

## Risk factors for colic

Fernando Malalana DVM PhD DipECEIM FHEA FRCVS  
Philip Leverhulme Equine Hospital, University of Liverpool, Leahurst Campus

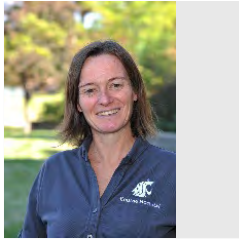
Colic is a significant problem in terms of welfare and economics. Its incidence differs between populations but typically varies between 3.5-10.6 episodes per 100 horse years (i.e. if you keep 100 horses for 1 year expect between 3.5 -10.6 episodes of colic). Estimated case fatality rates are between 6.7-15.6%, but this depends on the type of population studied (approximately 9% for medical colic vs 30% for surgical colic). Epidemiological studies have identified a number of risk factors for colic. These can be divided into those at horse level and those at management level.

At horse level, sex or age have not shown a clear or consistent association with colic. However, certain breeds or horse types have been associated with certain types of colic; for example, large colon volvulus or epiploic foramen entrapment are more common in large breeds whereas pedunculated lipomas are seen more frequently in pony breeds.

A number of variables at management level have been associated with an increase in the risk of colic. For example, recent changes in feeding, a recent reduction in turn-out time, lack of regular dental treatment or lack of routine worming programme, have been shown to predispose a horse to colic.

In addition a number of risk factors associated with mortality or complications post-surgery have also been identified in a number of epidemiological studies.

*I graduated from the Complutense University of Madrid in 2001 followed by 6 years in mixed practice in East Yorkshire, UK. In 2008 I moved to the University of Liverpool where I completed an ECEIM residency in Equine Internal Medicine. I am a European Specialist in Equine Internal Medicine since 2011 and currently work as a senior lecturer at the University of Liverpool. In 2021 I completed a PhD on the Epidemiology of Uveitis. I am interested in all aspects of Equine Medicine but have a particular interest in ophthalmology, oncology, neurology and gastrointestinal medicine.*



## Managing horses with colic on the farm

Macarena Sanz, DVM, PhD, DACVIM-LA  
Washington State University, Pullman, WA, USA

Colic is one of the most common medical conditions equine practitioners see in the field. Most of these colics will resolve with minimal intervention in the field but ~10% may require more intense management. The clinical signs of colic vary with disease severity but non-gastrointestinal conditions such as laminitis, pleuropneumonia, and rhabdomyolysis, among others, can also cause similar clinical signs. Thus, it is important to keep an opened mind when evaluating these cases.

Medical colics include gas/spasmodic colic, large colon impactions or displacements. It is key to identify horses in need of more aggressive treatment early on as this increases prognosis for survival and decreases the cost of treatment.

### Medical management:

1. History, signalment and geographic location are very important when compiling a list of differential diagnosis.
2. Colics should have a thorough physical examination. If the horse is painful or if it has a high heart rate (~ 60 bpm), a nasogastric tube (NGT) must be passed immediately to prevent stomach rupture as horses can't vomit. The physical examination can be continued once the tube is in place. In severe cases, sedation may be required to assess the horse. In these cases, an abbreviated physical exam is usually performed.
3. If sedation is needed, a combination of xylazine or romifidine and butorphanol is recommended prior to transrectal palpation. Butorphanol may not be needed for NGT placement alone. Sedation decreases HR and GI motility. Whenever possible, record the TPR parameters before drug administration. Detomidine is a very potent analgesic, and is best not to use it until a decision about surgery is made.
4. Borborygmi is usually decreased if the horse has been anorectic.
5. Tacky mucous membranes are an early indicator of dehydration. Other clinical signs like increased HR and CRT, decreased jugular filling, weak peripheral pulses and cold extremities are observed in more severe cases.
6. If the heart rate is not high and the horse does not appear overtly painful, transrectal palpation before passage of a nasogastric tube is of benefit as this will allow to decide on the size of the NGT (large if distended loops of small intestine are palpated vs small for oral fluid therapy if an impaction or large colon displacement are identified).
7. Transrectal palpation can be challenging in the field. One should consider the age, size, and temperament of the horse and the facilities available. Sedation using a combination of alpha2-agonists and butorphanol is advised over alpha2-agonists alone to minimize the risk of being kicked. Additional forms of restraint such as a twitch or lip chain may be needed. N-butylscopolammonium bromide injection (Buscopan®) relaxes the rectum and facilitates rectal palpation. It may also aid with spasmodic colic, although its duration of action is short, < 30 min.

8. Ensuring adequate hydration is key. This can be achieved using oral (given by NGT, my preference when possible) transrectal or IV fluids. Balanced oral electrolyte solutions should be used for oral fluids, but plain water should always be used for transrectal fluid therapy. For oral fluids, our clinic uses an isotonic solution made of 6L of water + 35 g of NaCl (2.5 tablespoons of regular salt) + 22 g of NaHCO<sub>3</sub> (5 teaspoons of baking soda) and 4 g of KCl (1 teaspoon of Lite salt).
9. Impactions of the large intestine can be managed in the field but may require significant (aggressive) fluid therapy. This can be achieved using an indwelling NGT and having the owner administer fluids frequently (if the owner is considered knowledgeable enough).
10. Ultrasound of the abdomen is helpful to assess visible portions of the GI and peritoneal fluid characteristics and amount.
11. Radiographs of the abdomen are limited with portable equipment. Cranioventral evaluation of the abdomen may reveal sand.
12. Point of care, hand-held devices are available for evaluation of blood gases, creatinine, lactate, SAA and electrolytes. Some of these tests can be also used in peritoneal fluid. These are not needed in every single colic case but can be helpful for specific cases. Alpha2-agonist administration significantly decreases PCV but does not affect TP.
13. Abdominocentesis: Evaluation of peritoneal fluid is helpful to diagnose peritonitis or GI rupture, and to evaluate progression (total protein, lactate values). Normal peritoneal fluid is light yellow and has a low total protein (<2.5 g/dL). Protein increases with inflammation. Lactate should always be evaluated in correlation with peripheral (blood) lactate. If the abdominal fluid lactate is higher than the peripheral lactate, ischemia of a segment of the GI should be suspected.
14. Pain management:
  - Mild, medical colics may resolve after NSAID administration (and most likely without it). If a horse colics after flunixin administration, further work up is required.
  - Acetaminophen (20mg/kg PO q12-24h) is a nontraditional NSAID that has analgesic and antipyretic properties but is not a good anti-inflammatory. This drug has not been thoroughly evaluated in colicky horses.
  - Dipyrone, a nonclassical NSAID (30mg/kg IV q12h), provides mild to moderate analgesia in other species, some work suggests that this may also be the case in horses, but more information is needed.
  - Alpha2-agonists and opioids are also analgesics.
  - Buscopan® (0.3 mg/kg IV or IM) can provide short-acting (20-30 min) smooth muscle spasm and pain. Buscopan administration increases HR for about 20 min.

**When to refer:** When money is taken out of the equation, almost all horses with colic can be saved if the problem is recognized early and the appropriate treatment is instituted. Unfortunately, economics do play a very important role and the conversation about cost is very important. More details about referral can be found elsewhere in these proceedings.

### Summary

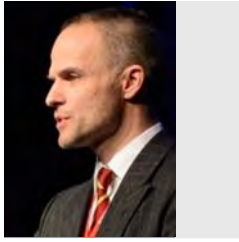
Colic is a very common condition of horses. Although most horses with colic will improve with medical treatment, early identification of horses in need of more aggressive treatment is key for success. Field management of colics should include pain management, treatment of the primary lesion and restoring of hydration/volemia when needed.

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**Dr. Sanz** graduated as a veterinarian in La Plata, Argentina. She completed an Equine Internship, a Large Animal Internal Medicine Residency and a Master's of Science degree at Washington State University and she is a Diplomate of the ACVIM College. She also completed a PhD in equine immunology at the Gluck Equine Research Center; her research focuses in equine immunology and infectious diseases. She worked as a Senior Lecturer in Equine Medicine at the Onderstepoort Veterinary School in South Africa for 3 years. Dr. Sanz is an Associate Professor in Equine Medicine at Washington State University in the US.



## When Does it make Sense to Refer a Colic ?

James L. Carmalt MA, VetMB, MVetSc, PhD, FRCVS, DABVP(Eq), DAVDC(Eq), DACVSMR(Eq), DACVS Professor – Equine Surgery, Dentistry, Sports Medicine and Rehabilitation, Department of Large Animal Clinical Sciences, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, SK S7N5B4 Canada.

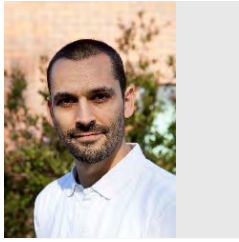
Colic is a common equine problem and a veterinarian who spends any part of their professional time dealing with horses will have to manage a horse with colic at some point. Deciding whether, and how, to send a horse with colic to a referral clinic can be a source of stress to the treating clinician and to the client. Sometimes the choice is not really a choice. It is a case of referring the horse, or euthanasing it. This may seem harsh, but in reality, one part of the job of a veterinarian is to make tough decisions. Addressing the client's wishes and concerns is one thing, but ultimately the welfare of the animal needs to remain paramount. It is also important to remember that referral is an active process in which one professional colleague contacts another and they agree on a case transfer. Before the animal is sent. "Just take the horse to Dr. X" or "Call Dr. Y" is not a referral.

There are four reasons when it makes sense to refer a colic. A surgical lesion has been diagnosed (with or without considerable pain); the horse is in uncontrollable pain; a desire, or need, for a second opinion; or a situation where the management required to address the problem would be facilitated by referral.

If there is an option to refer, the ultimate questions becomes ones of animal health status and the more practical ones of whether the clinician has the materials, expertise, staff, and time to deal with this colic? Irrespective of the underlying colic problem, if the veterinarian does not have the latter at their disposal, then referral is the only ethical option. However, it is important that the referring veterinarian only send animals that they believe will benefit from the transfer. Sending horses that are unlikely to survive the transport, or those that are so sick that they will not survive the intervention for which they were referred (e.g. surgery), is irresponsible. If the primary care clinician can determine the packed cell volume (PCV), total protein (TP) and lactate concentration of the horse's venous blood it will help them determine the likelihood of a successful outcome. This can be combined with an assessment of the lactate concentration of the abdominal fluid, if it is safe to perform an abdominocentesis.

Horses with colic require management and monitoring. Veterinarians providing after-hours service typically do so for a wide geographical area, or for more than one person. As such, they typically diagnose and treat the colic and leave the monitoring of the animal to the owner, trainer, or horse manager. They do not have the time. Nor can the horse owner afford to have veterinarians sitting and monitoring the animal. Intravenous (IV) fluids are routinely administered on farm. However, if there is a need for prolonged IV fluid administration with, or without, intermittent nasogastric intubation (such as an impaction colic) then moving the animal to a central facility (whether it is a "referral" or not) may be more efficient and result in improved case management.

**Dr. James Carmalt** graduated from the University of Cambridge in 1998. He did an internship in large animal medicine and then went into general practice in Tasmania (Australia). Following that, he did two back-to-back residencies (Equine Practice and Large Animal Surgery) combined with a Masters degree (Equine Dentistry) and a Fellowship of the Royal Veterinary College (FRCVS). Dr. Carmalt is currently a full professor, with tenure, at the University of Saskatchewan in Canada. He holds a PhD and Diplomate-status (by examination) with multiple internationally recognised speciality Colleges including equine practice (ABVP), equine dentistry (AVDC), equine surgery (ACVS), sports medicine & rehabilitation (ACVSMR). Dr. Carmalt travels extensively to work for individual clients, private practices and academic institutions.



## Practical fluid therapy

Fernando Malalana DVM PhD DipECEIM FHEA FRCVS  
Philip Leverhulme Equine Hospital, University of Liverpool, Leahurst Campus

The main purpose of fluid therapy is restoring circulating volume in cases dehydration or hypovolaemia. This will in turn improve cardiac output and increase oxygen delivery to tissues. In addition, fluid therapy is used to correct metabolic derangements such as electrolyte imbalances or acid-base disturbances.

There are two main types of fluids:

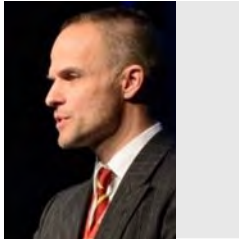
Crystalloid solutions consist of electrolytes in water and can be isotonic, hypertonic or hypotonic. Isotonic crystalloids have the same osmolality as plasma and can be administered in large volumes. Hypertonic fluids are used to restore circulating volume rapidly by drawing water from the intracellular fluid. Hypotonic fluids are typically only used to correct plasma hypertonicity.

Colloids are solutions containing larger molecules, allowing them to persist longer in the circulation whilst exerting osmotic pressure to draw water into the vascular space in a similar way to hypertonic crystalloids. Examples of colloids include gelatines, starches or plasma.

Two main routes of administration of fluids are used: intravenous and enteral. The administration of fluids via the intravenous route is mainly done through the jugular vein but other options are available. The enteral route, via a nasogastric or naso-oesophageal tube provides an affordable alternative in cases where the intestinal function is unaffected. More recently, administration of fluids per rectum has been described.

Any fluid therapy plan must replace the fluid deficit present (as determined by clinical signs or laboratory markers), provide the daily maintenance requirements and consider any potential ongoing losses (such as reflux or diarrhoea).

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## Post-surgical management after enterotomy:

Expectations and Outcome

James L. Carmalt MA, VetMB, MVetSc, PhD, FRCVS, DABVP(Eq), DAVDC(Eq), DACVSMR(Eq), DACVS  
Professor – Equine Surgery, Dentistry, Sports Medicine and Rehabilitation, Department of Large Animal Clinical Sciences, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, SK S7N5B4 Canada.

Return an animal to its stall after having “fixed” a colic problem is only the beginning of the journey. Broadly speaking, 80 % of horses undergoing colic surgery survive to hospital discharge. In the long-term (1 yr or more) survival rates range from 34-90%, depending on age and location of lesion. The post-operative phase is critical and yet there is little “glory” to be had at this point. This is also the point at which the client is ever-present, thus the specter of a lawsuit looms in cases with unsuccessful outcomes. The expectations are that the horse will be free of colic/pain; that it will be able to manage its fluid and nutritional intake; that the gastrointestinal tract will function normally; and the catheter and incision will remain infection free. The outcome however, may be very different.

### Fluid and Nutritional Management

Fluid therapy is a massive topic that has the potential to directly influence GI motility. Overall, however it is important to deliver sufficient fluids to address any surgical, or trauma-related, loss as well as ongoing maintenance. In most cases 1 liter per hour is necessary (in temperate climates) to address normal needs in a 500kg horse. These can be delivered intravenously using a balanced, isotonic solution, or parenterally via a stomach tube. For post-enterotomy fluid management, either the horse is not administered any additional fluid (large colon enterotomy at the pelvic flexure) or an appropriate, electrolyte managed fluid (calcium, potassium or magnesium enriched). The benefit of fluids administered per os (via a stomach tube) is that no special or expensive materials are needed, and the fluid delivered induces a gastrocolic reflex, which may actually assist in developing, or improving, large colon motility.

Post-operative nutrition is a very important aspect of the post-operative colic patient. It will not be discussed in this lecture as it is covered elsewhere

### Post-operative ileus (POI)

POI has a prevalence ranging from 10-56%. Risk factors have been reported as being high packed cell volume (PCV) and heart rate, longer durations of surgery and anesthesia, and small intestinal involvement. In one study there were no incidences of POI with jejunojunostomies, but increased risk after jejunocostomies. There is also one study suggesting that a pelvic flexure enterotomy may reduce the risk of POI but that is not a consistent finding in the literature.

### Re-laparotomy & Adhesion formation

Post-operative pain with, or without gastrointestinal ileus, is a reason to re-operate a colic. If there is a need to go back to surgery, it is better to re-operate early. However, it is important to realize that approximately 50% of horses who are put back on the table are euthanased during the second surgery. There is also a much higher risk of incisional infection and subsequent herniation with a second surgery in the post-operative period.



The development of abdominal adhesions post-celiotomy is well documented in humans as well as in domestic animals. They are a cause of significant post-operative morbidity, especially in small intestinal surgery. The majority of adhesions pose no clinical threat, however their prevalence accounts for adhesions being the most common cause of small intestinal obstruction in humans (26-64%), some of which will necessitate a repeat surgery and adhesiolysis. In a human post-mortem study 67% of patients had abdominal adhesions after a single celiotomy; whereas 97% of those people having more than one abdominal surgery had adhesions.

In the horse, between 6 and 26% of animals undergoing abdominal surgery will develop adhesions, which may result in small intestinal obstruction, internal herniation and strangulation post-surgery. These may result in an acute, emergency situation (usually within the first 60 days post-surgery) or recurrent episodes of abdominal pain in the post-operative patient. Foals, similar to human children, are considered at increased risk of developing post-operative abdominal adhesions (33%).

Unfortunately, the presence of adhesions can only be made at a second surgery (laparotomy or laparoscopy) or at post-mortem and thus the true incidence is unknown. The majority of adhesions are likely asymptomatic however it is not known how many or whether a single adhesion in a particular anatomical location will be a cause for concern. Common sites of adhesion formation in the horse are between the tip of the cecum and the ventral body wall and between loops of small intestine.

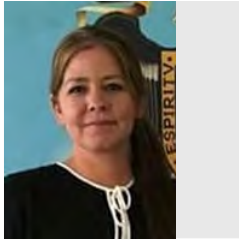
Overall, the myriad products and multiple interventional strategies aimed at reducing adhesion formation in the horse (specifically the foal) highlight a lack of basic pathophysiological knowledge that needs to be addressed before yet another "wonder product" is tested.

### **Infection (fever of unknown origin (FUO))**

FUO is a troubling complication of surgical intervention. There is often a transient post-operative increase in body temperature. This is usually within the first 12-24 hours after surgery and is thought to be associated with the systemic stress of anesthesia. Usually of low grade, this is usually self-limiting and does not need treatment. Persistence of a fever beyond this time, or development of the same in the 4-5 day post-operative period needs careful assessment. Common sites of sepsis are the catheter and, or the incision. An adverse behavioral response to gentle palpation, and ultrasound investigation will usually help determine whether these sites are infected.

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## Equine nutrition in the post-operative colic

MVZ Cert. Elena Garcia-Secco, MVZ Ms. Cert. Mariano Hernández Gil  
Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México

Postoperative nutrition plays a crucial role in the recovery and overall well-being of horses undergoing colic surgery. Colic, a common gastrointestinal disorder in horses, can result in surgical intervention, which places significant stress on the digestive system. The primary goals of postoperative nutrition for colic in horses are to support the healing process, maintain hydration and electrolyte balance, provide adequate energy and nutrients, and prevent complications such as postoperative ileus and laminitis. The nutritional requirements during this period may vary depending on the severity of the colic, surgical procedure, and individual horse's needs.

Several challenges are associated with postoperative nutrition in horses with colic. Postoperative ileus, a condition characterized by decreased intestinal motility, can impair feed intake and digestion. Pain, stress, and the use of analgesics may also affect appetite and nutrient absorption. Additionally, horses recovering from colic surgery may have altered gastrointestinal function and nutrient utilization, requiring careful monitoring and adjustment of the feeding regimen.

To meet the nutritional needs of horses post colic surgery, a gradual reintroduction of feed is typically recommended. Initially, horses are provided with small, frequent meals of easily digestible feeds such as hay pellets or soaked hay. As the horse's gastrointestinal function improves, the amount and complexity of the feed can be increased gradually. Monitoring the horse's appetite, body condition, and gastrointestinal function is essential to ensure appropriate feeding adjustments.

Supplemental feeding may be necessary to meet the increased energy and nutrient requirements during the recovery period. Commercially available complete feeds or specially formulated supplements can provide the necessary balance of carbohydrates, proteins, fats, vitamins, and minerals. The use of probiotics and prebiotics may also aid in restoring a healthy gut microbiota and improving nutrient absorption.

Water intake is crucial for postoperative recovery, as horses may become dehydrated due to decreased feed intake or surgical stress. Access to clean, fresh water should be provided at all times, and electrolyte supplementation may be necessary to maintain proper hydration and electrolyte balance.

In conclusion, gradual reintroduction of feed, supplemental feeding, and attention to water intake are essential strategies for successful postoperative nutrition in horses with colic. By implementing appropriate nutritional support, the recovery process can be optimized, leading to improved outcomes for these valuable animals.

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**MVZ Cert. Elena García Seco**

*Born in Mexico, Elena obtained a First Degree (Hons.) in Veterinary Medicine and Animal Science by the National Autonomous University of Mexico (UNAM). She performed externships at the University of California Davis and the University of Minnesota. She then achieved an Equine Internship at Louisiana State University, a Residency in Equine Surgery at the University of Missouri and a Clinical Instructorship in Surgery at the Marion duPont Scott Equine Medical Center of Virginia Tech. Worked as a professor and surgeon at the Universidad Alfonso X in Madrid and since 2013, she is a Faculty Member of the Equine Department at the College of Veterinary Medicine (UNAM) taking part as an equine professor and a senior surgeon.*