

1

What is Colic?

Understanding a problem is the first step toward preventing it, so before discussing ways of preventing colic, it's worth spending some time looking at what exactly colic is, and what causes it.

Colic is a sign of abdominal, or belly, pain. It is a *symptom* of disease, rather than a disease itself. There are dozens of specific conditions that can cause a horse to show signs of abdominal pain. In most cases, colic signs indicate a problem with the digestive system, the focus of this book. Less often, they are caused by a problem with one of the other abdominal organs (liver, kidneys, ovaries, *etc.*). Occasionally, diseases in the chest cause signs that mimic colic; and some horses with laminitis or muscle cramps can appear colicky. (Table 1.1 on page 17 lists various conditions that can cause colic-like symptoms but do not directly involve the digestive tract.)

Signs of Colic

Horses show signs of abdominal pain in a wide variety of ways. Some signs, such as curling the upper lip or stretching out the neck, are subtle or ambiguous, whereas other signs, such as repeated rolling or violent thrashing, are hard to mistake. Signs of colic include one or more of the following abnormalities.

Abnormal behavior

- pawing
 - horses paw for a variety of reasons unrelated to colic, including impatience or frustration; when horses are pawing because of abdominal pain, they typically have other signs of colic as well and they appear more inwardly focused than when pawing for other reasons
 - it's not uncommon for colicking horses to hold the foreleg up for a few moments, foot suspended in the air, before pawing again
- repeatedly turning to look at the flank or belly and perhaps even biting at the flank/belly
 - the side to which the horse looks (left or right) is not particularly useful information; it is the basic behavior that is telling
- kicking at the belly when there is no obvious reason for doing so (*e.g.*, there are no flies annoying the underside of the belly)
- lying down and either repeatedly getting up and lying down again or remaining down for longer than is normal for that horse and that time of day
 - each horse has his own habits of lying down to rest during the day and at night; knowing what is normal for the individual horse helps distinguish this normal behavior from colic behavior
- rolling repeatedly, or even just rolling in a place or at a time that is unusual for that horse
 - depending on the degree of pain, the horse may roll in a distracted, half-hearted way, alternating between flat-out on his side and resting up on his chest, or he may roll more violently, flipping all the way over from one side to the other and thrashing his legs

- horses without colic often roll when turned out in a pasture, paddock, or other spacious area (e.g., arena or round pen); however, normal horses usually get up and shake off any dirt and debris after they've rolled, whereas colicking horses don't always get up after rolling in pain and they don't usually shake off when they do stand
- curling or quivering of the upper lip
 - lip curling in horses with colic is similar to, but usually less pronounced than, the classic flehmen response that stallions display around mares, in which the upper lip is curled all the way back, exposing the upper incisor teeth and gums
- grunting or groaning, especially when lying down
 - normal horses occasionally let out a soft grunt or groan when they first lie down, but there is no mistaking the grunts or groans of pain in a horse with severe abdominal pain
- grinding the teeth
 - teeth grinding is more common in foals, particularly in those with stomach ulcers, but it does also occur in adult horses with colic pain
- leaving food or being completely disinterested in food
 - some horses with mild colic refuse grain or hay but they'll nibble at fresh grass
- playing in water with the lips or tongue, or hanging over the water container, but not drinking
 - often, horses showing this behavior are dehydrated; but not all dehydrated horses do this, and not all horses who do this are dehydrated
- either anxious or restless behavior, which in more severe cases may become distressed or violent behavior, or the opposite: lethargy/depression

Abnormal posture

- crouching, as if wanting to lie down, but remaining standing; this posture may be repeated several times
- frequently stretching out as if to urinate, or standing stretched out for several minutes
 - this posture may also be seen in horses with laminitis or exercise-induced muscle damage (myositis or "tying up"); it is not specific to colic pain
 - it is often mistakenly interpreted as indicating kidney stones (which are rare in horses) or some other urinary tract problem, when in most cases it simply indicates abdominal pain
- holding the head in an unusual position, such as with the neck extended and the head rotated to one side
 - this posture is often combined with grimacing, lip curling, or teeth grinding
- lying on the back (more common in young foals than in adult horses)
- sitting like a dog, on the haunches with the forelegs extended
 - "dog-sitting" usually indicates excessive pressure in the stomach
- standing very still, with the abdomen tensed ("splinted")

Abnormal appearance

- abrasions (grazes or superficial wounds), swellings, or caked dirt on the side of the head, body (*e.g.*, point of the hip), and legs as a result of thrashing about on the ground
 - with severe colic, swelling, bruising, and abrasions near the eye may make the horse look like a prize-fighter
 - obviously, these signs are not specific for colic, they simply indicate some type of trauma; however, they are important to note when accompanied by other signs of colic
- bloating (swelling of the abdomen, most obvious in the flank and when looking at the horse from behind)
 - bloating, or abdominal distention, is more noticeable in foals and Miniature Horses because the abdominal wall is thinner and more easily stretched or distended than that of a full-size horse
 - abdominal distention in nonpregnant horses generally indicates gas buildup in the large intestine; in foals, gas buildup in the small intestine or stomach may also cause bloating

Abnormal body function(s)

- inappropriate sweating (*i.e.*, not caused by exercise, hot weather, or fever)
 - sweating in horses with colic is usually caused by pain
 - sweating tends to be patchy in horses with mild colic, if present at all; common sites are the base of the ears, the side of the neck, and the lower flank
 - horses with severe colic may be dripping with sweat
- straining to pass manure
 - this behavior is most common in newborn foals with meconium impaction (see Chapter 2), in which straining is often accompanied by swishing or flapping ("flagging") of the tail
- absence of manure passage for several hours, or finding less manure than normal in the stall for that time of day
 - these signs do not necessarily mean there is a problem, but they can indicate slowed or reduced bowel activity
- change in the appearance of the manure, such as loose ("cow pie") or watery manure, hard manure balls that are coated with whitish-yellow mucus or blood, or manure that has a particularly foul odor

As you can see, horses show signs of abdominal pain in a variety of ways. Usually, a horse shows only a handful of these signs during an episode of colic. But seeing *any* of these signs should prompt you to take a closer look. (What to do when your horse is showing signs of colic is the subject of Chapter 4.)

Correlating signs with specific problems

For the most part, signs of colic are nonspecific; they simply indicate that the horse is in pain. In very few cases do specific signs signal a particular problem; and even when they do, they are not proof of that problem. For example, teeth grinding is common in foals with stomach ulcers, but it is simply a sign of pain. It does not occur in every foal with ulcers, and foals without ulcers may also grind their teeth. Frustration, anxiety, neurologic disease, and pain elsewhere in the body are other possible causes.

Some other specific behaviors or postures that bring to mind particular problems include:

- dog-sitting in horses with excessive pressure in the stomach from a buildup of food, fluid, and/or gas
- lying on the back, often with one foreleg drawn forward over the head, in foals with stomach or small intestinal pain
- straining and tail-flagging in newborn foals with meconium impactions
- lying on the back in some broodmares with torsion or volvulus (twist) of the large colon; this condition is extremely painful and causes dramatic bloating

As already mentioned, the side of the belly at which a horse looks or kicks usually is not significant. Even when severe, pain originating in the bowel typically is fairly diffuse. This type of pain (visceral: relating to the internal organs, or *viscera*) is not as easy for the mind to localize as pain arising from a more superficial structure such as skin, muscle, tendon, ligament, joint capsule, or bone. All the horse knows and expresses is that his belly hurts.

Correlating signs with severity

In general, the more obvious the signs of pain, the more serious the problem. For example, horses with mild colic typically show subtle signs, such as curling the lip, holding the head in an abnormal position, or lying down more than usual. Repeated rolling, sweating, and groaning are signs of more severe pain. Also, in horses with serious conditions, the signs tend to be persistent and may become more severe, whereas with mild colic, the signs often are intermittent and they may disappear without treatment.

There are two uncommon but important exceptions: (1) twisting of the intestine or some other problem that causes a section of the bowel to die, and (2) an obstruction that ended in bowel rupture. In each of these cases, the horse passes through a distressed, violently painful stage (which may have been missed if it happened overnight or at pasture), but once the bowel has died or ruptured, the horse may not seem very painful. Dead bowel cannot transmit pain signals, and rupture suddenly relieves the pressure of bowel distention.

However, by this time these horses are in shock — circulatory failure from fluid loss into the bowel or abdomen, and absorption of bacterial toxins from the damaged bowel or escaped bowel contents. They tend to stand very still, with the abdomen tensed ("splinted"). They are severely depressed, weak and shaky, and reluctant to move. As shock progresses, the color of the horse's gums changes from dark pink to brick red to bluish-purple to gray. (More on gum color in Chapter 4.) Horses at this late stage are very difficult to save and they are at high risk for multisystem organ failure and for laminitis if they survive. But once again, *these scenarios are uncommon*.

Individual response to pain

A final consideration is that each horse responds to pain a little differently. Some are stoic and tough, while others are less tolerant of mild pain. Knowing the individual horse's pain tolerance is useful when interpreting signs of colic. Looking or kicking at the belly takes on far more significance in a horse who normally puts up with minor pain than in a horse who reacts to every little injury. That said, *signs of colic should not be ignored in any horse*.

The Horse's Digestive System

The horse's digestive system, from mouth to anus, is adapted to digest a high-fiber diet that primarily consists of grasses, legumes, and other plant material. In order to break down the plant fiber into digestible substances, horses rely on the large and diverse population of bacteria and other microorganisms (microbes) in their digestive tracts. This process is called *microbial fermentation*, in contrast to the breakdown of feed material by the horse's own digestive enzymes.

Cattle, sheep, and goats also rely on microbial fermentation to make use of dietary fiber. But in these animals the process occurs in the large, vat-like forestomach (the rumen), whereas horses do the bulk of their fiber digesting in their large intestines. Thus, horses are called *hindgut fermenters*, and ruminants (cattle, sheep, goats) are called foregut fermenters.

The length and volume of the horse's digestive tract reflects this reliance on hindgut fermentation. Horses have a relatively small stomach, a long and narrow small intestine, and a complex and voluminous large intestine, consisting of the cecum and the large and small colons. In the average-size adult horse, the digestive tract is about 100 feet long and can hold approximately 56 gallons of water, digestive juices, and food/manure.

Stomach

Horses have a simple stomach: a single chamber in which food is mixed with gastric acid and pepsin (an enzyme that starts the process of protein digestion) before the food is sent on to the small intestine. A small amount of microbial fermentation also occurs in the stomach.

Anatomically speaking, the stomach in the average-size horse holds about 4 gallons (range, 2 to 5 gallons). Although that may sound like a lot, it's less than 10% of the total capacity of the horse's digestive tract. Practically speaking, when delivering fluid to the horse's stomach via nasogastric ("stomach") tube, the horse may start to get a bit uncomfortable after about 2 gallons.

Sphincters

The horse's stomach has two valves, or sphincters, which control the flow of food material out of the stomach. The upper sphincter is the cardiac or lower esophageal sphincter. It is located at the junction between the esophagus and the stomach, and it prevents backflow (reflux) of material from the stomach into the esophagus. The other is the pyloric sphincter, between the stomach and the small intestine. It prevents the normal forward flow of food into the small intestine until the food is well mixed with gastric secretions and is somewhat softened.

The cardiac sphincter, and the way in which the esophagus meets the stomach at an angle, forms such a tight seal that it prevents the horse from vomiting or regurgitating stomach contents into the esophagus under most circumstances. This arrangement presumably is designed to protect the esophagus from acidic reflux during high-speed activity. However, it puts the stomach at risk of rupturing when it is overfilled with food, fluid, or gas.

In most cases, overfilling of the stomach occurs not from excessive food or water intake, but from a problem further downstream (usually in the small intestine) that slows or prevents emptying of the stomach and/or allows fluid and gas to back-flow into the stomach.

So, seeing food material or greenish fluid at the nostrils in a horse who is showing signs of colic indicates that the stomach is at risk of rupturing unless it is immediately decompressed. (To decompress the stomach, the veterinarian passes a nasogastric tube, or "stomach tube," into the horse's stomach *via* a nostril, which allows the excess food, fluid, and gas to exit *via* the tube.)

Choke. A common exception is esophageal obstruction, or "choke," in which a mass of food becomes stuck in the esophagus. The feedstuffs most likely to cause choke are hay, pelleted feeds, and solid foods such as carrots and apples. Sometimes, the horse is able to relieve the obstruction by repeatedly swallowing. But in other cases, a veterinarian is needed to relieve the obstruction.

Horses with choke often have saliva containing food material streaming from their nostrils. They may also seem anxious or distressed and they may stand with their head and neck stretched out. (Having accidentally swallowed a throat lozenge which got stuck in my esophagus, I can attest to how painful esophageal obstruction is!)

Choke can usually be distinguished from colic in two ways: (1) the obstructing mass of food can often be seen or felt in the jugular groove on the left side of the horse's neck, and (2) horses with choke often make repeated gagging sounds and efforts to swallow, which is very specific for choke. The good news is that once the obstruction is relieved, either spontaneously or through veterinary treatment, most of these horses recover uneventfully.

Small intestine

Although it is a single structure — one long, narrow tube — the small intestine is divided into three different sections based on their relationships and functions:

- duodenum, into which the stomach empties
- jejunum, the middle (and longest) section
- ileum, which empties into the large intestine

In total, the small intestine in the average-size adult horse is about 75 feet long (range, 60 to 100 feet). Most of that length, about 70 feet on average, is jejunum. In comparison, the duodenum and the ileum combined account for only about 5 or 6 feet.

The entire small intestine accounts for about 75% of the total length of the horse's digestive tract, but because it is narrow (just a few inches in diameter when empty), it represents only about 30% of the total capacity of the horse's gut (about 17 gallons).

Duodenum

The duodenum is the short section of small intestine into which the stomach empties. Although it is only about 3 feet long, it is an important site for the digestion of dietary proteins, fats, and simple carbohydrates (starches and sugars), as bile from the liver and digestive enzymes from the pancreas are delivered into the small intestine in this section.

The duodenum is a relatively common site for ulceration in foals. In adult horses, it is one of the bowel segments that becomes inflamed and filled with gas and fluid in cases of proximal or 'anterior' enteritis, also called duodenitis-proximal jejunitis (discussed on page 7).

Jejunum

This long, middle section of the small intestine is where most of the nutrients are absorbed into the bloodstream. Most of the dietary proteins, fats, and simple carbohydrates that were broken down by digestive enzymes in the stomach and duodenum are absorbed as food moves down the length of the jejunum. Most vitamins, minerals, electrolytes, and water are also absorbed here.

The jejunum is suspended from the roof of the abdominal cavity (directly under the spine) by a broad, fan-shaped, thin, translucent sheet of connective tissue called the mesentery. The blood supply to the small intestine runs within the mesentery from large blood vessels at its base ('root of the mesentery'). The mesentery is fairly long, which allows the 70 feet of jejunum to fold in and out around the rest of the abdominal contents. But because of this mobility, the jejunum is the section of bowel that most often twists on itself (torsion or volvulus) or gets itself trapped in tight places (see page13).

Duodenitis-proximal jejunitis. This condition involves severe inflammation of the lining of the duodenum and first part (proximal portion) of the jejunum. Because the jejunum is so long and the small intestine can hold about 17 gallons of liquid, large amounts of fluid can be lost from the bloodstream into the bowel with this condition. The result is severe dehydration and shock, and moderate to severe pain as the fluid and gas build up in the jejunum and duodenum, and eventually the stomach.

Sometimes, horses with proximal enteritis are more depressed than painful. This is probably because of the degree of dehydration and absorption of bacterial toxins from the inflamed bowel, and also because the bowel is less distended than with severely obstructive conditions such as intestinal twists. Proximal enteritis can often be treated medically, with intravenous fluid therapy and continuous removal of fluid from the stomach with a nasogastric tube. However, sometimes the condition is only diagnosed during colic surgery.

Ileum

The ileum is the short, final section of the small intestine. Its wall is relatively thick and muscular, so it acts a little like a valve, preventing backflow of material from the cecum (first part of the large intestine) into the small intestine. In fact, the junction between the ileum and cecum is called the ileocecal valve.

The ileum is a fairly common site of obstruction. The two most common causes are impaction with feed material (*e.g.*, coastal Bermuda grass hay; see Chapter 2) and intussusception (folding or telescoping of the bowel into itself). The ileum can also be involved in intestinal twists and in tapeworm infestations.

Cecum

The cecum is the first part of the large intestine. It is a large, sac-like structure that is roughly triangular or comma-shaped. The base of the cecum, where the ileum enters and the colon exits, is located in the upper, right-hand side of the horse's abdomen (top of the right flank). The tip, or apex, of the cecum lies close to the floor of the abdomen, just behind the sternum. The cecum is only about 3 feet long, but it holds on average about 9 gallons of food and fluid.

The cecum's primary role is to thoroughly mix the food material exiting the small intestine with bacteria and other microbes that will continue the digestive process (particularly the breakdown of dietary fiber into useable nutrients), before delivering this mixture to the large colon. A significant amount of microbial fermentation of fiber and undigested proteins and simple carbohydrates occurs in the cecum.

Cecal problems, such as impaction, distention with gas (tympany), and parasitic damage, are fairly uncommon. But when they do occur, they can be very difficult to treat successfully. A primary reason is that the signs of cecal disease are not very obvious until the condition is fairly advanced and the cecum is in danger of rupturing — or has already ruptured. Cecal diseases seem to be more common in horses who are hospitalized because of illness or for surgery (see Chapter 2).

Large colon

The large colon is so-named because of its large diameter compared with the small intestine. The large colon measures only about 11 feet in length but it accounts for nearly 40% of the total capacity of the digestive tract, holding an average of about 21 gallons, and up to 34 gallons. Together, the cecum and large colon fill most of the abdominal cavity in nonpregnant horses.

Configuration

The large colon in the horse is arranged in two U-shaped layers, one (the dorsal, or upper) stacked on top of the other (the ventral, or lower). There is a tight "hairpin" bend, the pelvic flexure, where the ventral colon empties into the dorsal colon on the left side of the abdomen. The broader curve in each of the U-shaped sections lies close to the liver, which sits up against the diaphragm (the sheet of respiratory muscle that separates the abdominal and chest cavities).

Beginning at the base of the cecum, in the upper-right side of the abdomen, the large colon runs thus:

- *right ventral colon*, which runs forward and down toward the sternum, curving to the left side of the horse just behind the liver (at the sternal flexure), before continuing as the...
- *left ventral colon*, which runs backward toward the pelvis, where the large colon then doubles back on itself (at the pelvic flexure) to become the...
- *left dorsal colon*, which runs forward, along the top of the left ventral colon, before curving to the right just behind the liver (at the diaphragmatic flexure) to become the...
- *right dorsal colon*, which runs along the top of the right ventral colon toward the base of the cecum, where it empties into the...
- *transverse colon*, a short segment that connects the end of the large colon with the start of the small colon.

The large colon narrows at the pelvic flexure and again where the right dorsal colon meets the transverse colon. These two points are common sites of obstruction, whether from feed material, sand, enteroliths (see Chapter 2), or foreign objects.

Another feature that contributes to the large colon's common role in colic is its mobility. The dorsal and ventral halves are connected to each other by a short membrane which keeps the stacked 'U's together, but the entire large colon is attached to other structures at only two points: beginning (the base of the cecum) and end (the transverse colon, which is anchored in place near the roof of the abdomen).

Thus, the large colon can get into trouble in a variety of ways: (1) move out of its normal position in the abdomen (displacement); (2) become trapped, such as over the ligament between the left kidney and the spleen (nephrosplenic entrapment); (3) twist on itself (torsion); or (4) twist around its point of attachment (volvulus). But under normal circumstances, its size when filled with plenty of good-quality roughage and water keeps the large colon in place.

Function

The large colon has two major functions: (1) microbial fermentation of dietary fiber, and (2) absorption of water secreted into the digestive tract during digestion. The bulk of microbial breakdown of fiber, and of any proteins and simple carbohydrates that escaped digestion and absorption further upstream, occurs in the large colon. The major products of this process — volatile fatty acids — are important energy sources. For herbivores such as the horse, fiber is not filler; it's food.

Microbial fermentation also produces a lot of gas. Ordinarily, this gas is produced at a fairly constant rate. Some is absorbed by the colon; the remainder passes down the digestive tract and is released from the anus. (The medical term for this gas has a delightfully Roman-sounding name, *flatus*. Hence, the excessive passage of gas is called flatulence, and gas colic is also known as flatulent colic.) If, for any reason, gas builds up in the colon, colic can result from distention or stretching of the bowel wall. Gas buildup can also contribute to large colon displacements and twists (see Chapter 2).

The three most common causes of gas buildup in the large colon are these: (1) diets that are high in readily fermentable carbohydrates (*e.g.*, grain-based feeds, lush pasture that contains a lot of clover), (2) obstruction of either the large or small colon (*e.g.*, impaction with firm, dry feed material), and (3) altered intestinal motility, which can occur for a variety of reasons. Gas buildup and other abnormalities that can cause colic are discussed in more detail later in the chapter.

Small colon

The small colon is the final section of colon before the rectum. It is narrower than the large colon, hence its name, but it is almost as long (about 10 feet on average). By this point, the feed material has been as completely digested as possible. The remaining indigestible material (now called feces, or manure) is formed into the characteristic oval-shaped balls in the small colon.

As with the jejunum and large colon, the small colon is relatively mobile. But unlike the other two segments, displacements and twists are uncommon in the small colon. The most common problem, obstruction, results from the narrow diameter of the small colon and the efficient way that the equine colon extracts most of the water from the indigestible remains of the food. When poor-quality roughage is fed, this process sometimes leaves hard, dry balls of manure that are difficult to pass.

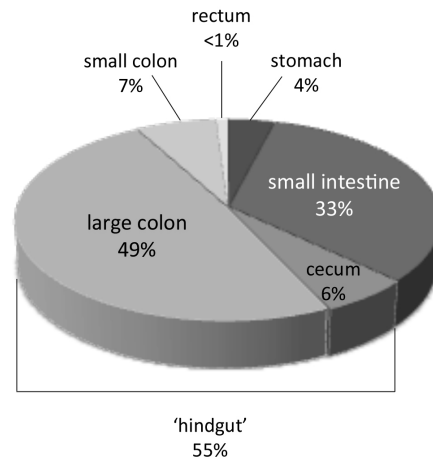
The narrow diameter also makes obstruction with foreign material (*e.g.*, baling twine) and enteroliths more likely in this segment. In newborn foals, the small colon is a relatively common site of meconium impaction (see Chapter 2), although the rectum is the most common site.

Rectum

The rectum connects the small colon with the anus. It is about 12 inches long and serves as a holding area for manure. Rarely is the rectum the primary site of colic, except in newborn foals with meconium impaction. In adult horses, impactions occur a long way upstream from the rectum, such as in the large colon or the ileum. So, enemas are of little use in adult horses, and they can even be dangerous when administered incorrectly. Likewise, removing manure from the horse's rectum will not relieve a colonic impaction.

Incidence of colic at specific sites

Problems can occur at any point along the digestive tract, but colic most often involves an abnormality in the large colon or small intestine, in that order. The fact that the 'hindgut' alone accounts for 55% of all colic cases illustrates the importance of the gut microbes in digestive health.



What Causes Colic?

As colic is not a single disease, but rather a manifestation of abdominal pain, the question "what causes colic?" does not have a simple answer. The pain could be originating anywhere along the 100-or-so feet of digestive tract, and it could result from one of several different processes.

What's causing the pain?

The pain of colic arises from one or more of the following processes:

1. Spasms — persistent or unco-ordinated contractions of the bowel wall.
2. Distention — buildup of food, fluid, and/or gas within the bowel.
3. Traction — pulling on the wall of the bowel or its mesentery (supporting tissue).
4. Ischemia — profoundly reduced or interrupted blood flow to the bowel.
5. Inflammation of the bowel, with or without ulceration.

1. Spasms

Normally, bowel motility consists of a co-ordinated series of contractions in the muscle layers of the bowel wall. Some of the contractions mix the food in place, and others move the food downstream in waves. This progressive motility is called peristalsis.

Sustained or unco-ordinated contractions of the bowel, called spasms or cramps, can occur for a variety of reasons:

- excessive intake of readily fermentable carbohydrates, such as grain-based feeds or lush pasture
- obstruction by a mass of dry, firm feed material (*i.e.*, an impaction)
 - the bowel may spasm as it tries to move the material downstream
 - in addition, buildup of gas behind the obstruction may contribute to the problem
- internal parasites (worms), especially the larval stages (see Chapter 2)
- irritation or inflammation (*e.g.*, accumulation of sand, enteritis)
- low blood flow

Colic that primarily involves this process is called *spasmodic colic*. Overall, it is the most common type of colic. Dietary factors, such as high-grain diets, lush pasture, or poor-quality roughage, are the most common causes, but in many cases a definite cause cannot be found. Fortunately, spasmodic colic tends to be mild and usually resolves either on its own or with simple medical treatment. It is not, on its own, a surgical situation.

2. Distention

The bowel has pain receptors that register discomfort when the bowel wall is stretched ('distended') from a buildup of food, fluid, and/or gas. There are several possible causes of distention:

- feeding a high-carbohydrate diet
 - rapid fermentation of starches, sugars, and fructans (fermentable polysaccharides) can produce large amounts of gas in the cecum and/or large colon, a condition called primary tympany
- simple obstructions
- strangulating obstructions, in which both the intestine and its blood supply are obstructed
 - a dramatic example is large colon volvulus; so much gas can build up in the colon that the horse becomes obviously bloated within a matter of hours
- enteritis — *e.g.*, bacterial enteritis in foals and proximal enteritis (duodenitis-proximal jejunitis) in adult horses
 - in addition to buildup of fluid and gas in the affected segment of bowel, inflammation contributes to the pain
- ileus — marked reduction or absence of peristalsis (normal gut motility)
 - food, fluid, and gas build up behind the affected segment

Specific causes are listed in Table 1.2 on page 18. The severity of colic signs depends on the amount of bowel wall distention: the more the wall is stretched, the more painful the condition, and the more severe the colic signs.

Primary tympany. When used as a medical term, 'tympany' refers to an abnormal buildup of gas in a hollow structure, in this case the intestine. Accumulation of gas in an otherwise normal section of intestine is termed *primary* tympany. Gas accumulation as a result of an obstruction or other abnormality is called *secondary* tympany.

The cause of primary tympany is microbial fermentation of carbohydrates, such as concentrates (grain and grain-based "sweet feeds" and pellets) or lush pasture (grasses and legumes such as clover). The result is rapid accumulation of gas in the large intestine, which stretches the wall of the bowel. The products of fermentation and even the distention itself may also alter bowel motility, so spasmodic colic can contribute to both the discomfort and dysfunction. Provided that there is no obstruction, the gas is gradually propelled downstream and passed out the anus. For this reason, this type of colic is sometimes termed *flatulent colic*. As long as there is sufficient bowel motility, the colic signs resolve once most of the gas is passed.

Simple obstructions. Simple obstructions are the second most common type of colic (behind spasmodic colic). They are obstructions in which the blood supply to the bowel is not affected to any great degree

(unlike strangulating obstructions, which are discussed on page 13). Flow of food, fluids, and gas along the digestive tract can be interrupted by an obstruction at one of three sites:

1. within the hollow center ('lumen') of the bowel—*luminal* obstructions include impaction with firm, dry feed material and blockages caused by foreign material (*e.g.*, baling twine) or enteroliths;
2. the bowel wall itself—*mural* obstructions include thickening of the muscular layer of the wall;
3. outside the bowel—*extramural* obstructions include tumors and abdominal abscesses.

Simple obstructions can be subdivided into *physical* obstructions, such as impactions, and *functional* obstructions, such as ileus (reduction or absence of progressive bowel motility). In adult horses, the most common cause is impaction of the large colon, and specifically the pelvic flexure, with fibrous feed material. Although these obstructions are termed "simple," intensive medical treatment, and sometimes even surgery, is often needed to relieve the obstruction.

3. Traction

Traction on the bowel generally involves one of three structures:

1. the mesentery — the broad, thin sheet of tissue that suspends the small intestine;
2. the ligaments that connect two segments of bowel or a section of bowel to another structure;
3. adhesions — fibrous bands that form between two segments of bowel, or between the bowel and another structure as a result of inflammation, similar to scars that form at sites of injury

Only a few conditions cause enough tension on the mesentery or an intestinal ligament to produce obvious pain. Displacements and twists are the two most likely causes. Entrapment of small intestine is another possible cause. But in all of these conditions, the pain is caused not only by tugging on the bowel wall, mesentery, or ligament, but also from gaseous distention and reduced blood flow associated with the displacement, twist, or entrapment.

Adhesions. Adhesions result from inflammation of the outer surface of the bowel, most often caused by disease but sometimes by surgery. In most cases, colic caused by adhesions is simply a result of pulling or tugging on the surface of the bowel during normal bowel activity. These fibrous bands are inelastic, so when one segment of bowel moves in the normal course of digestion, it can pull on the section of bowel to which it is adhered, potentially causing pain. But occasionally, the adhesions are in a location, or are extensive enough, that they partially obstruct the bowel.

4. Ischemia (low blood flow)

The bowel has, and needs, a rich blood supply. Reduction of blood flow ('ischemia') can alter bowel motility, and when severe, it may result in tissue damage which can be irreversible. It also leads to the release of substances which sensitize the nerve endings in that part of the bowel, increasing the intensity of painful impulses.

Blood flow to the bowel can be reduced by three basic processes:

1. compression of the blood vessels
2. blockage of the blood vessels from within (*e.g.*, by a blood clot or by parasitic larvae)
3. overall reduction in blood volume, and thus blood flow to all tissues (*e.g.*, dehydration, toxic shock)

Compression. The classic example of this type of ischemia is strangulating obstruction, in which blood flow to the bowel is severely reduced by compression or twisting ('strangulation') of the blood vessels. As the vessels that supply the bowel are intimately associated with the bowel wall and mesentery, conditions that strangulate the bowel's blood supply typically also strangulate the bowel, obstructing the flow of food, fluids, and gas.

Strangulating obstructions fall into the following categories:

- twisting of the bowel (torsion or volvulus)
 - *torsion* is twisting of the bowel along its length, much like wringing out a wet towel
 - *volvulus* is twisting or knotting of the bowel around itself or around its point of attachment (*e.g.*, the mesentery)
 - the distinction between these two terms is usually only important to the surgeon
 - **note:** *twisted bowel is not caused by rolling*
- intussusception — folding of the bowel into itself, like closing the barrel of a telescope
 - not all intussusceptions are strangulating obstructions; some are simple obstructions, but most have at least some compromise of blood flow to the affected bowel
 - the most common site for intussusception is the ileum itself or the ileocecal junction
- entrapment of bowel within a confined internal space or through a tear in the mesentery
 - the epiploic foramen (a narrow space near the liver and stomach) is one of the more common sites of entrapment that leads to strangulating obstruction
- entrapment of bowel in a hernia or abdominal wall defect
 - hernias can be congenital (present at birth) or acquired (usually resulting from physical trauma or surgery)
 - bowel can become trapped in an umbilical hernia, the inguinal canal (in the groin), or in a tear or surgical defect in the muscles of the abdominal wall or diaphragm
 - **note:** umbilical hernias only occasionally cause strangulating obstructions; most do not contain bowel, and in those that do, the bowel does not always become entrapped
- twisting of some other structure around the bowel (or the bowel twisting around that structure)
 - a common example in old horses is strangulation by a *pedunculated lipoma*, which is a benign fatty tumor that forms on a thin stalk which lengthens as the tumor enlarges
 - although very uncommon, the small colon in mares can twist around an ovary and become strangulated

Strangulating obstructions are life-threatening conditions that cause severe colic and rapid deterioration in the horse's physical and mental status. Without exception, *they require immediate surgical correction.* If surgery is performed within a few hours of the strangulation occurring, the prognosis for survival is reasonably good. But the longer the horse must wait before surgery, the poorer the prognosis.

Blockage. The most common cause of blood vessel blockage involving the intestines is damage by the larvae of *Strongylus vulgaris* (redworms or bloodworms; see Chapter 2). These larvae penetrate the bowel wall and make their way into the arteries that supply the bowel for part of their life cycle. Parasite-induced blood vessel damage is called *verminous arteritis*. As one of the consequences is

obstruction of blood flow by blood clots, this type of colic is sometimes termed *thromboembolic colic*, a thrombus being a blood clot that obstructs a blood vessel, and an embolus being a clot that travels downstream and causes obstruction at a distant site. The thrombus/embolus of verminous arteritis may also contain the parasitic larvae.

Overall reduction of blood flow. Dehydration is common with many conditions in horses. But with the exception of large colon impaction, colic resulting from dehydration alone is very uncommon. Reduction in blood flow severe enough to compromise the bowel usually occurs only with shock, whether from severe infection, endotoxemia (absorption of bacterial toxins into the bloodstream), or blood loss.

5. Inflammation

Terms for inflammation of the bowel vary by location: *gastritis* for the stomach, *enteritis* for the small intestine, *typhlitis* for the cecum, *colitis* for the colon, and *proctitis* for the rectum. Ulceration is a severe form of inflammation of the bowel lining ('mucosa'), in which erosions or craters develop in the mucosa and may extend into the tissue beneath. Ulceration severe enough to cause signs of colic usually is limited to the stomach (and in foals, the first few inches of the duodenum) and the right dorsal colon.

Causes of inflammation (± ulceration) include:

- internal parasites, especially strongyle larvae (see Chapter 2)
 - internal parasites can also cause spasmodic colic
- stress (a common cause of gastric ulcers in sick foals and young racehorses in training; see Chapter 2)
- nonsteroidal anti-inflammatory drugs (NSAIDs), especially phenylbutazone ("bute")
 - both gastric ulcers and right dorsal colitis can occur with NSAID use
- abrasions caused by sand accumulation in the large colon
- microbial infections
 - *Salmonella* species
 - *Ehrlichia risticii* (the cause of Potomac horse fever)
 - *Clostridium* species — the probable cause of "colitis X," and incriminated in proximal enteritis and antibiotic-induced colitis in adults and in severe enterocolitis in foals
- toxins such as blister beetles, acorns, and arsenic (see Chapter 2)

Signs of colic vary with the site and severity of the inflammation. In addition, other problems occur with some of these conditions, such as diarrhea with *Salmonella* infection, laminitis with Potomac horse fever, and kidney damage with blister beetle poisoning. These other problems influence which signs are most obvious in a particular horse. For example, colic may accompany or even precede the diarrhea in a horse with colitis, but it is the diarrhea that is the most serious problem, potentially being life-threatening.

How common are these problems?

A landmark study, published in 1986, examined data collected from 4,644 horses with colic that were referred to one of 16 university veterinary hospitals in the United States or England.¹ Of all the horses with colic, surgery was performed in 2,055 (44%). The following statistics were reported from the data collected on all 4,644 horses:

- *simple obstruction* accounted for 34% of cases
 - most involved the large colon; next most common sites were the small colon and small intestine
- *strangulating obstructions* accounted for 21% of cases
 - most involved the small intestine
- *vascular compromise* (reduced blood flow without strangulating obstruction) comprised 3% of cases
- *enteritis* (inflammation of the small intestine) was diagnosed in 5% of cases
- *peritonitis* (inflammation of the lining of the abdominal cavity, typically caused by bacterial infection) was diagnosed in 4% of cases
 - this category included horses with ruptured bowel, so the incidence of primary peritonitis was much lower than 4%
- colic was caused by a problem that *did not involve the digestive tract* in 6% of horses
- the cause of colic was *undiagnosed* in 27% of cases

For the most part, these were horses referred because of severe colic or colic that was not responding to treatment on the farm. In other words, they represent a select population of horses with moderate to severe colic.

Statistics from routine veterinary practice

A more recent study, conducted in Texas and published in 1995, compiled the findings from 821 horses with colic that were examined *on the farm* by the regular equine veterinarian.² In other words, this study more accurately reflects the incidence of particular colic problems in the horse population at large. In this study, almost one-half (46%) of the horses had spasmodic or 'gas' colic (29%), or colic in which a diagnosis was unable to be made (17%), typically because it resolved with medical treatment and needed no further evaluation.

Of the remainder, about 29% of the horses had a simple obstruction, most often a large colon impaction. A little less than 6% had strangulating obstructions, and 8% had enteritis. "Other" causes accounted for 11% of the colic cases.

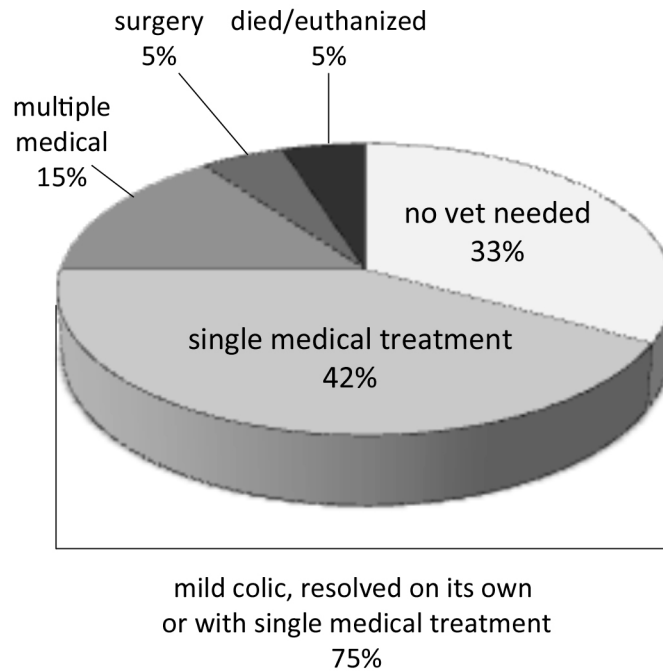
No mention is made of the number of horses that underwent surgery in the Texas study. But as the incidence of strangulating obstructions was only about 6%, and as most other problems can be managed medically, the surgical case rate was probably around 10–15% of all horses seen for colic in this study.

Statistics from an owner/manager survey

An extensive study of colic incidence on horse farms in Virginia and Maryland, in which the incidents were recorded by horse owners or farm managers over a full year, provides an even more complete view.³ More than 1,400 horses were involved in the study, and all incidents of colic were recorded, even those not needing veterinary attention. In all, there were 104 incidents of colic in 86 horses during the year-long study period. This represents an annual colic incidence of 10.6 cases per 100 horses.

Most (75%) of the colic incidents were mild and resolved either without treatment or with a single medical treatment on the farm (*e.g.*, a single injection of pain reliever). In fact, 33% of all colic incidents were so mild or transient that veterinary attention was unnecessary.

Only 9 horses — about 10% of all horses with colic — had severe digestive tract problems. Four of these horses (less than 5% of all colic cases) went to surgery. Three had strangulating obstructions and one had an impaction of the stomach. The five other horses died or were euthanized (“put down”) because of serious digestive tract problems that, in other circumstances, may have been amenable to surgery. The remainder, roughly 15% of colic cases, recovered with repeated or more intensive medical treatment (*e.g.*, intravenous fluids).



In summary

Various other studies show regional differences in the incidence of certain colic conditions (*e.g.*, sand colic, proximal enteritis, enteroliths; all discussed in Chapter 2). But a consistent finding is that *mild, spasmodic colic is by far the most common type of colic*. Typically, it either resolves on its own or it readily responds to medical treatment. Another consistent finding is that problems requiring surgery (*e.g.*, strangulating obstructions, severe impactions or displacements that do not respond to medical therapy) are uncommon, comprising only about 10% of all colic cases.

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Table 1.1 Causes of colic signs not associated with the digestive tract

<p>Reproductive System</p> <p>large follicles or painful ovulation</p> <p>labor (foaling) or abortion</p> <p>dystocia (difficulty foaling)</p> <p>retained placenta</p> <p>torsion (twisting) of the uterus</p> <p>ruptured uterine artery (post-foaling)</p> <p>ruptured uterus (late pregnancy)</p> <p>ovarian tumor or hematoma (hemorrhage into an ovarian follicle)</p> <p>lactation tetany (calcium depletion in nursing mares)</p> <p>vaginal tear during breeding</p> <p>torsion (twisting) of a testicle</p> <p>Musculoskeletal System</p> <p>laminitis (“founder”)</p> <p>exertional rhabdomyolysis (“tying up,” myositis, “Monday morning disease”)</p> <p>neck or back injury</p> <p>hyperkalemic periodic paralysis (HyPP)</p> <p>Respiratory System</p> <p>pleuritis (inflammation/infection of the chest cavity lining)</p> <p>pneumothorax (air in the chest cavity, between the lung and chest wall)</p> <p>Urinary System</p> <p>bladder or kidney stones, or other causes of urinary obstruction</p> <p>bladder rupture (newborn foals; see Chapter 2)</p>	<p>Cardiovascular System</p> <p>pericarditis (inflammation of the thin sac surrounding the heart)</p> <p>aortic-iliac thrombosis (blood clot in the aorta and/or iliac arteries)</p> <p>Nervous System</p> <p>eastern or western equine encephalitis (EEE/WEE)</p> <p>rabies (colic may be an early sign)</p> <p>brain or spinal cord injury</p> <p>tetanus</p> <p>botulism (colic may be an early sign)</p> <p>Miscellaneous</p> <p>peritonitis (inflammation/infection of the abdominal lining)</p> <p>abdominal (internal) hemorrhage (bleeding into the abdomen)</p> <p>abdominal abscess or tumor</p> <p>abscess, tumor, or rupture of the spleen</p> <p>acute hepatitis (inflammation of the liver)</p> <p>cholelithiasis (obstruction of the bile duct)</p> <p>pancreatitis (inflammation of the pancreas with release of digestive enzymes into surrounding tissue)</p> <p>pheochromocytoma (adrenal gland tumor that secretes adrenaline)</p> <p>choke (obstruction of the esophagus; see page 6)</p>
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Table 1.2 Specific causes of simple obstruction leading to colic

<p>Physical Obstruction — foals and young horses</p> <p>meconium impaction (newborn foals)</p> <p>atresia (absence or incomplete development of a segment) or other malformation of the bowel</p> <p>intussusception* (folding or ‘telescoping’ of the bowel into itself)</p> <p>impaction with roundworms (<i>Parascaris equorum</i>; ascarids) or with tapeworms</p> <p>foreign material (<i>e.g.</i>, hair, rubber fencing material, baling twine, rope)</p> <p>abscess in the bowel wall or associated lymph nodes, most often caused by <i>Streptococcus equi</i> (‘strangles’) or <i>Rhodococcus equi</i> (‘rattles’) infection</p> <p>Physical Obstruction — adult horses</p> <p>feed impaction (obstruction with firm, dry feed material)</p> <p>enterolith (intestinal ‘stone’; see Chapter 2)</p> <p>fecalith (obstruction of the small colon with hard, dry manure balls)</p> <p>sand impaction (accumulation of sand in the large colon, with compaction and obstruction at a point of narrowing, most often the pelvic flexure, occasionally the transverse colon)</p> <p>stricture (scarring and narrowing of the bowel from past damage)</p> <p>adhesions (fibrous bands resulting from inflammation of the bowel’s outer surface)</p> <p>abscess, hematoma, or tumor within the wall of the bowel or in the abdomen adjacent to the bowel</p> <p>intussusception (as for foals and young horses)</p> <p>ileal hypertrophy (narrowing of the ileum from thickening of its muscular layers)</p> <p>inflammatory bowel disease (thickening of the bowel lining from infiltration with inflammatory cells)</p> <p>strangulating lipoma* (benign fatty tumor that, as it enlarges, develops a long, thin stalk which can wrap around the bowel; most common in old horses)</p> <p>foreign material (as for foals and young horses)</p> <p>displacement,* especially of the large colon</p> <p>Functional Obstruction</p> <p>ileus (temporary reduction or absence of bowel activity); causes include:</p> <ul style="list-style-type: none"> • dehydration and electrolyte disturbances (especially potassium and calcium) • drugs (<i>e.g.</i>, atropine, xylazine [Rompun®], detomidine [Dormosedan®], and morphine) • chemicals (<i>e.g.</i>, amitraz [an insecticide used to control ticks]) • endotoxin (Gram-negative bacterial cell wall components) and bacterial exotoxins (<i>e.g.</i>, <i>Clostridial</i> enterotoxins) <p>proximal/anterior enteritis (aka duodenitis-proximal jejunitis)</p> <p>cecal atony (loss of motility, resulting in gas and fluid buildup in the cecum); the cause is unknown but may include the items listed above for ileus</p> <p>peritonitis (reduces bowel motility, and is a source of abdominal pain on its own)</p> <p>aganglionosis (absence of nerves that control bowel motility), or “lethal white foal syndrome,” in Paint Horse foals (see Chapter 2)</p> <p>grass sickness (dysautonomia; affects the nerves that control bowel motility; see Chapter 2)</p> <p><i>*May also have a strangulating component</i></p>
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