Equine large colon volvulus presents surgical challenge

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The ascending colon in the horse, also known as the large colon, is a large, highly mobile u-shaped intestinal viscus. Along with the caecum it is responsible for volatile fatty acid absorption and reabsorption of the majority of 125 litres of water secreted into the oral digestive tract every 24 hours\(^1\).

The gastrointestinal contents are propelled from the caecocolic orifice into the right ventral colon. From there the ingesta passes into the left ventral colon via the sternal flexure then into the dorsal large colon via the pelvic flexure. The left dorsal colon meets the right dorsal colon at the diaphragmatic flexure.

The exact positions of the diaphragmatic and sternal flexures are variable as once the colon is exteriorised there is no anatomic demarcation that identifies them; however, the pelvic flexure is anatomically distinct, narrower and marks the end of the ventral colon and the start of the descending colon. The ventral colon has small sacculations otherwise known as haustra and has four taenial bands. There are lateral and medial “free bands” and two bands located within the intercolic ligament. The dorsal large colon is smoother and, because there are no sacculations, it is less elastic than the ventral colon\(^1\).
The blood supply to the large colon runs through the intercolic ligament. A branch of the cranial mesenteric artery divides into the dorsal and ventral colic arteries to supply the large colon. The lateral colonic free band on the ventral colon is contiguous with the lateral band of the caecum. A short mesentery that tethers the caecum, duodenum and ascending colon to the dorsal body wall is the only fixed point within the abdomen\(^1\). This short proximal attachment and relative long intestinal length allows for the highly mobile nature of the large colon (Figure 1).

An accumulation of gas within the ventral colon will cause it to rise within the abdomen. This may result in a right or left dorsal displacement of the large colon. Once out of its normal anatomical location there is an increased risk the large colon will twist, or volvulus, along its length.

The positioning of the abdominal viscera may also be disturbed by conditions such as pregnancy, which appears to be one of the reasons why broodmares are predisposed to developing the condition, especially after foaling. Broodmares may also experience atrophy of the right liver lobes during pregnancy that may also predispose to volvulus in the first six weeks postpartum\(^2\).

Volvulus may occur anywhere along the length of the colon, but there are two main locations: the base very close to the caecocolic junction or slightly further aboral beyond the attachment of the caecocolic fold. Typically, the more oral the volvulus, the more difficult it is to correct surgically. As the colon twists around it first occludes the venous and lymphatic drainage, creating oedema, and this is typical of an incomplete torsion, commonly referred to as a 180° colon torsion. If the colon twists more – commonly referred to as a 360°(or more) colon torsion – the arterial supply will be occluded, creating ischaemia.

Large colon volvulus is one of the most painful and rapidly fatal forms of colic in horses. Marked colonic distension (usually due to tympany) plus ischaemia, which occurs due to obstruction of the colonic vasculature, is exquisitely painful. Ischaemia leads to a cascade of haemodynamic changes giving rise to systemic shock. Mucosal swelling leads to compromise of the intestinal barrier allowing translocation of Gram-negative bacteria from the intestinal lumen and consequent endotoxaemia\(^3\).

**Signs**
Figure 2. The appearance of the large colon in a typical large colon volvulus at exploratory coeliotomy.

As a result of the severe compromise experienced by horses with colonic volvulus, the clinical signs are often severe. They include uncontrollable abdominal pain, cardiovascular compromise, generalised shock, increased heart/respiratory rate, purple mucous membranes, prolonged capillary refill time, severe depression and, eventually, death. Clinical examination is often curtailed due to the severe pain horses experience. Horses showing uncontrollable pain should be subjected to general anaesthesia as soon as possible. If this is not possible then strong analgesia is warranted, opioids, ?2 agonists and NSAIDs can be used in combination.

Transabdominal ultrasonography, if not precluded by abdominal pain, may reveal distended colonic vessels running longitudinally and thickened intestinal walls, measuring more than 5mm or even 10mm in severe cases. The best place to measure the right dorsal colon wall thickness is the 14th intercostal space, halfway between the dorsal and ventral abdomen. The right dorsal colon should be visible just ventral to the liver.

Classically, the findings from transrectal palpation are described as tight taenial bands running transversely across the abdomen. However, in the author’s experience, findings are highly variable, from a massively distended viscus, making examination per rectal difficult to perform, to much less obvious gaseous distension of the large colon.

Reflux may be obtained on passage of a nasogastric tube if the gastric outflow is occluded. Passage of a tube is always recommended, but may be a low-yield exercise. Abdominocentesis will usually yield a serosanguineous sample; the ischaemic changes within the colon will usually cause an associated increase in both systemic and peritoneal lactate concentration.

Correction
Correction of large colon volvulus is via exploratory laparotomy. After induction of general anaesthesia and routine aseptic preparation of the abdomen, the large colon is exteriorised, usually through a standard midline coeliotomy. The diagnosis is usually confirmed from the position of the colon and colour of the serosa (Figure 2). The large colon will often be oedematous with the oedema worst in the mesentery around the colonic vessels. Gaseous distension of the large colon can be severe. Extensive needle decompression is often required and should be performed prior to exteriorising the colon to minimise incisional length (Figure 3).

Usually the ventral colon can be traced cranially in the abdomen and it may be possible to palpate the twist in the cranial right dorsal quadrant. If the twist can be palpated it may be possible to palpate the direction of the twist. The majority of large colon volvuluses are anticlockwise in direction when viewed from behind the twist from the surgeon’s perspective. More accurately, an anticlockwise volvulus is a ventrolateral dorsomedial twist. Therefore these are corrected by moving the colon in a dorsolateral ventromedial direction, or clockwise from the surgeon’s perspective when standing behind the origin of the colon.

It may be easier to start correcting the volvulus by twisting the exteriorised part of the colon, then

Figure 3. Extensive needle decompression of gaseous distension may be required prior to full exteriorisation of the colon.
continuing down inside the abdomen. It may be necessary to reduce tension on the colon by returning the whole large colon to the abdomen and attempting to reduce it from an intra-abdominal position.

**Surgery**

![Surgical Image](image)

**Figure 4.** Pelvic flexure enterotomy may decrease the endotoxic load within the large colon and facilitate reduction.

Pelvic flexure enterotomy and evacuation of the gastrointestinal contents may facilitate correction of the volvulus and may prevent iatrogenic colon rupture during manipulation. It will also decrease the endotoxic load within the colon once the horse recovers from general anaesthesia.

The decision to perform any ancillary procedures, such as colopexy or large colon resection, will usually rely on the experience and personal preference of the surgeon. In geographic locations such as the mid-east United States, where recurrent large colon volvulus is common, such ancillary procedures are more frequently performed. Some authors have also argued it is better to perform a large colon resection to decrease the burden of endotoxin and reperfusion injury once the horse has recovered. In the UK, the recurrence rate of large colon volvulus is usually very low, so it is not common practice among UK surgeons to perform either colopexy or large colon resection.
Once the diagnosis of large colon volvulus has been made it may be prudent to initiate antiendotoxic therapy while the horse is still under general anaesthesia\textsuperscript{11-16}. Due to the loss of protein into the lumen of the large colon, it may also be necessary to supplement the horse with intravenous colloids for intravascular oncotic support\textsuperscript{17}. If the serosa of the colon is purple or black it may be necessary to consider euthanasia on humane grounds, especially if the changes in serosal colour manifest throughout the whole length of the large intestine meaning sufficient margins for resection are not possible.

On performing the pelvic flexure enterotomy it is possible to gauge the colour and amount of bleeding from the mucosa of the colon (Figure 4). Lack of haemorrhage from the cut edge of the intestine is a negative prognostic indicator. Black mucosa may appear non-viable at surgery, but as enterocytes are some of the most rapidly reproducing cells in the body, it is possible for the entire mucosa lining to slough and reform in a horse recovering from large colon volvulus. Despite several histological studies looking at the effect of volvulus on intestinal mucosa, the appearance at surgery is an unreliable guide as to prognosis\textsuperscript{18}.

\begin{figure}[h]
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\caption{Figure 5. Exteriorisation of the caecocolic ligament, ensuring the large intestine is in correct anatomical alignment.}
\end{figure}

Once the volvulus is corrected, normal anatomical relationships between the large colon and the caecum should be readily discernible. In practical terms this means the caecum should take its normal anatomical place on the right side of the abdomen and it should be possible to exteriorise the caecocolic ligament through the midline incision (Figure 5). The remainder of the abdomen should be explored to rule out any further surgical lesion. Decompression of the small intestine is useful to ensure there is no surgical lesion and also as a secondary means of ensuring correct anatomic alignment of the intestine. Should there be a problem in decompressing the small intestine from ileum to caecum this may indicate the alignment of the base of large colon and caecum is not entirely corrected. Once the surgeon is satisfied the abdominal contents are in normal anatomic alignment, midline closure is routine.
The endotoxaemia and resultant cardiovascular shock experienced by horses undergoing large colon volvulus may mean recovery from general anaesthesia is prolonged and by no means certain. Once recovered from general anaesthesia, intensive postoperative support will be necessary. Extensive damage to the large intestine will inhibit water reabsorption, loss of electrolytes and protein into the gut lumen leading to profuse diarrhoea. Postoperative ultrasonographic monitoring of intestinal wall thickness has been shown to be useful in prognostication in the postoperative period. In horses where the intestinal wall thickness is reduced to below 5mm within 18 hours postoperatively the prognosis for survival is improved markedly when compared to individuals with a still thickened colon at 18 hours.

Summary

In conclusion, the anatomical and physiological peculiarities of the equine large colon lead it to be predisposed to displacement and volvulus. The haemodynamic changes associated with large colon volvulus can have rapidly fatal consequences. Timely surgical intervention is necessary to give the best chance of a successful outcome; however, given the severity of the disease, even with the best surgical care, a positive outcome is far from guaranteed.

References