatory function and progressive intestinal distention.

Manual reduction, enterotomy, intestinal resection, jejunocoeostomy, and other anastomoses have been performed in the treatment of horses with ileal impaction. Although some researchers recommend an intestinal bypass procedure, more recent retrospective studies support extraluminal massage of the impaction and manual emptying of the ileal contents into the cecum. If necessary, the mass can be softened by intraluminal injection of saline. An increase in postoperative morbidity and mortality for ileal impactions has been associated with intestinal resection or jejunocoeostomy.

Intestinal resection should be reserved for horses with small intestinal obstruction compounded by intestinal ischemia. In these cases, intestinal resection and anastomosis are mandatory for survival. Although there was no significant difference in the incidence of intraabdominal adhesions between horses that had intestinal resection or bypass and those that did not, fewer than 20% of horses with clinically significant postoperative adhesions survived. Horses that remained asymptomatic for more than 60 days after small intestine surgery were less likely to develop complications associated with intraabdominal adhesions.

Ileal impactions have been previously associated with muscular hypertrophy of the ileum and ileal dysfunction. As a result, jejunocoeostomies were routinely performed to prevent reimpaction. Jejunocoeostomy has been abandoned except in cases in which ileal ischemia or hypertrophy of the muscular layers is suspected.

If muscular hypertrophy of the ileum is present with associated ileal dysfunction, a bypass procedure should be considered to prevent recurrence of the impaction. If necrosis or evidence of infarction is not present and is unlikely to develop, however, a bypass between the distal jejunum and cecum (without ileal resection) should be created. This bypass ensures passage of ingesta and preserves the original anatomic conformation. Although feed material may still attempt to pass through the ileum and potentially cause abdominal pain, clinical case report surveys suggest that postoperative morbidity and mortality are lower after this procedure than if resection and anastomosis are performed.

Studies have reported that 55%, 39%, and 64% of horses in which ileal impaction was diagnosed by exploratory celiotomy survived long-term (i.e., five months to six years). Reasons for death or euthanasia include ileus, shock, gastric rupture, intestinal adhesions, jejunal incarceraion, impaction, and/or peritonitis. Most of these conditions (and corresponding increases in mortality) were due to complications associated with the intestinal resection or bypass procedure. Reimpaction of the ileum following manual reduction has not been reported. Although ileus is a common complication of abdominal surgery, there was no difference in the rate of occurrence of postoperative ileus between survivors and nonsurvivors.

SUMMARY

Successful medical therapy of horses with ileal impaction can be facilitated by an accurate, early diagnosis of the disease. Early surgical intervention is generally indicated, however, if rectal palpation reveals persistent distention of the small intestine rather than progressively smaller impaction of the ileum. As the time from disease onset to surgical intervention increases, the continuing deterioration of circulatory status and progressive intestinal distention become the primary reasons for the decrease in survival rate. Manual reduction of ileal impaction produces fewer postoperative complications and greater long-term survival than enterotomies or intestinal bypass procedures. In horses with inadequate patency of the ileal lumen and/or intestinal ischemia or necrosis, the surgeon should not hesitate to perform an intestinal resection and/or jejunocoeostomy. These procedures are, however, associated with increased morbidity and mortality.

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REFERENCES


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1. Impaction accounts for what percentage of cases that involve surgery of the ileum in horses?
   a. more than 5
   b. 20 to 25
   c. 40 to 45
   d. 60 to 65

2. The ileocecal fold attaches the antimesenteric border of the ileum to which taenia band of the cecum?
   a. dorsal
   b. medial
   c. lateral
   d. ventral

3. The ileum has a thicker muscular wall and narrower lumen than the jejunum. This difference is most conspicuous when the ileum is
   a. impacted.
   b. contracted.
   c. relaxed.
   d. distended with gas.

4. Which of the following parasites has been reported to be associated with ileal impactions and is found near the ileocecal junction?
   a. *Strongylus vulgaris*
   b. *Anoplocephala perfoliata*
   c. *Oxyuris equi*
   d. *Dictyocaulus arnfieldi*

5. Ileal impaction is most commonly seen in which region of the United States?
   a. Northwest
   b. Southwest
   c. Northeast
   d. Southeast

6. What type of hay diet is most commonly associated with ileal impaction?
   a. alfalfa
   b. coastal Bermuda grass
   c. timothy
   d. none of the above

7. The surgical treatment of choice for ileal impaction when no hypertrophy or ischemia of the intestine is evident is
   a. enterotomy.
   b. ileal resection.
   c. side-to-side jejunocecostomy.
   d. manual reduction only.

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