Advances in Management of Small Intestinal Diseases Causing Colic

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Advances in treatment include preventive treatments such as anthelmintics effective against tape-worms, peri-operative medications such as lidocaine, and the prospect of more selective non-steroidal anti-inflammatory drugs for the treatment of colic. Author’s address: Department of Clinical Sciences, North Carolina State University, 4700 Hillsborough Street, Raleigh, North Carolina 27606; e-mail: anthony_blikslager@ncsu.edu. © 2009 AAEP.

1. Introduction
In terms of advances in management of small intestinal colic, substantial improvements in short- and long-term survival after surgery have been documented. Increases in survival are likely attributable to a number of factors, including referral time, surgical techniques, and post-operative care. In addition, not all causes of small intestinal colic are surgical. Documentation of changes in referral time is difficult, and surgical techniques have remained similar over the last decade with only some changes in attitudes toward the most appropriate techniques. Additionally, there has been a greater recognition of the injury that can be caused by surgical manipulation, and methods to reduce this trauma have been developed. However, the most dramatic improvements have arisen in intra-operative and post-operative medical treatment, which may in part explain changes in survival. These treatments are almost all aimed at rapid resuscitation of the horse from shock, and treatments are directed to control the most frequent cause of shock, lipopolysaccharide (also known as endotoxin).

2. Recognition of Small Intestinal Colic
Horses with colic attributable to the small intestine are typically recognized on the basis of two key findings: nasogastric reflux and distension of the small intestine on rectal palpation. If a horse has recurrent colic (not appropriately responsive to medical treatment), these parameters can be used in an attempt to localize the source of colic. Ultrasonic examination is also being increasingly used so that the diameter of the small intestine can be measured and wall thickness and motility evaluated. The entire abdomen can be scanned to look for distended loops of small intestine. When attempting to treat horses suspected of small intestinal colic, abdomino-centesis is particularly useful to determine the degree of intestinal injury. Changes in the integrity of the small intestinal wall are evident in the abdominal fluid. Specifically, the gross appearance, total protein cell count, and total nucleated cell count (TNCC) of abdominal fluid can be used to determine if the small intestine is degenerating. In the field, this is most simply accomplished by evaluating gross appearance and measuring total protein. Initially, during strangulating obstruc-
tion, enteritis, or long-standing simple obstruction, the total protein will become progressively elevated (>1.5 mg/dl is abnormal), and if the bowel is strangulated, the fluid becomes serosanguinous (Fig. 1). Finally, the TNCC will become elevated (>5000 cells/μl). As the cells increase, the percentage of neutrophils increases. Horses with simple obstruction (impaction) of the small intestine often have two to three loops of distended small intestine and if fluid has backed up into the stomach, gastric reflux. Early in the disease process, there should be no abnormalities in the abdominal fluid. As the disease progresses, loss of protein through the intestinal wall will be evident, and the TNCC will increase.

Horses with enteritis typically have several loops of mild to moderately distended small intestine, gastric reflux, and early changes in abdominal fluid (serosanguinous and elevated total protein but no change in TNCC). Horses with strangulating obstruction frequently have tightly distended loops of small intestine, gastric reflux, and progressive changes in abdominal fluid from normal fluid initially to marked increases in protein, red blood cells (RBC), and white blood cells (WBC) as the intestine undergoes necrosis. If monitoring of abdominal fluid is planned, it is best to use a teat cannula to obtain the fluid, because needles have been shown to induce some degree of change in fluid on subsequent taps, presumably because of trauma to the bowel.

3. Ileal Impaction
The most clearly recognizable causes of small intestinal colic that may be treated medically are ileal impaction (Fig. 2) and proximal enteritis. This section will focus on ileal impaction.

There are two major risk factors for ileal impaction: feeding of suboptimal quality coastal Bermuda hay and tapeworms. The latter are infrequently identified on routine fecal flotations, but an enzyme linked immunosorbent assay (ELISA) test is available for detection of tapeworm infection. A search of the internet will provide a list of veterinary centers that can run this test. Regardless of detection, veterinarians now have an effective anthelmintic for tapeworms because of the addition of praziquantel. Use of these products should be performed 1–2 times/yr, depending on the veterinarians’ level of concern of the overall parasite load at a particular facility and the location of the horse farm. For example, in northern locations, at least one dose should be administered after the first hard frost. In addition, pyrantel-containing anthelmintics, although less effective than praziquantel, confer some degree of protection against tapeworms.

The source of hay is a real concern in the southeastern United States where Bermuda hay is frequently fed. To avoid ileal impaction, horses need to be acclimated to this hay source slowly, and high-quality hay should be used. Because coastal Bermuda hay has relatively fine stems compared with other types of hay (Fig. 3), the fiber and ligand content can be very high, and the author speculates that mastication may be insufficient so that this type of hay is swallowed before the stem length has been reduced to a reasonable size. This hay accumulates at the ileocecal junction where the muscular ileum can hypothetically squeeze out fluid; this forms a dehydrated mass, which combines with mucus to form an impaction. Horses with early stage ileal impaction can usually be detected based on mild signs of colic and two to three loops of distended small intestine adjacent to the cecum on the right side of the abdomen.
Horses with acute impactions typically do not reflux, because abdominal fluid is usually normal and has not backed up to the stomach. On occasion, fluid may look normal with a slight elevation in protein levels, but if distension on rectal palpation and the horse’s pain level suggest medical treatment, these horses can be successfully treated without surgery. Referral is a viable option, because the most appropriate treatment is carefully titrated pain control (so that recurrence of pain can be detected) and IV rehydration. Because of gastric reflux, laxative medications or oral fluids will not reach the site of the impaction and should be avoided. There are concerns that IV fluid will increase small intestinal fluid accumulation, but it is far more important to make sure that the horse is well hydrated. It is doubtful that net fluid flow into the small intestine (approximately one-third of the horse’s body weight/day) is altered by administration of IV fluid. The prognosis for horses with ileal impaction is good according to recent studies.

4. Non-Steroidal Anti-Inflammatory Drugs
If a horse has a strangulating obstruction of the small intestine, surgical treatment is indicated. However, there are still medical considerations before surgery. Recent research has shown that non-selective non-steroidal anti-inflammatory drugs (NSAIDs), such as flunixin meglumine, retard the ability of the intestine to repair its mucosal surface. This does not mean flunixin meglumine (0.25–1.10 mg/kg, IV) is not indicated for treatment of medical colic, but it does bring up the subject of selective NSAIDs that are currently available in the veterinary market. NSAIDs inhibit the enzyme cyclooxygenase (COX), but COX is not always delete-
Recently, the COX-2 inhibitor firocoxib\textsuperscript{d} has been available for treatment of arthritis. A recent pre-clinical trial with an IV form of firocoxib indicated that intestinal recovery after experimental strangulation was optimal with firocoxib compared with flunixin meglumine.\textsuperscript{17} Both medications were equally effective at reducing post-operative pain, which was determined by a behavioral scoring system developed for horses.\textsuperscript{18} The overall advantage of the increased intestinal recovery that can be achieved with COX-2 inhibitors is not yet known, because such results would take large clinical trials. However, we have shown that post-operative treatment of horses with experimental ischemic and reperfused small intestine is significantly more permeable to lipopolysaccharide when horses are treated with flunixin meglumine compared with firocoxib.\textsuperscript{17} Whether or not the significant increase in lipopolysaccharide absorption in horses alters survival is unknown, but it does highlight the complexity of medical management. It also suggests weaning horses off flunixin meglumine as soon as possible or using alternate methods of pain control. Prior studies have shown that the effect of flunixin meglumine is not reduced by lowering the dose to 0.25 mg/kg (unpublished data). In addition to peri-operative treatment, if an IV COX-2 inhibitor does become available for use on the equine market, veterinarians might consider using this medication for suspected cases of small intestinal disease, particularly those that might warrant referral. Studies have shown that the same beneficial effects are present with IV meloxicam,\textsuperscript{19} which is available in Canada and the European Union for equine use but not in the United States. Some countries in the European Union have already begun to test the use of meloxicam as a replacement for flunixin meglumine in horses with colic.\textsuperscript{9}

5. Lidocaine

Lidocaine is currently the most popular method to treat post-operative ileus in horses, which is a condition most commonly noted in horses after surgery for small intestinal obstruction or strangulation. Similarly, it is used in horses with proximal enteritis. More recent literature suggests that lidocaine may have other beneficial effects. For example, in a trial in which horses were treated with flunixin meglumine, lidocaine, or flunixin meglumine and lidocaine after experimental small intestinal strangulation, lidocaine prevented the deleterious effects of flunixin meglumine on small intestinal mucosal recovery. Unfortunately, lidocaine has a short duration of action, requiring constant infusion. However, there is the possibility that the loading dose (1.3 mg/kg, IV) could be used before referral to provide optimal pain control and subsequent recovery of small intestinal mucosa.\textsuperscript{16,20}

6. Intra-Operative Treatments

Although it has often been stated in textbooks and reviews that minimal surgical manipulation is optimal, it has only been recently that the effect of manipulation on the small bowel has been documented. In a study in which small intestine was “stripped” just as would occur during manual decompression, it was shown that the serosal surface is easily injured, and neutrophils rapidly accumulate at the site.\textsuperscript{5} This is the level of trauma that can lead to adhesions, which are one of most important complications that lower survival rate after discharge from the hospital.\textsuperscript{21} Interestingly, the neutrophils continue to migrate through the muscle layers along facial planes, finally residing within the submucosa. This form of inflammation has implications for post-operative ileus.\textsuperscript{5}

New information on techniques to reduce manipulation of the small intestine is available. For example, small intestine can be decompressed through an enterotomy rather than into the cecum.\textsuperscript{22} There are also new treatments that can be applied to reduce serosal trauma, including Seprafilm\textsuperscript{f} (a sheet of film that is essentially a combination of carboxymethylcellulose and hyaluronic acid) and carboxymethylcellulose applied liberally during surgery.\textsuperscript{23–25} Carboxymethylcellulose is prepared by making a 1% solution using the purchased powder and sterile water placed into bottles suitable for surgical application. Although Seprafilm and carboxymethylcellulose have been shown to reduce experimental adhesion formation, Seprafilm is expensive and can only be applied to a small area.

\textsuperscript{d}COX-2 inhibitor firocoxib

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of serosa suspected of being susceptible to adhesion formation. This film application would be most applicable at the site of an enterotomy (Fig. 5) or a site of focal inflammation, including an adhesion that has been broken down at surgery. In a study assessing long-term survival in horses after small intestinal surgery that had no topical treatment, Seprafilm, or carboxymethylcellulose (250–500 ml 1% solution), the horses in which treatment, Seprafilm, or carboxymethylcellulose after small intestinal surgery that had no topical treatment had a significant reduction in post-operative colic. Because the latter has been associated with a reduction in survival, this study suggests a clear benefit of the use of carboxymethylcellulose during small intestine surgery.

References and Footnotes


IN-DEPTH: COLIC

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