Pathophysiology of large intestinal displacements
Displacement of the large, or ascending, colon is defined by the abnormal position of the large bowel in the abdominal cavity. A predisposing factor for this displacement is the normal anatomy of the equine gastrointestinal organs. The large colon of the horse is only affixed to the body wall at the junction of the right dorsal and transverse colon, and to the cecum by the cecocolic fold. Therefore the majority of this section of intestine can move freely about the abdomen. A displaced colon may be found in a number of different positions at surgery, and four typical presentations for a displacement have been described: 1) retroflexion of the pelvic flexure towards the diaphragm, 2) left dorsal displacement where the colon is positioned lateral to the spleen, or trapped over the nephrosplenic ligament (nephrosplenic entrapment), 3) right dorsal displacement where the colon lies between the cecum and body wall, and 4) a non-strangulating volvulus of <180 degrees. Although displacements are not technically described as a strangulating lesion, they may cause intestinal compromise if significant bowel distention occludes venous outflow, or if the colon continues to twist into volvulus of >180 degrees.

While the lack of anatomic attachment to the abdominal wall allows the colon to displace, the cause of this type of colic is still unknown. One theory is that gas distention may cause the colon to become lighter than the surrounding viscera and alter gastrointestinal motility, resulting in movement of the colon out of its normal position. One cause of gas production includes the fermentation of carbohydrates in the colon that are allowed to pass through the small intestine undigested. Carbohydrate loads that reach the large intestine may be secondary to a sudden change in diet or a large meal of carbohydrates (>0.4% of body weight) that does not allow for adequate production of pancreatic amylase. The result is fermentation by lactic acid-producing bacteria, luminal acidosis and gas production. A second cause of displacement may be due to changes in microbial flora of the colon secondary to oral antibiotics, resulting in a similar pathologic overgrowth of acid-producing bacteria. Gas distention may also result secondary to obstruction caused by impactions or foreign bodies, such as enteroliths or sand, both of which may complicate the treatment of a simple colon displacement. For right dorsal displacements, specifically, it has been proposed that aberrant gastrointestinal motility patterns at the pelvic flexure are involved. Finally, medications or disease that directly impact gastrointestinal motility, including anticholinesterase medications (atropine), can alter the normal flow of ingesta, and predispose to displacement.

Clinical findings and diagnosis
Large colon displacement can present with variable signs of abdominal pain, depending on the degree of obstruction of the intestinal lumen that the displacement causes. While it is typically an acute disease, the owners in some cases may have noted intermittent discomfort in the days prior to presentation. Abdominal distention is commonly observed, and fecal production is reduced to absent. Horses with displacements may produce net nasogastric reflux, which may confound the diagnosis; the cause of reflux is suspected to be secondary to ileus, compression of the duodenal outflow tract, or tension on the duodenocolic ligament.

On rectal palpation, a tight band is often noted if the colon is within reach, and gas distention or a concurrent impaction may be palpated within the colon. If the band courses over the nephrosplenic ligament, between the caudal pole of the left kidney and the head of the spleen, the diagnosis of a nephrosplenic entrapment can be made. If the band traverses horizontally, between the cecum and body wall, a right dorsal displacement should be suspected. Characteristic rectal exam findings may not be present if the pelvic flexure is retroflexed, and horses with this type of displacement will be described as feeling “empty” when palpating in the caudal abdomen. However, it is important to note that false positives are common when diagnosing displacements by rectal examination; about 20% horses are incorrectly diagnosed with a displacement. Differentials to consider for rectal findings consistent with displacement include cecal impaction, cecal or colon tympany, simple large colon impaction, enteroliths, or large colon volvulus.

Advanced diagnostics to consider should include transabdominal ultrasound for both right and left dorsal displacement. Left dorsal displacement has been described as a gas shadowing of the dorsal border of the spleen, ventral displacement of the spleen, presence of the colon lateral to the spleen, or failure to identify the left kidney medial to the spleen when imaged through the flank in a lateral plane. Sensitivity of ultrasonography for identification of left dorsal displacement is around 89%. Right dorsal displacement may also be identified on ultrasound, but has a lower sensitivity, between 56% and 67%. A tentative diagnosis of right dorsal displacement may be made by identification of the vessels that normally lie on the medial surface of the colon incorrectly positioned against the right lateral body wall. If the colon is malpositioned, these vessels can be located by ultrasound between intercostal spaces 10 to 16, and dorsal to the costochondral junction. The vessels of the colon should be differentiated from the cecal vessels, that are normally located by ultrasound in the right flank.
Bloodwork is not necessarily required for diagnosis, but may be helpful for identification of electrolyte abnormalities and hypovolemia that may affect choice of treatment. On serum chemistries, right dorsal displacements have commonly been described to have a distinctive increase in gamma glutamyltransferase activity (GGT), due to compression and obstruction of the bile duct. These changes in serum chemistry have not been associated with an incidence of hepatic insufficiency or failure, and do not require additional therapy. However, there have been cases of left dorsal displacement with elevated serum GGT, which cautions its use as the definitive diagnosis for a right dorsal displacement. 

Treatment of colon displacements

Large intestinal displacements are treated similarly, regardless of the position of the colon in the abdomen. If the horse is hemodynamically stable, it is held off feed, and administered fluids to both correct deficits and to hydrate the ingesta if an impaction is suspected. Fluid therapy may be provided orally or intravenously. Oral fluids are preferred, due to the fact that they can directly rehydrate an impaction, when present. They are also cost effective compared to intravenous administration. Contraindications to oral fluids would be if the horse is significantly dehydrated, or if the horse is producing net reflux (>2 liters every 2 hours). In addition to fluids, therapy should include analgesics (non-steroidal anti-inflammatory medications), antispasmodics, and low doses of sedation. Providing light exercise (jogging for 10-20 minutes x times a day) may be helpful to improve gastrointestinal motility and return the colon the correct position.

In addition to these treatments, horses with a left dorsal displacement are often treated with phenylephrine and exercised on a lunge line for 15 to 25 minutes to displace the colon from the nephrosplenic space. Phenylephrine is an alpha-1 adrenergic sympathomimetic that causes vasoconstriction, resulting in splenic contraction by up to 28%. The dosage for phenylephrine is 0.04 mg/kg, or 10-20 mg per 1000 lb (450 kg) horse, administered as an intravenous infusion over 15 minutes. Once administration is complete, phenylephrine has a relatively short duration of action, with splenic contraction lasting only 25 minutes. It is currently unknown if phenylephrine actually improves the odds of resolving a left dorsal displacement. A recent publication noted a 96.5% survival rate in horses treated conversationally with only fluids, anti-spasmodic medications, and analgesics. Of these horses, only 9 out of the 114 were administered phenylephrine, which calls into question the effects, if any, of this medication for therapy of a nephrosplenic entrapment. Treatment with phenylephrine is not benign, and side effects include increased pulmonary artery and right atrial pressures, second degree heart block, hypertension, bradycardia, bradyarrythmias, and decreased cardiac output. Phenylephrine should also be used with caution in older horses (>15 years), where severe and fatal hemorrhage into the thorax or abdomen has been reported.

An alternative medical therapy to consider for nephrosplenic entrapment would include rolling under general anesthesia. This technique involves anesthetizing the horse in right lateral recumbency, rolling the horse over its back into left lateral, and continuing on into right lateral again to evaluate progress with either rectal palpation or ultrasound. If possible, it is preferred to lift the horse into the air by the hind limbs while in dorsal recumbency to allow for agitation of the abdomen before rolling into left lateral recumbency, to help dislodge the colon from the nephrosplenic space. While rolling is considerably cheaper than surgery, it has similar anesthetic risks, and should be approached with caution if surgical facilities are not readily available. Reasons for treatment failure can include a second problem or the wrong diagnosis. The rolling procedure was initially described in conjunction with administration of phenylephrine, however, a recent publication noted no improvement in success rates in horses administered this drug.

If the colon or cecum is moderately distended, trocarization may allow for medical management in cases where surgery is not an option. Decompression will improve blood flow to the abdominal organs and can provide the colon space within the abdomen to return back to its normal position. Trocarization is typically performed high in the right flank to decompress the cecum, however, decompression can also be performed on the left if a significant gas cap is present in the displaced colon. Ultrasound should be used to identify the position of the gas filled viscous subcutaneously, and to avoid large vessels or the spleen that may be between the skin and the colon. After routine sterile preparation, a 14 gauge, 5 inch (12 cm) catheter is placed percutaneously perpendicular to the skin, and advanced until gas is noted exiting an attached extension set. If the end of the extension set is placed in a cup of water, it is easier to determine if gas is still exiting the lumen of the bowel. Redirection of the catheter should be avoided to prevent laceration of the intestine, but the catheter can be slowly advanced if needed. Successful trocarization should take 30-45 minutes to significantly reduce gas distention if gas is evacuated passively. As the catheter is removed, an antibiotic may be injected to prevent subcutaneous abscess. Complications of this procedure include hemorrhage and peritonitis, and the horse should be monitored closely after this procedure for pyrexia, that could indicate a developing infection.

Indications for surgery in horses diagnosed with a large colon displacement include the presence of significant abdominal pain or distention on initial exam that is unresponsive to sedation and analgesics, or increasing distention and discomfort despite medical therapy. Horses with significant gastric reflux are also often taken to surgery. Horse that will respond to medical therapy should require only low doses of sedation, and repeated administration may indicate the need for surgery or reevaluation of the diagnosis. Clinical signs consistent with endotoxemia including hyperemic mucous membranes, tachycardia, increasing hematocrit with a concurrent hypoproteinemia, and cold extremities are also often indicative of a surgical lesion. In addition, an abnormal
abdominocentesis or gas distention that severely limits rectal examination of the abdomen may suggest that medical management will not be successful.

Horses suspected to have a right dorsal displacement, 180 degree volvulus, or retroflexion of the pelvic flexure require a ventral midline or paramedian laparotomy to allow for correction of the displacement and concurrent enterotomy for lavage of an impaction may be needed. While ventral midline is preferred by the author to allow for full exploration of the abdomen, it is possible to perform a flank procedure to remove the colon from the nephrosplenic space, as well as simultaneously allow for ablation in horses with a left dorsal displacement.15 However, standing procedures should not be attempted in horses exhibiting intractable pain, significant feed impactions or if there is a suspicion of a second intestinal abnormality.

**Prognosis after colon displacement**

The success of medical and surgical therapy for left dorsal displacement or nephrosplenic entrapment is excellent, between 90% and 100% for all treatments combined.4,13 When the success of individual treatments are examined individually, the rolling procedure has a recurrence rate of up to 21%.16,17 The risk of left dorsal displacement can be reduced by surgical ablation of the nephrosplenic space, whereas surgical success rates between 80 and 93%.3 The success of medical and surgical therapy for left dorsal displacement or nephrosplenic entrapment is excellent, between 90% and 95.9%.11 As mentioned previously, palliative therapy including fluids, anti-inflammatory medications and antispasmodics has a success rate of 96.5%.11 For right dorsal displacements, success rates overall are around 94%. Success of medical management is 64% whereas surgical success rates between 80 and 93%.3

**Prevention of displacements**

Client education is important in horses that have been diagnosed with a large colon displacement. Because of the link with management strategies, a thorough assessment of the feeding and exercise protocols of these horses should be performed. Of the 4 types of displacement, horses with right dorsal displacement have been noted to be more likely to present with a second episode of colic. In one publication, approximately 42% of horses with a right dorsal displacement experienced an additional episode of abdominal pain within 6 months of surgery, with 10% of those requiring relaparotomy.16 Retroflexion of the pelvic flexure was also noted to have a high incidence of recurrent colic in this study (46%), but these horses were unlikely to need a second surgery. Horses with left dorsal displacement and non-strangulating volvulus had a recurrence rate of 8% and 21%, respectively.16 It is important to warn owners that horses with this diagnosis may be at a higher risk for colic in the future.

Recurrence of left dorsal displacement and nephrosplenic entrapment is much less common (about 8%), but some reports note a recurrence rate of up to 21%.16,17 The risk of left dorsal displacement can be reduced by surgical ablation of the nephrosplenic space, but this procedure does not prevent other types of colic, likely due to the management issues surrounding displacements or an underlying motility disorder.17,18 In addition, body type may predispose a horse to this type of colic, which appears to be more common in large, barrel-chested breeds.11 The incidence of colic after this procedure is around 11-21%.17,18

**References**

16. Smith LJ, Mair TS. Are horses that undergo an exploratory laparotomy for correction of a right dorsal displacement of the large colon predisposed to post operative colic, compared to other forms of large colon displacement? *Eq Vet J.* 2013;42(1):44-46.