



Colic: An Age-Old Problem

To make a perfect horseman, three things are requisite. First, to know how and when to help your horse. Secondly, how and when to correct him. And thirdly, how and when to praise him and to make much of him. —Thomas Blundeville

In spite of all the progress made in equine medicine in the last 30 years—significant advances in abdominal surgery, post-operative treatment and intensive care for horses—colic is still considered the most common cause of death in adult horses and accounts for a large proportion of emergencies for horse owners and veterinarians. It has been reported that approximately 920,000 horses nationwide will suffer an episode of colic each year, and more than 64,000 horses will face potentially life-threatening problems due to colic. Another report cites the incidence of colic at about 11 cases for every 100 horses per year. These are significant numbers, any way you look at them.

The word *colic* is a vague term that indicates clinical signs of pain in



the abdominal cavity. It is not a specific disease but rather a combination of signs that signal the presence of abdominal pain in horses. These signs can range from mild to severe and can rapidly become a life-threatening situation. The most common clinical signs easily noticeable to horse owners include:

- Repeated turning of the head toward the flank
- Pawing
- Repeatedly lying down and getting up or attempting to get up
- Sweating
- Kicking or biting at the abdomen
- Stretching out as if to urinate
- Rolling, especially violent rolling
- Sitting in a dog-like position or lying on the back
- Lack of appetite
- Putting head down to water without drinking
- Lack of bowel movements, as evidenced by fewer manure piles
- Rapid respiration and/or flared nostrils

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DIRECTOR'S MESSAGE



Dr. Gregory L. Ferraro

Over the past two decades, marked advances have been made in the diagnosis and treatment of equine colic. Laboratory analysis and imaging methods have been improved to allow for more accurate prediction of cause, effect and outcome. Likewise, improvements in surgical techniques have broadened the scope for successful surgical therapy, while advancements in internal medicine have greatly improved patient care.

At the UC Davis School of Veterinary Medicine and elsewhere, thousands of hours are devoted each year to researching the problem of colic in horses. Each advancement in knowledge has come through hard work on the part of the researchers, made possible by significant monetary investments from the horse industry. But in spite of this, a diagnosis of colic still brings chills to the spine of horse owners everywhere and with good reason: Colic remains the number one cause of death among horses. The fact is that while researchers have come a long, long way, there are still many miles to travel on the path to complete understanding and therapeutic success.

One of the Hardest Jobs in Veterinary Medicine

In this issue of the *Horse Report*, we review some of the common clinical signs and causes of colic and discuss some currently known avenues for preventing colic. We illustrate the complexity of the equine intestinal tract and discuss the underlying anatomic and physiologic causes for many of the most common forms of colic seen by horse owners. Our goal is to provide readers with a basic understanding of how veterinarians decide on a given course of therapy in an individual case of colic.

We also discuss what you as a horse owner can expect to experience when bringing your horse to the UC Davis Large Animal Clinic for treatment of colic. This description will help prepare you for the process of caring for a critically ill animal. While the procedures and processes described are for our hospital, they reflect the clinical processes employed in most modern equine hospitals. Consequently, they should be useful to you regardless of where your horse may be treated.

Additionally, we describe the ongoing colic research program in the UC Davis School of Veterinary Medicine. This program has been in existence for many years and has proven to be one of the best run and most productive of its kind in the country. Our Comparative Gastroenterology Laboratory has contributed much knowledge to the understanding of how the equine intestinal tract functions and has made significant contributions to the improvement of clinical treatments for colic worldwide. We share the most recent discoveries made by this group of outstanding

investigators with the hope that equine enthusiasts will revisit their commitment to the support of research in this area.

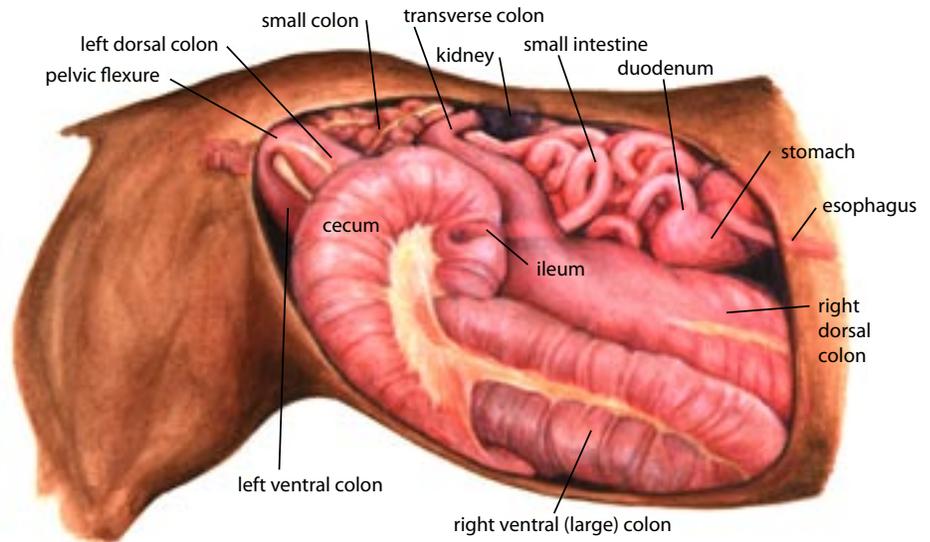
Finally, a word about the individual care-giving veterinarians and technicians involved with clinical cases of colic. Treating horses for colic is one of the hardest and most stressful jobs in the equine medical field. These cases, by their nature, often involve the most intense conduct of emergency care faced by clinicians. The patient is in pain, is distressed, sometimes hard to handle, and often extremely sick. The attending medical team must make rapid and accurate assessments of the patient's status, determine the cause of distress, and decide upon a course of treatment—all within a very short time. The treatments for colic, whether medical or surgical, are difficult and require extensive therapeutic knowledge, experience and concentration to accomplish. Moreover, the correction of equine colic (especially surgical correction) is one of the most physically demanding tasks in veterinary medicine. It is tiring work that is often required at odd hours during the night and on weekends when most people would prefer to be with their families. So please, the next time you have a horse treated for colic, take a minute to forget your discomfort and look at the faces of the attending veterinary staff. Mirrored there will be your own stress, fear and anxiety. Contained there as well, however, you will find the hope and determination necessary for achieving a successful outcome. Be kind to these colic specialists, they are among the best and most dedicated in the veterinary field.

Colic

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Although there are numerous causes of colic, including nonintestinal causes, the gastrointestinal tract of the horse is fundamentally a highly complex system—so much so that veterinarians like to say that it was designed by a committee. The digestive tract consists basically of a long muscular tube (about 100 feet) made up of six basic parts—the **esophagus**, the **stomach** (small, 4-gallon maximum capacity), the **small intestine** (about 70 feet), the **cecum** (a large digestion vat shaped like a giant comma about 4 feet in length), the **large colon** (about 15 feet in length with multiple bends and turns), and the **small colon** (the final 10 feet leading to the rectum, small in diameter compared with the large intestine).

The horse's digestive tract has become well adapted over millions of years to grazing small amounts of grass nearly continuously. Cellulose, a major component of grass, is poorly digestible and horses have adapted in two important ways to aid in its breakdown to usable nutrients. First, the total length of the intestinal tract prolongs the time that food stays in the body so there is a longer time to digest the cellulose. In addition, a population of bacteria living in the digestive tract, particularly the cecum and large colon, help break down the cellulose so the horse can absorb nutrients. Because of this evolution and adaptation to continuous grazing, the horse is very susceptible to disruptions of digestive function caused by modern-day management practices.

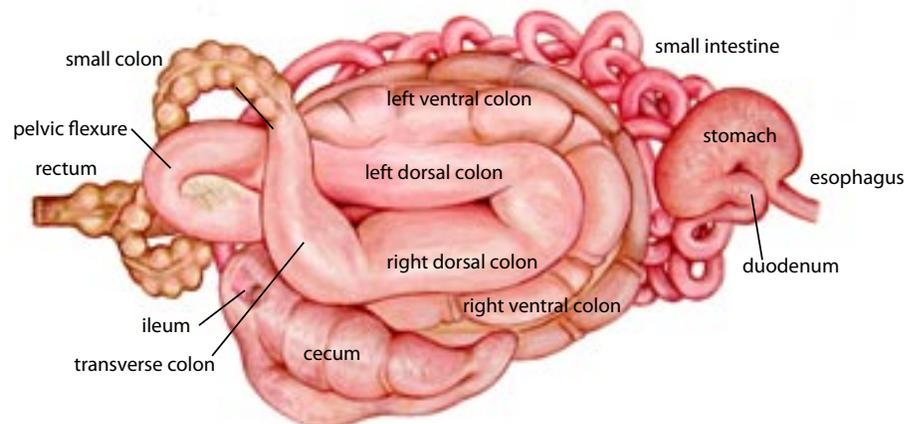


This illustration depicts the right side of the horse's gastrointestinal tract.

Colic is usually related to a problem in the abdominal cavity. These problems can generally be broken down into four groups, each of which will be discussed later in more detail. The four groups are:

Distension: No physical blockage but the digestive tract cannot move material along normally so that distension of the intestine becomes painful. Can be rapid and severe or slow and mild. Examples are gas colic, spasmodic colic and thromboembolic colic.

Simple obstruction or blockage: Material cannot move down the digestive tract due to an obstruction. Usually causes mild to moderate pain and relatively slow progression. Examples are feed impaction, parasite impaction, enteroliths, sand, foreign bodies, and entrapments.



This illustration shows the dorsal view of the gastrointestinal tract (looking down on the horse, head to the right).

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Obstruction or blockage with partial or complete shut-off of the blood supply: Usually this causes constant and severe pain with rapid development of shock because of intestinal death and subsequent release of toxins and bacteria into the bloodstream. Examples are **torsions** (abnormal twisting of the intestine), **twists**, **lipomas** (fatty tumors), **epiploic foramen incarceration** (the epiploic foramen is a natural opening between the portal vein, the caudal vena cava, and the caudate lobe of the liver and can be the site of intestinal incarcerations where a loop of intestine passes through this opening and results in swelling, obstruction and closing off the blood supply), and **intussusception** (tubular displacement of one segment of intestine into another segment).

Enteritis/colitis or inflammation of the bowel wall: Causes stasis of the intestine due to inflammation and subsequent distension of the intestine. Examples are *Salmonella* diarrhea, Potomac horse fever, anterior enteritis, *Clostridium* diarrhea, and gastric ulcers.

Colics are also categorized according to the type of treatment required: **medical** or **surgical**. Colics due to impactions, parasites, and inflammation, for example, are commonly treated medically, whereas obstructions, torsions and severe impactions often require surgery. Some types of colics can be treated initially with medical therapy, but if there is no improvement surgery may be required.

Although colic usually is related to problems of the intestinal tract, diseases in other organs can manifest in similar clinical signs. Some nonintestinal causes of colic are:

- Normal foaling
- Dystocia (difficult foaling)
- Placenta retention
- Abortion
- Uterine torsion
- Pleuritis (inflammation of the lining of the chest cavity; common after long periods of transport)
- Toxicity (e.g., oleander toxicosis)
- Botulism
- Renal and bladder stones
- Ruptured bladder
- Choke
- Liver problems and hepatitis
- Myositis (inflammation of muscle tissue)
- Laminitis
- Heart problems
- Rabies
- Exertional rhabdomyolysis or “tying up” (damage to muscle tissue)

Although some colics are relatively simple gastrointestinal disturbances that require a mild analgesic, some can only be managed surgically. *How do you tell the difference between a mild and severe colic?* Individual horses tolerate and exhibit pain to different degrees, some being more stoic than others. With such a wide range in the potential causes of colic and the severity of specific diseases, it is apparent that determining the specific cause of the pain can be difficult and why veterinary intervention is so important. Prompt veterinary care can make all the difference in the outcome, especially with a serious colic. Time lost with home remedies, home treatment, or reluctance to call your veterinarian may result in deterioration of a horse's condition, such that even with surgical treatment the horse may not survive.

A veterinarian will perform a thorough physical exam consisting of rectal temperature, pulse, gut sounds and mucous membrane color. The exam may also include an evaluation via stomach tube to determine whether intestinal contents are flowing from the small intestine back into the stomach—a sign of intestinal obstruction. A rectal exam would reveal the presence of distension, malpositioning of abdominal organs (e.g., spleen), and the presence or absence of manure. All of these factors would provide a general picture of the underlying problem and form the basis for recommended treatment.

Specific Problems in the Intestinal Tract

As stated earlier, colic is often related to a problem in the intestinal tract. Some of the more common problems are described here.

Gas accumulation in the colon and cecum is the most common cause of abdominal pain in horses. This can be produced by a decrease in normal motility or accumulation of feed in the bowel. Often horses may show some pain and get better without treatment or after some minutes of hand-walking or trotting. Other times, an analgesic or anti-spasmodic agent is required to relax the bowel and allow the gas to start passing out.

Feed impactions in the large or small colon are also common problems that produce abdominal pain in horses. Impactions can be produced by poor dental health (not being able to adequately chew the hay), lack of water in cold weather (frozen water), dehydration from exercise, decreased motility in the bowel, and poor-quality (coarse) hay. Clinical signs produced by feed impacts are usually similar to gas colic since the impaction will also prevent the passage of gas. Generally, an impaction is suspected if the horse has not produced feces in the last few days or if the feces appear dry, very small or covered by mucous.

Impactions tend to resolve after aggressive medical treatment, but in severe or prolonged cases surgery may be required to prevent the colon from rupturing. Treatment

includes the use of analgesics, intravenous fluids, and water combined with electrolytes, mineral oil or Epsom salt via nasogastric intubation. Analgesics for treating impactions should be given with caution because they may mask early signs of deterioration and the need for other treatment options such as surgery.

Sand impactions are a common problem if the horse is fed on the ground in sandy areas. It is a common problem in California. The impaction may consist of fine, coarse sand or gravel that obstructs the large or small colon. The sand can also rub and irritate the mucosa of the bowel and produce inflammation (enteritis or colitis) and sometimes diarrhea. Treatment is similar to that for impaction colic with the addition of psyllium powder or pellets. Although sand impactions can be treated medically, surgery may be indicated for severe cases. Early surgery may be less expensive than several days of unsuccessful medical treatment and may reduce both the duration of pain and the chances of intestinal rupture. The use of psyllium on a regular basis may help clear the intestine of sand before the horse develops an impaction.

Enteroliths are mineral accumulations around a nidus (a piece of metal, plastic or gravel) that form a rock inside the bowel. Usually, they are made of magnesium-ammonium-phosphate (struvite), forming round, triangular or flat shapes. They form in the large colon of horses where they can remain for some time until they move and cause an obstruction in the large or small colon. The problem is more commonly seen in the southwestern regions of the United States, with California having the highest incidence.



Enteroliths of various sizes and shapes that were removed from different horses. It is possible for one horse to have multiple enteroliths.

Enteroliths form as a result of certain diets (for example, feeding alfalfa hay exclusively), genetic predisposition, and/or management practices. Arab and Arabian-cross horses appear to be predisposed

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Colic

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to forming this type of stone, but any horse in California on an alfalfa diet may be at risk. Some horses have a history of passing stones in the feces without showing signs of colic. Clinical signs vary depending on the size and number of enteroliths and the part of the bowel where they are located. Horses with a single large enterolith in the large colon often have a history of chronic, intermittent colic. Horses with smaller-size stones that can move and become lodged within the small colon may have more acute signs of colic.

A definitive diagnosis for enteroliths can be achieved either by radiographs (x-rays) or through surgery. The ability for the radiographs to confirm the presence of stones will depend on the size of horse, the contents of feed inside the bowel and the radiographic equipment used. At UC Davis, we generally diagnose about 80% of horses with enteroliths by radiographs.

Early diagnosis is important, because an enterolith obstructing the bowel has the potential to rupture it with fatal consequences. The only successful treatment for horses with colic due to enteroliths is surgical removal. At UC Davis, our success rate after surgery for removal of enteroliths in horses is 90 to 95%.

Colon displacement is usually associated with colon tympany (an abnormal accumulation of gas) and is commonly seen in large Warmblood horses. The displacement can occur due to the accumulation of gas or to alterations in motility rather than from the horse rolling. There are two main types of displacement of the colon: to the right and to the left. When the displacement is to the left, the colon moves lateral and dorsal and becomes entrapped in a normal space between the left kidney and the spleen. The diagnosis of this problem is done by rectal exam and by the inability to observe the left kidney in the abdominal ultrasound. This type of displacement can be treated initially with medical therapy or by rolling the horse. Medical treatment consists of injecting an intravenous agent that shrinks the spleen, followed by exercising the horse. The idea is that by reducing the size of the spleen and trotting the horse, the colon will be able to move out from the entrapment. Another treatment for this type of displacement is to anesthetize the horse and roll them until the colon is free from the entrapment.

The second type of colon displacement (to the right of the abdomen) often involves the cecum. Clinical signs usually include severe gas distension and pain. The ability to feel tense bands of the colon through rectal examination usually confirms that this is the problem. The treatment for this type of colon displacement is surgical, with a good outcome in about 80 to 90% of the cases.

Colon torsions cause a severe form of colic where the colon and often the cecum displace and twist around, obstructing blood flow

to the tissue. There appears to be an age-related risk of torsions in horses around 7 years and in mares (65% of torsions occur in mares). Broodmares are often affected near or after parturition. Although the exact cause of the torsion is not known, we suspect gas distension of the ventral colon followed by floating of the ventral colon dorsal and medial. Abnormal movement of the bowel due to gas production is also believed to be involved in the causes.

The colon can be twisted from 180 to 720 degrees. The more tightly the twist, the less blood the colon will receive and the sooner the colon will die. Clinical signs in these patients are severe gas distension with acute and severe pain, not responding to analgesics. If a horse is suspected to have a colon torsion, the sooner it is referred for treatment the better the chances for recovering. Usually these horses deteriorate extremely rapidly if the torsion is not corrected by surgery. The treatment consists of aggressive medical treatment to stabilize the patient followed by emergency surgery and intensive post-operative treatment. At surgery, the colon is untwisted and evaluated. If the colon does not regain blood circulation or looks nonviable a *colon resection* (removal of a segment of the colon) may be indicated. The survival rate in these cases has improved from 50% in the past to approximately 70% in recent years. The increases in survival rates are due to early referral, improvement in intensive care medicine, and resection of the colon in severe cases. Some horses may have a recurrence

of the problem, in which case a colon resection or surgical fixation of the colon to the abdominal wall (colopexia) may be indicated.

Strangulations of the small intestine. The two most common strangulations of the small intestine of horses include strangulating lipomas and incarcerations of the bowel in the epiploic foramen. Lipomas are benign tumors of fat, commonly present in the belly of many old horses. As the tumors enlarge, they tend to form a long rope-like stalk from their attachment to the abdominal wall. These tumors may live in the abdomen without causing any problem for years until the bowel (usually a segment of the small intestine)

gets entrapped and forms a knot with the stalk of the tumor. The epiploic foramen is a small opening between the liver and the pancreas. Sometimes the small intestine migrates into this opening by its normal movement but becomes trapped when the bowel fills with fluid and the intestine cannot exit. It is believed that horses that suck air are predisposed to this problem due to an increase in intra-abdominal pressure with this vice. The end result of strangulating lipomas and incarcerations of bowel in the epiploic foramen is a decrease in blood flow to the bowel, followed by death of the affected segment.

Treatment of these problems requires emergency surgery, release of the strangulation, and evaluation of the bowel. Since the bowel cannot live without blood and oxygen for more than a few minutes, a resection of the affected segment is commonly required. Twenty years ago, the survival rate for these problems was approximately 40%. Extensive research and advances in surgical techniques and intensive care during the last 20 years have shown very positive results to improve the survival rate of these patients. Currently, approximately 70 to 80% of patients that have surgery for these types of lesions are discharged from the hospital. As with all surgical colics, an early referral improves the chances for survival. ✱



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What To Expect When Your Horse Is Seen for Colic at the UC Davis Veterinary Medical Teaching Hospital

As discussed earlier in this *Horse Report*, many problems can cause signs of colic. Often these problems originate from the gastrointestinal tract within the abdominal cavity, but other organs within the abdomen can also be involved. Furthermore, problems in other areas of the body can mimic signs of colic. A colic workup is a thorough evaluation of the entire horse to identify the source of the problem and determine the appropriate treatment to manage it.

Equine emergency services are available at UC Davis 24 hours a day throughout the year (including weekends and holidays) for colic complaints as well as all types of emergencies. Many horses are referred to the UC Davis Veterinary Medical Teaching Hospital (VMTH) after their veterinarian has initially examined and treated the horse. In this situation, the veterinarian calls the VMTH to talk to the emergency veterinarian and describe the nature of the problem, treatments given, and estimated time of arrival. However, horse owners can call the VMTH directly to make an emergency appointment for their horse without a veterinarian's referral. In either situation, it is helpful to call the VMTH 20 to 30 minutes before arrival at the hospital to alert the emergency veterinarians.

Upon arrival at the VMTH, the horse owner checks in with the Large Animal Clinic receptionist

during regular business hours or with the after-hours emergency receptionist by pressing the red button on the emergency alert intercom located to the left of the Large Animal Clinic entrance. The emergency surgery team (emergency surgeons, veterinary students and veterinary nurses) will meet the horse and horse owner and escort them to Large Animal Receiving for the colic workup.

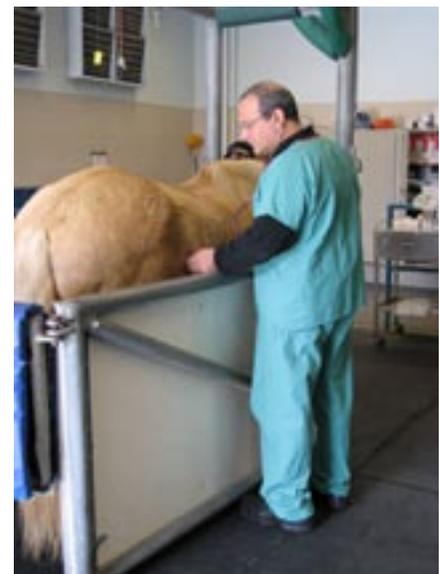
Even before the colicky horse arrives, the emergency surgery team considers the information provided by the horse owner or veterinarian to develop an initial list of potential diagnoses. Based on the horse's age, breed, sex, occupation, previous medical history, and the progression of the current colic, there are certain colic problems that may be more or less likely for that horse. The colic workup is a thorough evaluation of all possible colic conditions, with special attention being paid to the problems that the horse may be predisposed to having.

A typical colic workup at the VMTH includes a number of diagnostic procedures. Some of these are performed during nearly all colic workups, but other tests may be recommended based on the horse's risk factors and clinical findings. If the horse is critically ill, many tests and procedures will be performed simultaneously to rapidly stabilize the horse and identify the underlying problem.

During the colic workup, one or more intravenous catheters may be placed to allow the administration of intravenous fluids and other medications to help stabilize and treat the horse. Diagnostic tests that may be used to evaluate colic include:

1. Physical Examination and History

A complete physical examination is performed with special attention to the gastrointestinal tract. The cardiovascular and respiratory systems are closely evaluated for signs of shock or systemic compromise. More in-depth examinations of other body systems are performed as needed to localize the source of colic. A thorough medical history is obtained to identify possible risk factors and underlying conditions that may be important to the current colic problem.



A complete physical exam with special attention to the GI tract and cardiovascular system is part of the colic workup.

The progression of the horse's colic signs and the response to previous treatments are helpful for diagnosis and treatment recommendations.

2. Passage of a Nasogastric Tube

This procedure involves the passage of a long, hollow tube up the horse's nose, into the esophagus and down into the stomach to check for the presence of excess fluid in the stomach. This procedure is especially important in horses because they are unable to vomit and are prone to rupturing their stomach. If the stomach is not distended with feed or fluid,



A nasogastric tube is passed to relieve the pressure of a distended stomach.

treatments such as fluids or laxatives may be administered through the tube as a part of the management for colic.

3. Rectal Examination

Rectal examination is useful for evaluating the abdominal organs that are within arm's reach of the rectum. Abnormalities that may be detectable include impactions, gas or fluid distension of the large or small intestine, displaced



Rectal exam to evaluate abdominal organs within an arm's reach of the rectum.

intestines, masses or abscesses, and problems in the renal or reproductive organs. Some horses may not be candidates for rectal examination due to their size or temperament or to safety considerations for the horse and veterinarian.

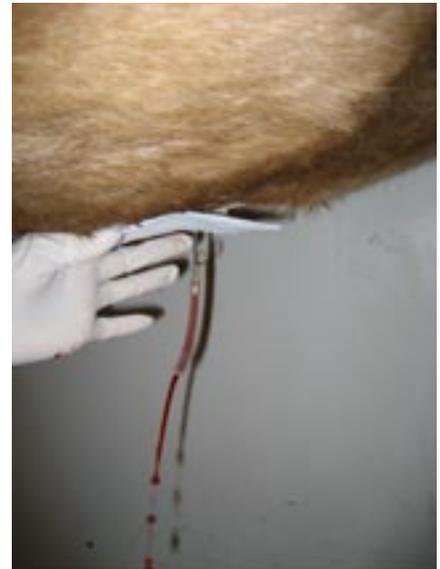
4. Blood Tests

A variety of blood tests may be performed to determine whether the horse is dehydrated or in shock and whether there is inflammation or organ dysfunction. Although these tests may not specifically diagnose the problem, they are helpful in determining the overall condition of the horse, directing treatment decisions, and predicting complications.

5. Abdominocentesis

This diagnostic test, also known as a "belly tap," involves the collection of a sample of abdominal fluid by inserting a small, blunt-ended cannula into the abdominal cavity. Normally there is a small amount of clear, pale-yellow fluid that bathes and

lubricates the intestines. During some types of colic, the color or consistency of the fluid can change, reflecting the health and status of the intestine. The amount and appearance of the fluid are assessed while the fluid is being collected, but additional laboratory tests are performed on the fluid to measure cell count, total protein, and other values.



Abdominocentesis, or belly tap, is done to collect a sample of abdominal fluid for analysis.

6. Abdominal Ultrasound

Abdominal ultrasound is a quick, noninvasive method for evaluating the intestines and other abdominal organs. The abdominal ultrasound examination can identify the amount and character of the abdominal fluid, the presence of intestinal distension or wall thickening, the degree of motility in the intestine, the location of abdominal structures, and the appearance of the liver, spleen, and kidney. The ultrasound can evaluate areas of the abdomen that are beyond the reach of

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Colic Exam at the VMTH — Continued from page 9



Abdominal ultrasound is a quick, noninvasive method for evaluating the intestines and other abdominal organs.

rectal examination, but the large size of the horse's abdomen and the presence of gas in the intestine and air in the lung prevent complete evaluation of all abdominal structures.

7. Abdominal Radiographs

Abdominal radiographs are an important part of the colic examination for most horses in California because of the prevalence of enteroliths and sand colic. Other abnormalities that can be visible on abdominal radiographs include metallic foreign bodies, such as wires or nails, and gas distension of the intestines. Abdominal radiographs are excellent for detecting sand, and they are approximately 80% successful in detecting enteroliths.

8. Other Tests

Other diagnostic tests that may be used to further evaluate colic in some horses include

gastroscopy to inspect (scope) the stomach for the presence of stomach ulcers; specialized abdominal ultrasound to further evaluate all visible abdominal organs; intestinal absorption tests to determine the intestine's ability to absorb nutrients; and laparoscopic surgery in which a small camera is inserted into the horse's abdomen to visualize the abdominal organs.

Once the colic examination is complete, the emergency surgeons evaluate the results of the tests in association with the horse's condition to determine the appropriate treatment plan and discuss the treatment options with the owner. If emergency colic surgery is needed to correct the underlying problem, anesthesiology specialists are available to help the emergency surgery team quickly get the horse into surgery.

If surgery is not needed to treat the colic, the horse is usually admitted to the Equine Intensive Care Unit for monitoring and intravenous fluid therapy. The unit is continually staffed with highly trained veterinary technicians to provide 24-hour monitoring of these critical patients under the direction of the equine emergency surgeons. Should the horse's condition change, the horse is re-evaluated by the emergency surgery team, repeating any tests as needed, to determine if surgical intervention or adjustments to the treatment plan are necessary.

If the horse needs surgery after the owner has left the hospital, the owner is contacted to obtain consent for surgery. Once the surgery is completed, the

horse is transferred to a padded recovery stall to recover from anesthesia, during which time it is continually monitored by the surgery and anesthesia team. Once the horse has recovered from anesthesia, the owner is updated with the horse's progress. The horse is then walked to the Intensive Care Unit for continual post-operative monitoring and intensive care.

Horses that require surgery are usually hospitalized for 5 to 10 days thereafter, whereas horses that resolve their colic without surgery may be ready to be discharged in 2 to 3 days. Detailed instructions are provided at time of discharge, summarizing the horse's diagnosis and treatment and recommending any continued treatments or management changes to continue at home. *



Colic surgery is performed to diagnose and correct problems that cannot be resolved medically.

What You Can Do to Reduce the Risk of Colic in Your Horse

Prevention is the best method to avoid the problems associated with colic. While horses seem predisposed to colic because of the anatomy and function of their digestive tracts, management can play a key role in prevention. Although not all types of colic are preventable, the following guidelines from the American Association of Equine Practitioners can maximize the horse's health and reduce the risk of colic:

- ⊙ Establish a set daily routine for feeding and exercise schedules and stick to it. REGULARITY of feed. REGULARITY of exercise. Make any changes in feed or exercise gradually over several days.
- ⊙ Feed a high-quality diet comprised primarily of roughage (high-quality, mold-free hay). Do not feed horses a 100% alfalfa hay diet (in California) because of the risk of developing enteroliths.
- ⊙ Feed two or more smaller feedings of grain or supplements rather than one large one to avoid overloading the horse's digestive tract. Hay is best fed free-choice.
- ⊙ Set up a regular parasite control program with the help of your equine practitioner. Have fecal samples tested to determine the effectiveness of the parasite control.
- ⊙ Provide exercise and/or turnout on a daily basis. Change the intensity/duration of an exercise regimen gradually.
- ⊙ Provide fresh, clean water at all times. In climate zones where water freezes, provide water that is warmed so that the horse will consume adequate amounts. A reduced water intake, combined with increased forage consumption can lead to a greater incidence of impaction and colic. Water should be maintained between 45 and 65°F and any ice crystals should be removed. **If you are in an area that has regular freezing, check the water supply twice daily as horses will drink eight to 12 gallons a day.**
- ⊙ OBSERVE your horse each and every day. How much has it eaten vs. how much has it passed?
- ⊙ Avoid medications unless they are prescribed by your veterinarian, especially pain-relief drugs (analgesics), which can cause ulcers.
- ⊙ Avoid the consumption of sand by feeding off the ground over rubber mats.
- ⊙ Inspect hay, bedding, pasture and environment for potentially toxic substances such as blister beetles, noxious weeds, and other ingestible foreign matter. Oleander is particularly toxic and problematic in California.
- ⊙ Reduce stress. Horses experiencing changes in environment or workloads are a high risk of intestinal dysfunction.
- ⊙ Pay special attention to animals when transporting them or changing their surroundings, such as at horse shows, trail rides, or other competitive events.
- ⊙ Observe mares before and after foaling for any signs of colic. Carefully watch any horses who have had a previous bout of colic as they may be at greater risk.
- ⊙ Maintain accurate records of management, feeding practices and medical health history.

The UC Davis Comparative Gastrointestinal Laboratory Making Major Headway with Gastrointestinal Diseases in Horses

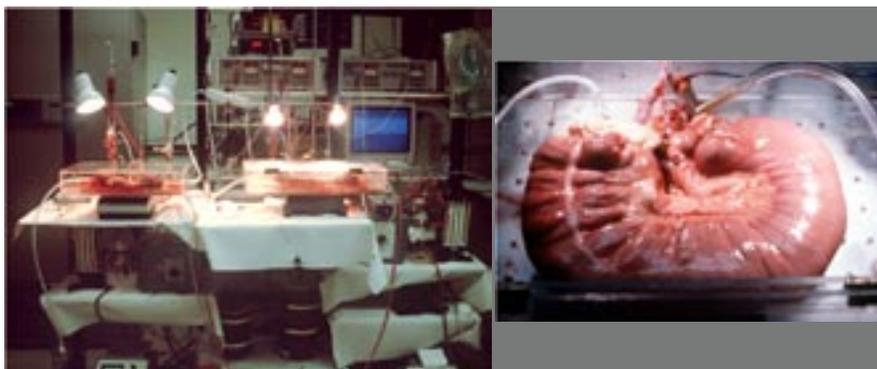
The Comparative Gastrointestinal Laboratory at UC Davis was founded in the early 1980s by Dr. Jack Snyder, Professor in the Department of Surgery and Radiological Sciences. Over the years, the laboratory has expanded from a single office to a fully staffed laboratory with state-of-the-art equipment, operating under the direction of both Dr. Snyder and Dr. Jorge Nieto, an equine surgeon specializing in emergency and critical care. The primary research focus is toward understanding and preventing equine gastrointestinal disease. The laboratory has made major advances in the areas of equine gastric ulceration and in the diagnosis and treatment of horses with acute gastrointestinal disorders or colic, including improvements in surgical techniques.

During the last 10 years, the laboratory has studied what happens to the bowel when the blood supply is blocked by a torsion or twist. We found that when oxygen levels decrease, metabolites accumulate in the tissue. At the same time, the intestine releases toxins and other chemicals which further damage the gut even after the blood supply is restored. Sometimes the reintroduction of oxygen—which produces oxygen radicals—can cause the death of the tissue, similar to what happens to heart tissue in humans after a heart attack. In order to study this problem in a controlled setting, we developed a system known as the “Gut in the Box”. One of the advantages of this system is that we can collect a segment of intestine and its blood vessels from horses that need to be euthanized for other reasons. We then connect the bowel to a heart-lung machine to keep the

tissue alive for several hours. This system has allowed us to study the causes of the lesions as well as possible medical treatments. The “Gut in the Box” has allowed us to develop a special solution, similar to the one used for delivering organs to be transplanted, which protects the bowel from these rebound lesions due to the reintroduction of oxygen when blood flow is restored. We studied this solution in our system, in normal horses, and in research horses, all with good results. We have named the solution gi-Boost® and are using it in selected clinical cases with positive results.

Some of the complications following colic surgery, especially when the small intestine is affected, relate to motility disturbances (bowel not moving). This is due in part to the anesthesia but more so to the severe inflammation and distension that occurs before surgery. In addition, the handling of the bowel at surgery also has a deleterious effect on motility. Because these horses cannot eat or drink, their stomachs must be intubated to prevent a rupture. This problem can persist for up to a week or more after surgery, resulting in critical illness and sometimes death.

We have studied the degree of distension in the bowel and found that severe distension also has a profound effect on motility.



(L) Photo shows the extracorporeal circuit, also known as the Gut-in-the-Box machine. Two systems were created side by side to enable researchers to compare experimental and control tissues. Several pumps drive blood from a container to a pediatric oxygenator and then to the tissue. The flow of the blood can be easily regulated to study the tissue during ischemia (simulating colic) and after reintroduction of oxygen (after a strangulation is corrected, for example). The tissue blood flow, arterial and venous pressure, temperature, electrolytes and weight are constantly monitored. (R) Close-up of a segment of the large colon of a horse after being in the extracorporeal circuit for 2 hours.



Photo showing the customized solution we named giBOOST. This solution is similar to that used to preserve transplant organs that need to be transported. The giBOOST was specifically designed with ingredients that target specific pathways that have been implicated in equine ischemia and reperfusion injury. The solution has a source of energy, electrolytes, radical oxygen scavengers and other substances to protect the bowel from further inflammation and damage. Currently the solution is being used in clinical cases where the blood supply has been affected. We use the solution during surgery and in the first 24 hours after surgery.

Because motility is a significant problem in horses with colic, we have tested various agents that are intended to normalize bowel motility such as ranitidine, domperidone, lidocaine and tegaserod (Zelnorm). Zelnorm is a drug commonly used in humans with irritable bowel syndrome. We found that Zelnorm, which has no effect in the small intestine of horses, is effective in the large colon and could potentially be used in cases of impactions of the cecum or large colon. Ranitidine is an anti-

ulcer medication that is also used as an intestinal stimulant in dogs and cats. Since there is an intravenous formulation, it could easily be used in horses with gastric reflux and at the same time prevent or treat gastric ulceration. Unfortunately we found that ranitidine does not improve gastric emptying in normal horses. We are currently studying other new agents, such as domperidone, and the preliminary results are encouraging.

The laboratory has also made major contributions to improve how colic surgeries are performed. We recently described a new technique to perform resections (removal of part of an organ) and anastomosis (when a segment of intestine is resected and the two remaining ends are sewn or stapled together) of the small intestine that will very likely decrease the number of horses that develop postoperative ileus (a disruption of the normal propulsive gastrointestinal motor activity). In addition, we recently published a new technique to treat horses with cecal impaction. Rupture of the cecum, follow by death of the animal, is a common complication of cecal impactions. The traditional recommended treatment has been to transect the small intestine and reconnect it to the colon. We described a new technique that only bypasses the cecum without the need to do a resection, reducing the surgical time, costs and possible complications. This technique is now used worldwide with good results.

Another area where the laboratory has made improvements is in the diagnosis of horses with colic. Horses with colon torsions sometimes need to have a large part of the colon removed. It is not easy to distinguish between a colon that is still alive and one that has no chance to recover and needs to be removed. This decision is critical for the surgeon as well as for the horse. The traditional method was to evaluate the colon at surgery, observe the color of the colonic tissue, and try to detect blood pulsations in the arteries, but this approach is far from being accurate. We developed a technique to determine whether the colon is viable within a 30-minute timeframe by collecting a small biopsy of the colon at the time of surgery in cases with colon torsions. We immediately freeze the sample in liquid nitrogen, take it under the microscope and evaluate whether the colon will be able to recover or whether the horse will need a colon resection while the horse is still anesthetized.

One of the challenges we have with horses suffering from colic is in determining whether the bowel is alive or dead before going to surgery. This affects the treatment, cost and prognosis of horses with colic, since horses with a dead bowel need resection and anastomosis. The sooner a piece of dead bowel is detected, the better the prognosis will be. As part of the colic workup, we collect a sample of abdominal fluid. Then, using a formula we developed and called the ischemic index, we analyze the fluid values to predict whether the bowel is alive or dead. We are currently using

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Giant Steps Gets a Second Chance

A Case Report from the UC Davis Veterinary Medical Teaching Hospital

Giant Steps was a three-month-old Thoroughbred male when presented to the UC Davis Veterinary Medical Teaching Hospital. The colt and his mother had been living on a breeding farm and now the colt had a yellow discharge coming from the nose. When the foal was examined, copious amounts of a white-yellow fluid flowed from its nose every time the foal lowered his head. He had aspirated some of the fluid into his lungs and developed severe aspiration pneumonia. The colt was depressed and in pain, rolling in the stall and grinding his teeth constantly.

On further examination, we determined that he had severe gastric, esophageal and intestinal ulceration. Some of the ulcers in the proximal segment of the intestine (close to the stomach) trying to heal formed scar tissue that contracted, preventing the food from leaving the stomach. Radiographs of the stomach after administration of barium (a dye that appears in radiographs) confirmed that the gastric contents were not able to leave the stomach due to a stricture (an abnormal narrowing) in a segment of intestine adjacent to the stomach. The stricture was caused by scar tissue from the healing ulcer. A large amount of gastric reflux had accumulated and contributed to loss of water and electrolytes from the stomach, rendering



Giant Steps when he presented at the Veterinary Medical Teaching Hospital.

the foal dehydrated and with an electrolyte imbalance.

The pneumonia was treated with antibiotics and oxygen, the ulcers with anti-ulcer medication, and the dehydration with intravenous fluids supplemented with electrolytes. In addition, since the foal was not able to eat, a complete feeding solution was infused into one of the jugular veins continuously. After four days of treatment, the pneumonia and the ulcers had improved somewhat but the colt was still in pain. He still was not eating and continued to be depressed, grind his teeth, and lose weight.

After discussion with the owner, it was decided to

perform surgery, even though the prognosis for success was low due to the severity of the problem. A surgery to bypass the most proximal segment of the intestine and connect the stomach with a more distal segment of bowel was performed.

The day after the surgery, an ultrasound of the foal's belly showed that his stomach was much smaller; moreover, the foal did not exhibit any signs of pain. The amount of reflux from the stomach started to decline rapidly and he was allowed to nurse for the first time in five days. Little by little the foal was allowed to nurse for a longer time more frequently, and the intravenous feeding was decreased.



A foal with severe abdominal pain. Some foals roll and remain in a dorsal position to relieve pressure in the stomach and bowel.

After 12 days of hospitalization, Giant Steps was discharged from the hospital to continue the treatment for the pneumonia at home and with a special diet. When the foal came back for a recheck 30 days after surgery, the pneumonia had significantly improved and there was some scarring in the stomach but no ulcers were observed. He had gained 35 kg of body weight in less than 30 days.

Giant Steps is currently a 6-month-old colt that will be weaned shortly. The owner reports that the colt is doing very well, that he is a wonderful horse, and that he is happy about the decision to give Giant Steps a second chance. *

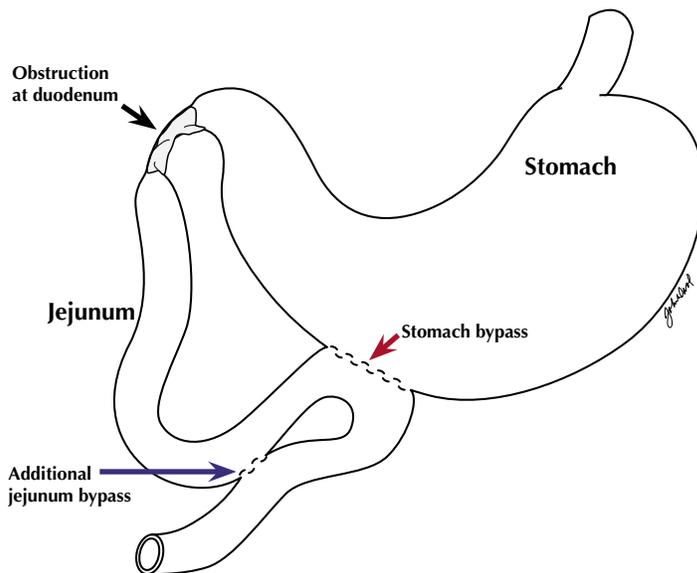


Diagram of the surgical procedure performed in Giant Steps to treat a duodenal stricture. A surgical bypass was created between the stomach and a segment of the small intestine caudal to the obstruction (red arrow). An additional bypass (blue arrow) was created between two segments of small intestine (caudal to the gastrojejunal bypass) to prevent food from impacting the duodenum or re-entering the stomach.

Gastrointestinal Laboratory
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this ischemic index in clinical cases to render the probability of a horse having a dead bowel.



Photo taken from a clinical case during colic surgery showing normal small intestine (pink bowel) and bowel that was deprived of blood and died (dark segment).

The UC Davis Comparative Gastrointestinal Laboratory has been one of the leading research groups to improve the survival of horses with colic. As a result of this work, veterinarians more thoroughly understand how intestinal motility or function is maintained and how to restore that function once it has been compromised. Using innovative techniques the laboratory continues to make great strides in understanding and minimizing the devastating consequences of intestinal disease and therefore improving the quality of life of horses worldwide. *

CONTACT INFORMATION

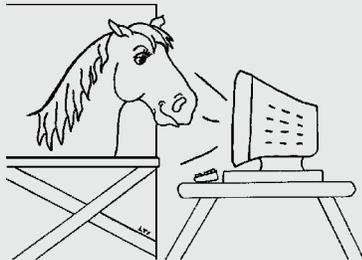
Equine Surgical Emergency and Critical Care Service
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The service is directed by three full-time faculty surgeons:

Dr. Jorge Nieto, DVM, PhD, DACVS
 Dr. Julie Dechant, DVM, MS, DACVS
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The Service's home base is the Equine Intensive Care Unit, a dedicated animal nursing unit that cares for critically ill equine patients. The Intensive Care Unit operates 24 hours a day, 7 days a week, to provide state-of-the-art care and treatment to equine colic patients and other critically ill horses.

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 January 2008

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The Center for Equine Health is supported with funds provided by the State of California Pari-Mutuel Fund and contributions by private donors.

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