Treatments for Colic
A primary method to alleviate abdominal pain is decompression of the distended stomach or intestine. Nasogastric intubation can help relieve gastric tympany or remove gastrointestinal reflux due to a small intestinal obstruction or ileus. The other site at which distention from gas can be relieved is the cecum. Decompression (enterocentesis) can resolve a primary cecal tympany or help relieve gas build up from a large colon or small colon obstruction.

Some of the most useful drugs for relief of pain associated with either surgical or non-surgical disease in horses are the nonsteroidal anti-inflammatory drugs (NSAIDs). They block the enzyme cyclo-oxygenase thereby decreasing the production of eicosanoids formed during degradation of arachidonic acid from cell membranes. Different drugs produce varying levels of analgesia possibly due to the different concentrations of the two types of cyclo-oxygenase, COX1 and COX2, in tissues (1). COX1 regulates the production of prostaglandins necessary for normal organ and vascular function. COX2 becomes active in response to cytokines, serum factors or growth factors and causes marked increases in prostaglandin production (2).

Flunixin meglumine (flunixin) is the most effective of the NSAIDs used to treat acute abdominal disease in the horse. In cases where a strangulated segment of intestine is suspected, the use of flunixin preoperatively can be helpful in diminishing the detrimental response due to the endotoxin release. The inability to eliminate pain with flunixin suggests a disease exists which requires more than simple medical treatment. For this reason horses given flunixin should be observed carefully after its administration. If signs of colic return, particularly after a short period (1-2 hours), the horse should be immediately suspected of having more than a simple medical colic. Disadvantages of the NSAIDs, particularly phenylbutazone, include the potential for adverse side effects such as mucosal ulceration of the gastrointestinal tract or renal damage (3,4,5).

Several alpha2 agonists are potent analgesics and cause muscle relaxation and sedation. This drug group includes xylazine and detomidine both of which have been used for control of abdominal pain in horses. These drugs appear to act by stimulation of central alpha2 adrenoceptors, which modulates the release of norepinephrine and directly inhibits neuronal firing. This causes sedation, analgesia, bradycardia, and in the horse with colic, relief of pain (6,7,8).

Butorphanol is a partial agonist and antagonist which gives the best pain relief with the least adverse effects of the opioids (6,9,10). It can be used in combination with xylazine or detomidine. The dosage can vary from 0.05 to 0.1 mg/kg, the high dosage being necessary for the most severe colic.

Spasmolytic drugs can indirectly provide analgesia by reducing spasms of the intestine. Increased frequency of intestinal contractions or spasms occur oral to intraluminal obstruction such as an impaction. The combination of hyoscine N-butylbromide and paracetamol drug derivative (dipyrone), is popular in Europe for treatment of horses with colic, specifically spasmodic colic and impactions (11,12).

Lidocaine has become popular as a prokinetic drug for use in the treatment of ileus (13,14,15). Its effects appear to include both stimulation of gut motility and analgesic effects (16). Lidocaine decreases inflammation by preserving microvascular integrity, preventing neutrophil migration and inhibiting cytokine production (17,18,19). An initial bolus of 1.3 mg/kg is followed by a constant rate intravenous infusion at 0.05 mg/kg/min. Prokinetics, distention, endotoxemia, sympathetic stimulation and bowel wall inflammation inhibit motility. The chief clinical problem is postoperative ileus involving the small intestine. Numerous drugs have been evaluated in normal horses. Few clinical trials have examined the efficacy of prokinetic drugs for treatment of equine postoperative ileus and those reporting success are limited to cisapride (20), metoclopramide (22,23,24), erythromycin (25), and lidocaine (24,13). Recent research has shown that these compounds are not effective in horses with clinical disease (25,26). Inflammation from...
intestinal distention or ischemia potentially prevents the enteric nervous system or agents acting directly on muscle from stimulating progressive motility (26). New compounds that have yet to have reported use in clinical cases include tegaserod, a selective serotonin subtype 4 receptor agonist and methylnaltrexone an opioid antagonist. Both stimulate pelvic flexure and jejunal motility in vitro (27,28).

**Treatment of impactions**

Impaction colic is the most frequent type of simple obstruction causing colic (29,30). Though administration of mineral oil via nasogastric tube is widely recommended for treatment of impaction colic, there is evidence that administration of oral or intravenous fluids may be preferable when an impaction is resistant to routine analgesic and laxative therapy. Administration of intravenous fluids has been used to "overhydrate" the circulatory system thereby stimulating secretion into the dehydrated ingesta in the colon (31). Treatment of colon impactions with water administered via nasogastric tube (10 liters every 30-60 minutes) until the impaction is resolved is effective, however alterations in serum electrolytes can result from prolonged treatment (32). Administration of MgSO4 (1 g/kg in 1-2 liters of water via stomach tube) does not increase colon ingesta hydration but hydration of the feces did occur. Sodium sulfate (1 g/kg in 1-2 liters of water via stomach tube) significantly increases colon content hydration and created hypernatremia. Saline, originally prescribed for sand colic, increased colon water content, but resulted in hypernatremia and hyperchloremia. Administration of a balanced electrolyte solution containing 5.37 g NaCl, 0.37 g KCl, and 3.78 g NaHCO3 per liter (Table 1) is as effective as any laxative in hydrating colon contents without altering serum electrolyte values.

**Treatment of reperfusion injury and inflammation**

Therapeutic options for reperfusion injury including pharmacologic mediators that target the effects of one part of the reperfusion pathway have yielded variable results (33,34). The goal of therapy is to stop the biochemical reactions which initiate the reperfusion cascade. This is not always possible as reperfusion may be initiated before the veterinarian sees the horse or diagnose the problem. Because the inflammation initiated by reperfusion can continue for days to weeks, treatment during the early phase of the process may prevent some of the pathologic sequelae. Treatments should be aimed at 1) preserving cell integrity, 2) preventing the formation of oxygen radicals 3) preventing neutrophil activation and migration, and 4) treating the vascular and tissue damage caused by inflammation (See Table 2).

Dimethylsulfoxide (DMSO), which is a commonly used anti-inflammatory agent, scavenges hydroxyl radicals and attenuates increased microvascular permeability and increased neutrophil adherence associated with ischemia-reperfusion in the intestine of cats and rats (35,36,37). When used in a model of low flow ischemia, DMSO (20 mg/kg, IV) administered prior to reperfusion was partially effective in attenuating the ischemia-reperfusion induced permeability changes in the equine jejunum (38). The true efficacy of DMSO administration to clinical cases is still unknown.

Lidocaine is being used commonly as a prokinetic and analgesic agent after surgery for intestinal strangulation or obstruction (19). Though used as a therapy for ileus, some of lidocaine’s beneficial effects may come from inhibiting inflammatory mediators or protecting endothelial cells.

When administered at the time of reperfusion and for 72 hours after 60 minutes of ischemia in foal jejunum, flunixin (250 mg/kg, IV, QID) combined with penicillin 22,000 U/kg, IV, QID and gentamicin (2.2 mg/kg, IV, QID) prevented intestinal adhesions which formed in untreated foals.

### Table 1: Formula in grams with estimates using measuring teaspoons to make a balanced electrolyte solution for use as an enteral fluid to treat colon impactions. Administered at 5-10 liters per hour, this solution will soften impactions and provide systemic hydration.

<table>
<thead>
<tr>
<th>Specific Ingredient</th>
<th>Grams/liter</th>
<th>Grams/5 liters</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaCl</td>
<td>5.37</td>
<td>26.85</td>
</tr>
<tr>
<td>KCl</td>
<td>0.37</td>
<td>1.85</td>
</tr>
<tr>
<td>NaHCO3</td>
<td>3.78</td>
<td>18.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount/5 liters</th>
<th>Total dose/5 liters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt</td>
<td>3 teaspoons</td>
<td>Equals 21 g NaCl</td>
</tr>
<tr>
<td>Litesalt®</td>
<td>1 teaspoon</td>
<td>Equals 3.5 g NaCl and 2 g KCl</td>
</tr>
<tr>
<td>Baking Soda</td>
<td>4 teaspoons</td>
<td>Equals NaHCO3 20 g</td>
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**Abstracts Voorjaarsdagen 2007 | 247**
5 Scientific Proceedings Equine Programme

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Administration</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flunixin meglumine</td>
<td>0.5 mg/kg</td>
<td>IV q 6 hours</td>
<td>To effect for pain, ileus or shock.</td>
</tr>
<tr>
<td>DMSO</td>
<td>20 mg/kg</td>
<td>IV in saline q 12 hours</td>
<td>48-72 hours or to effect for shock</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>1.3 mg/kg bolus followed by 0.05 mg/kg/min</td>
<td>IV continuous infusion</td>
<td>To effect for pain or ileus.</td>
</tr>
</tbody>
</table>

Table 2: Drugs administered to prevent or treat ischemia-reperfusion injury in the horse. These compounds are used individually or in combination. Early administration of each of these drugs is recommended for the optimal effect.

References
normal horses. 8th International Equine Colic Research Symposium 2005;74-75.


