Managing Pain Associated with Colic*

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Colic is one of the most frequent disease syndromes encountered in horses (affecting about 10% of horses annually) and the single largest cause of mortality (causing death due to complications in approximately 1% of horses annually). Fortunately, the vast majority of horses that suffer from colic can be medically managed without the need for intensive therapy or surgical intervention. Nevertheless, it is critically important that veterinarians be knowledgeable about how to manage abdominal pain to provide rapid and effective treatment of equine patients suffering from colic and to instill confidence in horse-owning clients. Because colic presents as an emergency, practitioners must commit to memory dosages of effective analgesics and be able to rapidly improvise if a particular analgesic is ineffective.

In addition to developing an approach to management of abdominal pain in horses, it is also worthwhile to consider what colic is and what varying degrees of pain indicate in terms of the need for referral for potential surgery. Although most horses with colic have gastrointestinal (GI)-associated pain, a number of other body systems can trigger signs of colic, including the urogenital and respiratory tracts. Regardless of the cause of colic, referral for potential surgery is indicated when colic is unresponsive to analgesia.

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DIAGNOSTIC CRITERIA

Historical Information

Gender: Risk factor for certain diseases.

- Male horses—Inguinal hernia.
- Mares—Large colon volvulus or displacement just before and after foaling.
- Geldings—Pedunculated lipoma.

Age: Some diseases are more common at particular ages.

- Foals, weanlings, and yearlings—Less likely to have colic.
- Neonates—Increased risk of meconium impaction.
- Weanlings and yearlings—Prone to ileocecal intussusception.
- Horses older than 12 years—More likely to have strangulating lipomas.

Breed Predisposition:

- Arabians—Found to have a higher risk of colic in some studies.
- Male Standardbreds, Saddlebreds, Tennessee walking horses, and Warmbloods—More prone to inguinal hernias.
- Paint foals from overo mares—Can have a recessive genetic trait that causes aganglionosis of the intestine, which causes functional obstruction.

Owner Observations:

- Initial observations (before colic is noticed) often include depression, poor appetite,

decreased frequency of defecation, lagging behind the herd, and more frequent recumbency.

- It is important to document colic duration and the amount of pain:
  - — Long period of mild pain—More likely to be a simple obstruction.
  - — Severe colic with rapid progression—More likely to be due to a strangulating lesion or severe distention.
- Owners often know about changes in diet, environment, activity, transport, or treatments that may be related to the horse's colic. A thorough history is imperative to ferret out these seemingly innocent changes.
- Exposure to toxic compounds can cause colic, and owners should be questioned about this possibility.

Other Factors:

- Evidence of trauma to the head or body may indicate a previous episode of severe colic.
- Recurrent colic after feeding grain may indicate colic from gastric ulcers.
- Severe pain changing to depression is often the result of a gastric rupture or enteritis with endotoxemia. Some strangulating diseases (e.g., strangulating lipoma) can mimic these clinical signs.
- Administration of excessive medication, exposure to sand or fine gravel, excessive feeding of grain, poor forage quality, and inconsistent feeding or exercise routines are all suspected of increasing the risk of colic.
- Prior surgery for colic often increases the risk of future colic due to adhesions or mesenteric constriction.

Physical Examination Findings Indicative of the Degree of Abdominal Pain

Increased Heart Rate (>48 bpm)

- Increases in heart rate in the early stages of colic (first 1 to 3 hours) tend to indicate the degree of abdominal pain.
  - — Normal heart rate: Mild pain.
  - — 50–65 bpm: Moderate pain.
  - — 65–80 bpm: Severe pain.
  - — >80 bpm: Excruciating pain.
- Increases in heart rate in the later stages of colic are more likely to be associated with the degree of endotoxemic shock.
  - — 50–70 bpm: Moderate shock.
  - — 70–90 bpm: Severe shock.
- Horses with severe pain, particularly those with a large colon volvulus, may have a paradoxically low heart rate (possibly associated with an increase in vagal tone).

Increased Respiratory Rate (>16 respirations/min)

- Indicative of pain during the early stages of colic.
- Associated with abdominal distention during the later stages.

Facial Trauma

Horses that have had progressive signs of abdominal pain typically have increasing degrees of facial trauma, particularly around the eyes.

Abnormal Mucous Membrane Color

- Pale pink mucous membrane color typically indicates vasoconstriction in response to pain-associated sympathetic tone and early endotoxemia.
- Red or purple mucous membranes, especially a dark red "toxic" ring around the upper incisors, are indicative of progressive endotoxemic shock (in order of increasing severity: red, light purple, dark purple).

Abnormal Frequency of Auscultable Gut Sounds

- Increased frequency of gut sounds ("spasmodic colic") may be associated with abdominal pain during the early stages of colic.
- Decreased frequency of gut sounds is recognized during the later stages of colic and is associated with ileus or progressive intestinal obstruction.

Laboratory Findings

Initially, a painful, hypovolemic horse has an increased packed cell volume (e.g., >50%) and an increased total protein concentration (e.g., >8.0 mg/dL). A patient with a compromised, devitalized bowel (e.g., volvulus) shows a decrease in total protein concentration (e.g., 5.0 to 6.0 mg/dL) over time because of protein leakage into the abdomen. Obviously, these levels will decrease even more if the patient is given IV fluids. The key point is that packed cell volume and total protein can give

Box 1. Pain Assessment Based on Signs

Mild Colic
- Refusing to eat normal ration.
- Pawing infrequently.
- Lying in sternal recumbency and being reluctant to stand.
- Looking briefly at one of the flanks.
- Circling the stall slowly.

Moderate Colic
- Pawing frequently or vigorously.
- Lying in lateral recumbency and repeatedly attempting to roll.
- Looking consistently at one of the flanks.
- Circling the stall vigorously and repeatedly attempting to lie down.
- Sweating.

Severe Colic
- Lying down or falling violently.
- Rolling vigorously and repeatedly.
- Sweating profusely.
- Preferring to lie in dorsal recumbency.
- Moving violently without regard for the handler.

important clues as to the duration and severity of the intestinal lesion.

Differential Diagnosis

The large majority of horses that exhibit signs of colic have GI-associated pain. However, diseases of other body systems can result in signs that closely resemble colic:

- Reproductive tract complications in mares (uterine tear, uterine rupture, uterine torsion, ovarian artery hemorrhage).
- Urinary obstruction (ureteral, cystic, or urethral calculus).
- Biliary obstruction.
- Pleuropneumonia.
- Neurologic disease that causes abnormal mentation.
- Exertional rhabdomyolysis.

TREATMENT RECOMMENDATIONS

Initial Treatment

Colic will resolve in many cases before the veterinarian arrives at the farm. In horses that are actively showing signs of colic, the degree of pain should be assessed (Boxes 1 and 2). The more severe the signs of colic, the more difficult the pain will be to manage.

Box 2. The Evolution of Pain Management

- Before the 1960s, veterinarians had to rely on opiate derivatives, such as morphine, to treat colic; although morphine is a potent analgesic, it has marked central nervous system excitatory effects in horses.
- With the advent of tranquilizers (e.g., acepromazine) and sedatives (e.g., xylazine) in the late 1960s, morphine could be administered in combination to minimize excitatory effects.
- As NSAIDs such as flunixin meglumine and dipyrone became available in the late 1970s, they became the favored drugs for treatment of colic.
- In the 1980s, concern arose over excessive use of flunixin meglumine, which was able to mask pain and delay referral.
- In the early 1990s, although considered useful because of its safety for use by owners, dipyrone was discontinued.
- In the 1980s, several opiate derivatives with reduced excitatory effects, such as butorphanol and pentazocine, became available. In the 1990s, these drugs were classified as controlled substances.
- In the 1980s, detomidine became available but was initially feared because of its ability to mask severe pain. This drug should be used with utmost care.
- Today, selective NSAIDs that may reduce gastrointestinal side effects are entering the market. However, as with any NSAID, rapid referral for horses that may need surgery is the key to survival. NSAIDs should be used cautiously so that the time to referral is not increased.

If possible, take a thorough history and complete a physical examination before administering analgesics. If the horse is in too much pain to allow these procedures to be completed, attempt to at least obtain information on the cardiovascular status of the horse by assessing mucous membrane color, capillary refill time, and the heart rate. These will give pertinent information on the severity of pain and systemic shock if obtained prior to administration of an analgesic and may allow more appropriate use of medications (Table 1).

For horses with mild or moderate colic, administer a **short-acting, potent analgesic** that will control pain but allow an estimate of the severity of the colic episode (based on the speed of recurrence of signs of colic).

Choices of short-acting, potent analgesics include:

- Xylazine (0.3–0.5 mg/kg IV).
- Butorphanol (0.01–0.02 mg/kg IV).
- A combination of xylazine and butorphanol.

Table 1. Analgesics for Treating Colic

Drug	Dose (mg/kg IV)	Amount (mg) for an Adult Horse (450–500 kg)
Xylazine	0.3–0.5	150–250
Butorphanol	0.01–0.02	5–10
Flunixin meglumine	1.1	450–500
N-butylscopolammonium bromide	0.3	130–150
Detomidine	0.01–0.02	5–10

Commit dosages for an average-size horse (990 to 1100 lb [450 to 500 kg]) to memory:

- **Xylazine (150 to 250 mg IV; 1.5 to 2.5 mL of 100 mg/mL concentration).**
- **Butorphanol (5 to 10 mg IV; 0.5 to 1.0 mL of 10 mg/mL concentration).**
- **Combination of xylazine and butorphanol (e.g., 1.5 mL of xylazine + 0.5 mL of butorphanol), which may be mixed in the same syringe and administered IV.**

Short-acting agents can be administered as needed (up to every 15 minutes), but they have a cumulative effect on the systemic condition of the horse:

- Xylazine is an α_2-agonist that causes bradycardia, transient hypertension, and sweating in addition to sedation (depending on the degree of pain present).
- Butorphanol is an opiate that has mild excitatory effects, including coarse muscle tremors and increased sensitivity to environmental stimuli.
- Butorphanol is usually given in combination with xylazine to reduce excitatory effects of butorphanol.
- Other opiates, including pentazocine, meperidine, and morphine, may be administered. However, excitatory signs are more severe, particularly with morphine, so pretreatment with sedatives is critical.
- These agents are appropriate in treating horses with mild, moderate, or severe signs of colic. However, they may fail to control signs of severe colic.

If administration of a short-acting analgesic relieves signs of colic for the duration of the veterinary visit (approximately 1 hour), a dosage of a **long-acting, moderate-strength analgesic** can be administered to ensure that the horse will remain comfortable. Choices of long-acting, moderate-strength analgesics include NSAIDs (Boxes 3 and 4):

- Flunixin meglumine (1.1 mg/kg IV q12h).
- Ketoprofen (2.2 mg/kg IV q24h).

NSAIDs may be used once for initial treatment of mild or moderate colic. Careful veterinary monitoring is necessary to ensure that additional intervention, if warranted, is promptly initiated. NSAIDs must be given according to a strict schedule to avoid signs of toxicity. These agents should not be readministered at less than the prescribed interval if they fail to relieve signs of colic.

- **Flunixin meglumine (500 mg IV; 10 mL of 50 mg/mL concentration). Flunixin meglumine may be administered more frequently at a reduced dosage (0.25 mg/kg IV q8h [125 mg for a 500-kg horse]) to control mild pain or treat signs of endotoxemia.**
- **Ketoprofen (1 g IV; 10 mL of 100 mg/mL concentration).**

Severe Colic

Controlling signs of severe colic is challenging and requires a slightly different approach. Initial management of pain is similar to that of treatment of mild or moderate colic (including determining the heart rate prior to administration of a potent, short-acting analgesic). If xylazine and/or butorphanol has no effect when repeatedly administered IV and signs of abdominal pain remain violent, administration of detomidine (0.01 to 0.02 mg/kg IV) and referral to an equine hospital should be considered. Butorphanol can be readministered with detomidine.

Commit the dosage of detomidine for an average-size horse (990 to 1100 lb [450 to 500 kg]) to memory:

- **Detomidine (5 to 10 mg IV; 0.5 to 1.0 mL of 10 mg/mL concentration) with or without butorphanol (0.01 to 0.02 mg/kg IV).**

If detomidine is required to manage severe pain, refer the horse as rapidly as possible rather than waiting to see if pain recurs. This is because detomidine, a potent α_2-agonist, can

Box 3. Related News

- NSAIDs (such as flunixin meglumine) reduce signs of abdominal pain by inhibiting production of prostaglandins by cyclooxygenase (COX).
- It has been determined that there are three forms of COX:
  —**COX-1** is responsible for production of prostaglandins involved in normal GI physiologic function.
  —**COX-2** produces excessive prostaglandins during inflammation that may exacerbate abdominal pain.
  —**COX-3** is expressed in the central nervous system and likely provides central analgesia when inhibited without antiinflammatory effects. In human pharmaceuticals, acetaminophen inhibits COX-3, but this drug is not recommended for horses.
- Nonselective inhibitors of COX-1 and COX-2 (e.g., flunixin meglumine) disrupt mucosal recovery in ischemia-injured equine intestine, whereas selective inhibitors of COX-2 do not affect mucosal recovery.
- The first selective COX-2 inhibitor to become available on the equine market is an oral product (firocoxib, Equioxx, Merial).
- Research is under way to determine whether COX-2 inhibitors can be used to treat abdominal pain in horses without disrupting normal physiologic function. For example, recent studies with the COX-2 preferential inhibitor meloxicam have shown good efficacy in terms of pain control while minimizing deleterious effects on the gut. However, although formulations of this product are labeled for use in dogs and cats in the United States, it is labeled for large animal use only in other countries, such as Canada and members of the European Union. I am hopeful that, based on this work, products such as Equioxx or alternative choices will soon become available in an IV form.

Box 4. Checkpoints

- Medications can be used in a variety of ways to successfully manage abdominal pain. For example, some practitioners choose to give flunixin meglumine as the initial treatment for pain.
- The "pain-masking" effects of flunixin meglumine may have been overemphasized in the past. Flunixin meglumine is a long-acting analgesic that can mask signs of pain, particularly from the owner's point of view. However, signs of ongoing colic can be detected by the veterinarian by careful physical examination.
- There are few good choices of analgesics that owners can be permitted to use in the absence of a veterinarian. In general, it is wise to have the owner call the veterinarian regardless of the perceived severity of the colic. However, for knowledgeable owners, one dose of flunixin meglumine (1 mg/kg PO) is probably the best choice. Although this medication has been given IM, IM administration can result in abscessation. In the worst-case scenario, these abscesses can culture positive for *Clostridium* spp. Clostridial abscesses are associated with a high mortality rate.
- While flunixin meglumine is the NSAID most frequently used to treat colic, other NSAIDs (e.g., ketoprofen, firocoxib [oral formulation only]) are also available.
- Veterinarians are encouraged to talk with owners and seriously think about referral if there is an initial lack of response to a short-term analgesic such as xylazine. This is the only way the profession will be able to reduce referral time and increase survival time.

mask severe pain for prolonged periods. Use of detomidine may be reserved for horses that are severely painful and that require a long trailer ride to a referral facility.

If the signs of colic are so violent as to prevent safe IV administration, an increased dose of xylazine (1.1 mg/kg) or detomidine (0.02 mg/kg) may be administered IM. The general rule is to double the IV dose. Expect a longer duration of effect with the IM route.

Alternative/Optional Treatments

- *N*-butylscopolammonium bromide (Buscopan, Boehringer Ingelheim) is an antispasmolytic that is particularly effective for horses with undiagnosed excessive motility (spasmodic colic; 0.3 mg/kg IV once, given slowly). However, it also transiently elevates the heart rate for approximately 20 minutes, which can be disconcerting but should not deter veterinarians from using this medication in the correct circumstances (spasmodic or gas colic). The medication is combined with dipyrone in other countries, including those in the European Union. Dipyrone is an NSAID that inhibits a cyclooxygenase isoform (COX-3) that is localized to the central nervous system. This inhibition provides relatively low-level but perceptible pain control. In the United States, one alternative is to use Buscopan in combination with a low dose of an NSAID (e.g., flunixin meglumine 0.25 mg/kg IV) to obtain similar mild analgesic effects. Veterinarians also report that Buscopan substantially reduces rectal tone, making palpation easier to perform.

CAUTION!

- A sustained heart rate at or above 60 bpm warrants close attention because the degree of pain may necessitate referral.
- NSAIDs are unlikely to control pain in horses with severe colic.
- Before administration of medications via a stomach tube, the horse should be checked for the presence of nasogastric reflux or distention of small intestine during rectal palpation.

Table 2. Physical Signs of Dehydration

Degree of Dehydration (%)	Duration of Skin Tent (sec)	Enophthalmos
Normal	2–3	None
6	4–6	None
8	6–8	Mild
10	>8	Obvious

- A new NSAID, firocoxib (Equioxx, Merial; 0.1 mg/kg PO q24h), is now available. It is selective for COX-2, which is largely responsible for pain and inflammation. Because COX-1 is responsible for physiologic functions such as gut barrier function, firocoxib is, in theory, safer than NSAIDs that inhibit COX-1 and COX-2. This is the premise behind the human NSAID COX-2 inhibitor celecoxib. Side effects led to the withdrawal of rofecoxib from the human market; however, they included heart attacks that are very rare in horses because the blood supply to the heart is different in horses than in people. Firocoxib comes only in a paste formulation; nonetheless, it could be used in horses with colic as an alternative NSAID that would, in theory, have fewer GI side effects. Because firocoxib must be given orally, horses with reflux are not candidates for receiving this drug, and the onset of action is slower than that of drugs that are administered IV (e.g., flunixin meglumine).
- The age-old management technique of walking horses with colic helps prevent horses from rolling and traumatizing themselves. In addition, this technique allows owners to take part in managing abdominal pain.
- More efficacious analgesics will continue to become available. For example, medetomidine is more potent than detomidine.
- Acupuncture has been advocated as a potential therapy for abdominal pain but is unlikely to reduce signs of acute colic.

Supportive Treatment

A nasogastric tube should be inserted to check for reflux. If there is no reflux, many patients benefit from nasogastric administration of one of the following laxatives:

- Mineral oil (2 L in 6 to 8 L of water) *or*
- Dioctyl sodium sulfosuccinate (180 to 240 mL in 1 gal of water) *or*
- Magnesium sulfate (1 g/kg in 4 L of water)

Fluids may be administered via nasogastric tube or IV, depending on the severity of dehydration and the presence of nasogastric reflux.

The level of dehydration can be based on the duration of a skin tent (by pinching a fold of skin on the neck) and the degree of enophthalmos (sinking of the eye into the orbit as a result of dehydration of periorbital fat; Table 2). To determine the fluid deficit of the horse, multiply the percentage of dehydration by the body weight in kilograms. For example, a 500-kg horse that is 6% dehydrated has a 30-L fluid deficit. Administration of at least half of the deficit is required to have a noticeable clinical effect. Additional signs of dehydration include abnormal mucous membrane color and prolonged capillary refill time.

Dehydration of less than 5% to 6% cannot be detected using physical parameters. Horses that are 8% to 10% dehydrated tend not to benefit from oral fluids because of the extent of dehydration and reduced GI motility.

Horses should have all feed withheld while they are actively showing signs of colic and for 4 to 6 hours following resolution of colic.

Patient Monitoring

Physical signs of abdominal pain (e.g., pawing, sweating, rolling) should be monitored continuously for the first hour following initial treatment, then every hour for approximately 4 to 6 hours (preferably in a controlled environment such as a stall).

In some horses that are stoic, the degree of pain can be determined only by monitoring the heart rate. Therefore, the heart rate should also be monitored every hour for the first 4 to 6 hours following initial treatment.

Box 5. Rectal Examination

Examination of the abdomen per rectum is recommended for the safety of the horse, handler, and veterinarian. The rectal examination helps detect distention and abnormal bowel positioning. The most common finding is a distended small intestine due to obstruction or enteritis or a distended large colon or cecum due to impaction, tympany, and/or displacement. In all cases, the abnormal bowel distention or position is an indication of bowel obstruction, which requires treatment.

Technique

- Apply a twitch and/or administer a sedative.
- Approximately 60 mL of Carbocaine (AstraZeneca) may be instilled onto the rectal mucosa to reduce straining and provide some relaxation.
- IV Buscopan can also be used to achieve rectal relaxation and may be appropriate for treating some types of colic (e.g., spasmodic colic).
- Allow rectum to relax around arm before deep palpation.
- Attempt to palpate all fixed structures (spleen, left kidney, cecal taenia, small colon, pelvic inlet).
- Examine for malposition.
- Examine for distention.
- If possible, identify the affected segment of the intestine.

Specific structures that the clinician should attempt to identify during normal rectal palpation:

- **Spleen**—Fixed position on the left side against the abdominal wall.
- **Left kidney**—Fixed just axial to the spleen and attached to the dorsal body wall.
- **Cecum**—The cecal base is fixed and taenia (bands) can be palpated on the right side of the abdomen.
- **Pelvic flexure**—Not always palpated because it can move within the abdomen; it is usually just below, and on the left side of, the pelvic brim.
- **Small colon**—Normally identified by the presence of fecal material.
- **Urogenital organs:**
  —**Mare**—Bladder, uterus, and ovaries.
  —**Stallion**—Inguinal rings.

If reflux or small intestinal distention is present, nasogastric medications or fluids should not be administered.

In addition, horses should be monitored for dehydration by evaluation of skin tent, enophthalmos, mucous membrane color, and capillary refill time.

Milestones/Recovery Time Frames

Response to analgesic treatment includes:

- Progressive decrease in physical signs of pain.
- Progressive decrease in heart rate.
- Return of normal appetite.

Response to fluid therapy includes:

- Progressive decrease in the duration of a skin tent.
- Progressive decrease in capillary refill time.
- Progressive improvement in mucous membrane color.

Treatment Contraindications

- Excessive or too-frequent dosing of NSAIDs (including administration of more than one NSAID at the full dose at one time).
- Excessive treatment of horses with mild colic (e.g., use of detomidine or excessive use of an NSAID that may mask further signs of colic when xylazine may suffice).

- Nasogastric administration of any medication or fluids in a horse that is actively refluxing.
- Spasmolytic, parasympatholytic agents such as atropine (these agents dramatically exacerbate signs of colic). The best option for treatment of suspected increased motility is Buscopan.

PROGNOSIS

Favorable Criteria

(Indicating the horse can be managed without referral)

- Response to analgesic treatment.
- Normal heart rate.
- Passage of feces.

Unfavorable Criteria

(Indicating the need to refer for possible surgery)

- Poor response to analgesic treatment (particularly if there is no response to detomidine).
- Escalating heart rate or persistently elevated heart rate.
- Signs of abdominal pain in the presence of abnormal findings, including abnormal mucous membrane color, abnormal rectal palpation findings (Box 5), or nasogastric reflux.

RECOMMENDED READING

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