

colon, may aid in breaking up impacted material. The administration of neostigmine may also cause increased pain and risk of rupture of compromised bowel.

Surgical intervention for correction of colonic impactions should be considered when medical therapy becomes prolonged or when the horse exhibits signs of uncontrollable abdominal pain, shock, peritonitis, or evidence of intestinal degeneration characterized by changes in the peritoneal fluid. Successful outcomes can still result after several days of medical therapy, provided that there is no irreversible deterioration present within the colon. The risk of colonic rupture should be considered and conveyed to the owners when surgery is contemplated as treatment for colon impaction. In the study of 147 horses, 24 (16.3%) with colonic impactions underwent surgery after medical treatment was unsuccessful. Out of the 24 horses 5 (20.8%) were euthanized after transmural tearing of the right dorsal colon occurred during attempts to exteriorize the colon.

A large ventral midline incision (40–50 cm) is necessary to aid in exteriorizing the colon. The impaction should be carefully palpated intra-abdominally before it is exteriorized to assess the colon for devitalized tissues which could rupture with manipulation. Moderate impactions involving relatively small amounts of ingesta can be softened with water and infused directly into the center of the impaction. Evacuation of the colon through a pelvic flexure colotomy may be necessary before attempts are made to manipulate the heavier segments of the colon. Filling of the abdominal cavity with sterile lactated Ringer's solution can assist in lifting heavy, diseased portions of the colons in extreme situations where necessary manipulation would result in rupture of the colon. Closure of the pelvic flexure colotomy with synthetic absorbable 1-0 suture in a two-layer closure consisting of a full thickness simple continuous pattern oversewn with a Cushing pattern, produces good anatomical alignment and healing.

## OUTCOME

The prognosis for most horses with colonic impactions that receive treatment is excellent. In one study the short term survival rate for horses requiring advanced medical or surgical treatment was 95 per cent. Horses that require surgery have a significantly higher fatality rate, attributable to deterioration of the colon. In the group of 147 affected horses, mean heart rate, respiratory rate, peripheral white blood cell, blood lactate concentration, and protein concentration in the peritoneal fluid were significantly higher in non-survivors than in survivors. Cardiovascular parameters were the most accurate indices in predicting survival. The most com-

mon non-life-threatening complications for the treatment of colon impactions were jugular vein thrombosis and diarrhea.

Long term survival for horses 1 year after hospitalization and treatment for colonic impactions was 58 per cent for horses that underwent surgery and 95 per cent for horses that responded to medical therapy alone. All of the medically treated horses returned to their previous performance activity. Twenty five (30 per cent) of those treated medically had at least one episode of colic after discharge. Four of these horses died. Eight of nineteen (38%) horses requiring surgery for large colon impaction had recurrent episodes of colic and seven of these horses died. The additional colic episodes may have been the result of a dysfunctional colon which was responsible for the original impaction. Alternatively, intestinal damage caused by the impaction may have resulted in permanent colon damage and adhesions that predisposed the horse to further colic episodes.

## PREVENTION

Horses that have a change in feed, activity, or are being treated for some musculoskeletal conditions are at higher risk for the development of colonic impaction. The incidence of recurrence of colonic impaction in these horses is also higher than the incidence of colonic impaction in the normal population. Careful attention to changes in management practices and feeding of a good quality high fiber diet with adequate exercise should be followed to prevent the development or recurrence of this condition.

## Sand impaction

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## INTRODUCTION

Horses may ingest sand either by eating from the ground in sandy locations, or because of its inclusion in hay. In certain areas sand impaction is relatively common. Horses with insufficient pasture or too little roughage in their diets are more prone to accrue sand, gravel, and/or bluestone shale while scavenging. Horses with sand impaction are more difficult to treat than horses with feed impaction and surgical intervention is required more often.

Sand impaction occurs most frequently at the pelvic flexure and the terminal aspect of the right dorsal colon.

Ingested sand may cause foreign body enteritis or it may accumulate in the ventral colon, pelvic flexure, and/or transverse colon causing impaction. The inflammatory response, associated with accumulation of a sufficient volume of sand, can result in colonic rupture.

## EPIDEMIOLOGY

Sandy environments such as those found in Florida, California, and Arizona, are common locations for horses with this disorder. Young horses and horses with indiscriminate eating habits occasionally consume sand voluntarily, making them more prone to developing the condition.

## ETIOLOGY

Horses stabled in a sandy environment and fed from the ground appear to be at risk. Offending sand is generally fine beach sand or clay, but gravel or bluestone shale can occasionally be found. Sand is also found in the feces of clinically normal horses.

## CLINICAL SIGNS

Clinical signs range from mild to severe pain and normal to deteriorating cardiovascular status. Most horses with clinical signs of sand colic are older than 1 year of age. Sand impactions of the ventral colon may be substantial (25 kg); however, they are often difficult to palpate transrectally because of their location in the cranial portion of the gastrointestinal tract and hence may be out of reach. Cecal and large colon gas distention is inevitably present. Horses with this condition may have small amounts of diarrhea and clinical signs of endotoxemia.

Abdominal paracentesis should be conducted cautiously since the sand-impacted colon can be inadvertently lacerated. An abdominal paracentesis should not be performed in horses that clearly require surgical intervention or in horses in which the procedure may be of low diagnostic value. Sand present within an enterocentesis is pathognomonic for the disease. Auscultation of the ventral abdomen of horses with sand impaction may reveal 'friction-like' rub sounds compatible with sand borborygmi.

## DIAGNOSIS

Sand impaction can be difficult to differentiate from feed impaction, and tests for fecal sand do not correlate

well with the presence of sand in the colon. History or observation of sand in the feces only indicates exposure to sand. Sand may be detected during transrectal palpation or it may be found on the rectal sleeve. Dissolving feces in water and observing for sand in the bottom of a bucket or on a rectal sleeve may provide evidence of the possibility of sand impaction. Although small amounts of sand are frequently found in feces and do not necessarily reflect sand impaction, large amounts of sand are more indicative of sand accumulation. Comparison of the normal discharge of sand in normal horses from that of the diseased horse may assist in the diagnosis of sand impaction.

Ultrasonographic examination of the ventral abdomen along the midline caudal to the xiphoid process with a 5-MHz ultrasound probe may reveal the presence of sand in the ventral colon, appearing as floating starburst spicules as the sand is suspended in the ingesta. Abdominal radiographs, if available, can aid in the diagnosis of sand impaction.

## TREATMENT

Psyllium mucilloid (0.5–1.0 g/kg p.o. q. 6–24 h) has been implemented to lubricate the gastrointestinal tract and assist in the movement of sand out of the body. A solution of psyllium mucilloid and 4–8 liters of water must be pumped rapidly into the stomach via a nasogastric tube before the psyllium mucilloid forms a gel. The treatment is maintained for several days to a week depending on the severity of the case. The feces should be monitored for the rate of expulsion of the sand. Psyllium, however, had no effect in hastening sand evacuation from the large intestine in a controlled experimental study in six normal ponies. Further studies on the effect of psyllium in the diseased colon are needed.

Intravenous fluid therapy may be necessary in horses that do not respond to initial treatment with analgesics and laxatives. Intravenous fluid administration may increase the water content of the impacted ingesta in horses by raising the capillary hydrostatic pressure and decreasing plasma protein concentration. The recommended administration rate for intravenous fluids is 2–5 l/h or 2.5 times the maintenance rate.

Horses with sand impactions often do not respond to medical treatment alone and require surgical intervention. In many horses surgical exploration must be undertaken without an accurate pre-operative diagnosis, because of abdominal pain, large colon distention, and deteriorating cardiovascular signs. Sand impactions most commonly involve the pelvic flexure and/or the right dorsal colon. A colotomy along the pelvic flexure

allows for tap water lavage and drainage of colonic ingesta and sand. To prevent abdominal contamination it is important to deliver most of the large colons from the abdomen before beginning the colotomy. It can be difficult to remove excessive sand present in the right dorsal colon through a pelvic flexure colotomy. However, the use of a large bore nasogastric tube inserted into the colon lumen from the pelvic flexure colotomy to the right dorsal colon can aid in the removal of the sand. Copious lavage of the right dorsal colon, with manipulation of the colon to suspend the sand in the lavage, is needed to adequately dissipate the sand. Judicious technique eliminates the need for multiple colotomies which prolong the surgery and complicate the recovery period. Septic peritonitis can be minimized by using aseptic technique, atraumatic handling of the intestines, and appropriate supportive care.

Sand impaction of the pelvic flexure may act as a pendulum, predisposing the horse to volvulus of the colon. Cranial displacement of the pelvic flexure and non-strangulating and strangulating colonic displacements are associated with this condition. Postoperative complications include the recurrence of the disease, septic peritonitis, diarrhea, and incisional dehiscence.

## OUTCOME

The mortality rate is higher with sand impactions than ingesta impactions of the large colon. In recent studies, 44 of 48, and 30 of 40 horses with sand impaction were discharged from the hospital, and at 12 months following discharge 38 of 48 horses and 24 of 40 horses were alive. If the sand can be completely removed from the colon without unnecessary contamination, the prognosis for horses with sand impaction is no worse than for those horses with ingesta impaction.

## PREVENTION

Minimizing exposure to sand is important in preventing recurrence. This requires that horses eat their feed raised off the ground (in a manger or in buckets) or separated from sand (on rubber mats or in feeding troughs). Hay containing sand should not be a part of the horses' diet. Feeding hay free of sand prior to pasture turnout lessens the horse's desire for aggressive grazing and their exposure to sand.

Intermittent administration of psyllium mucilloid for several weeks may be indicated to remove accumulated sand. Longer term administration often results in an increased rate of degradation of the mucilloid by colonic microbes and a decrease in the laxative effect.

Administration of a moist bran mash containing 450 g of psyllium mucilloid, once a week, is a useful prophylactic measure to prevent the occurrence of sand impaction colic in horses exposed to sand.

