DECISION MAKING IN EQUINE COLIC PATIENTS

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Before understanding decision making in equine colic patients it is important to review applied anatomy of gastrointestinal tract of horse. For a surgeon the part(s) of large or small intestine which is/are commonly obstructed due to sudden changes in diameter of lumen, displacement of intestine, exploration and land marks in identification of parts of intestine, abdominal wall etc. are important to understand. A brief review of gastrointestinal tract is as under:

Stomach and small Intestine: The stomach in horses lies on the left side of abdomen below the rib cage and has a capacity of about 2-3 gallons in adult horse. The cardia is a one way valve Small intestine consists of duodenum, ileum and jejunum. The duodenum is located on the right side and suspended by mesentery which does not allow it to be displaced (volvulus). Distended duodenum (proximal enteritis) can be palpated rectally in the right paralumber fossa at the base of cecum. The mesentery of jejunum and ileum is fan like and allows the small intestine to rest on the ventral abdomen. The jejunum if 60-65 feet long and last 18 inch of small intestine with mesenry on both ends is ileum. The ileum joins the large intestine (cecum) and is identified by ileo-cecal fold from ileum to the dorsal band of cecum

Large Intestine: It consists of cecum, colon, rectum and anal canal. It extends from the ileum to anus, and functions to dehydrate fecal contents by absorbing water.

Cecum: A huge, comma shaped structure occupying much of the right abdominal cavity.It is also known as the "water gut" or "hind gut." It is a cul-de-sac pouch, about 4 feet (1.2 m) long that holds 7 to 8 gallons. These bacteria feed upon digestive chyme, and also produce certain fat-soluble vitamins which are absorbed by the horse. The reason horses must have their diets changed slowly is so the bacteria in the cecum are able to modify and adapt to the different chemical structure of new feedstuffs. Too abrupt a change in diet can cause colic as the new food is not properly digested.

It consists of **base**, **body** and **apex**. **Base:** is the bulbous beginning of the cecum in the right paralumbar fossa. ***Body***: the continuation of the base cranially along the right wall

and floor of the abdominal cavity. ***Apex***: The tapered end of cecum on the floor of the abdominal cavity, caudal to xiphoid cartilage. The ventral colon wraps around it. So, cecum is a blind sac that functions as a fermentation vat, and in some ways is similar to a cow's rumen. The fermenting material then passes from the cecum to the large colon. ***Ileo-cecal opening***: The ileal opening into the base of cecum. In other domestic species, the ileum opens into the colon. ***Cecocolic opening***: The opening at the base of the cecum to the ascending colon.

Colon: a highly modified structure with great capacity in the horse.The main site of fermentation - the process of breaking down “structural carbohydrates” in the diet such as cellulose.The large colon is 10–12 feet long and holds up to 20 gallons of semi-liquid matter. Due to its many twists and turns, it is a common place for impaction.

Ascending colon (Large colon): due to its size, also called the great colon. Imagine the generalized short ascending colon grasped in its middle stretched out. The formed loop is then again folded on itself. This gives the double horseshoe loop of the ascending colon. The two loops lie on top of each other, with the front of loops towards the diaphragm, and turns between the two loops at pelvic inlet. The different portion of the ascending colon listed as they receive food are- right ventral colon - sternal flexure - left ventral colon - pelvic flexure - left dorsal colon - diaphragmatic flexure – right dorsal colon.

Right ventral colon: the beginning of the ascending colon at the cecocolic opening and extending cranially on the right abdominal floor to the sternum. ***Sternal flexure***: The connection between right and left ventral colons curving around the apex of the cecum. ***Left ventral colon***: The continuation of the sternal flexure that ends into pelvic flexure. ***Pelvic flexure***: The connection of the left ventral and the left dorsal colon in the left paralumbar fossa near the pelvic inlet. ***Left dorsal colon***: The continuation of the pelvic flexure cranially on the top of the left ventral colon, and against the left abdominal wall. ***Diaphragmatic flexure***: the continuation of the left dorsal colon on the top of the sternal flexure. ***Right dorsal colon***: The greatly expanded continuation of the diaphragmatic flexure caudally to the transverse colon. The ampulla coli (stomach like dilation) is the expanded terminal portion of the right dorsal colon. ***Transverse colon***: The segment of colon curving from right to left cranial to the root of the mesentery.

Descending colon (Small colon): the continuation of the transverse colon to the rectum. Smaller than the ascending colon, the descending colon is called the small

colon.The small colon is 10–12 feet in length and holds only 5 gallons of material. It is the area where the majority of water in the horse's diet is absorbed, and is the place where fecal balls are formed. Compared to the domestic species the horse's descending colon is long with long mesocolon, allowing it a wide range of motion. ***Rectum***: the terminal portion of the intestines located in the pelvic cavity. The terminal dilation of it is known as rectal ampulla. The rectum is about one foot long, and acts as a holding chamber for waste matter, which is then expelled from the body via the anus. ***Mesocolon***: The connecting peritoneum arising from the abdominal roof and extending between the dorsal and ventral colons.

Bands or teniae: The variable number or longitudinal smooth muscle cords on the cecum and the different segments of the colon. Some of these are hidden in the mesentery attached to different segments. On the ventral colon there are two bands on mesocolon and two free are free. The small colon has a mesocolon and a free band. The cecocolic fold connects the right ventral colon to the lateral band of cecum. The ileocecal fold connects the ileum to the dorsal band of the cecum. ***Sacculatons or haustra***: The series of pouches in the walls of the cecum and ventral colon formed by the bands of these intestinal segments.

In brief, in horses the stomach, duodenum, diaphragmatic flexor, sternal flexure along with associated parts of large colon cannot be exteriorised. Similarly the transverse colon cannot be exteriorised. The cecum, pelvic flexor and associated parts of large colon are the main parts of large intestine which can be explored and opened for drainage. The pelvic flexure and transverse colon get obstructed due to sudden changes in lumen. The pelvic flexure and associated parts of large colon left ventral colon and left dorsal colon easily are displaced (LDDDLC and RDDLC). The loose mesentry of small intestine allows mainly jejunum to move into epiploic foramen and mesenteric rents causing strangulation. Majority of small intestine and small colon can be easily exteriorised and can be opened to relieve obstruction. The Careful identification of omentum, mesentry, bands of cecum and colon are important for systematic exploration of abdomen. Location of abdominal incision and suturing plays important part in colic cases.

Colic is abdominal pain, but it is a clinical sign rather than a diagnosis/disease. The term colic can encompass all forms of gastrointestinal conditions which cause pain as well as other causes of abdominal pain not involving the gastrointestinal tract. The most common forms of colic are gastrointestinal in nature and are most often related to

colonic disturbance. There are a variety of different causes of colic, some of which can prove fatal without surgical intervention. Colic surgery is usually an expensive procedure as it is major abdominal surgery, often with intensive aftercare. Among domesticated horses, colic is the leading cause of death. The incidence of colic in the general horse population has been estimated between 10 and 11 percent on an annual basis.

Classification of colic: The list of types of colic is exhaustive but details of some of the types which may be encountered is given as under.

Pelvic flexure impaction

This is caused by an impaction of food material (Water, Grass, Hay, Grain) at a part of the large bowel known as the *pelvic flexure* of the left colon where the intestine takes a 180 degree turn and narrows. Impaction generally responds well to medical treatment, but more severe cases may not recover without surgery. If left untreated, severe impaction colic can be fatal. The most common cause is when the horse is on box rest and/or consumes large volumes of concentrated feed, or the horse has dental disease and is unable to masticate properly. This condition could be diagnosed on rectal examination by a veterinarian.

Spasmodic colic

Spasmodic colic is the result of increased peristaltic contractions in the horse's gastrointestinal tract. It can be the result of a mild gas buildup within the horse's digestive tract. The signs of colic are generally mild and respond well to spasmolytic and analgesic medication.

Ileal impaction: The ileum is the last part of the small intestine that ends in the cecum. Ileal impaction can be caused by obstruction of ingesta. Other causes can be obstruction by ascarids (*Parascaris equorum*) or tapeworm (*Anoplocephala Perfoliata*).

Sand impaction: This is most likely to occur in horses that graze sandy or heavily grazed pastures leaving only dirt to ingest. The ingested sand or dirt accumulates in the pelvic flexure, right dorsal colon and the cecum of the large intestines. As the sand or dirt irritates the lining of the bowel it can cause diarrhea. The weight and abrasion of the sand or dirt causes the bowel wall to become inflamed and can cause a reduction in colonic motility and in severe cases even peritonitis. Historically medical treatment of the problem is with laxatives such as liquid paraffin or oil and psyllium husk. The doctors

are also treating cases with specific symbiotic (pro and prebiotic) and psyllium combinations. Some cases may need surgery. Horses with sand or dirt impaction are predisposed to *Salmonella* infection. Horses should not be fed from the ground in areas where sand, dirt and silt are prevalent although small amounts of sand or dirt will still be ingested by grazing.

Enterolith: Enteroliths in horses are round balls of mineral deposits often formed around a piece of ingested foreign material, such as sand or gravel. When they move from their original site they can cause obstruction of the intestine. Enteroliths are not a common cause of colic, but are known to have a higher prevalence in states with a sandy soil and where an abundance of alfalfa hay is fed, such as California. Once a horse is diagnosed with colic due to enterolith it usually requires surgery to correct the condition.

Large roundworms: Occasionally there can be an obstruction by large numbers of roundworms. This is most commonly seen in young horses as a result of a very heavy infestation of *Parascaris equorum* that can subsequently cause a blockage and rupture of the small intestine. Deworming heavily infected horses may cause a severe immune reaction to the dead worms, which can damage the intestinal wall and cause a fatal peritonitis. Veterinarians often treat horses with suspected heavy worm burdens with corticosteroids to reduce the inflammatory response to the dead worms. Blockages of the small intestine, particularly the ileum, can occur with *Parascaris equorum* and may well require colic surgery. Large roundworm infestations are often the result of a poor deworming program. Horses develop immunity to parascarids between 6 months age and one year and so this condition is rare in adult horses.

Tapeworms: Tapeworms at the junction of the cecum have been implicated in causing colic. The most common species of tapeworm in the equine is *Anoplocephala perfoliata*. However, a 2008 study in Canada indicated that there is no connection between tapeworms and colic, contradicting studies performed in the UK.

Cyathostomes: Acute diarrhoea can be caused by cyathostomes or "small Stronglyle type" worms that are encysted as larvae in the bowel wall, particularly if large numbers emerge simultaneously. The disease most frequently occurs in winter time. Pathological changes of the bowel reveal a typical "pepper and salt" colour of the large intestines. Animals suffering from cyathostominosis usually have a poor de-worming history. There is now a lot of resistance to fenbendazole.

Left dorsal displacement of large colon (LDDLC): Left dorsal displacement is a form of colic where the left dorsal colon becomes trapped above the spleen and against the nephrosplenic ligament. It may necessitate surgery although often it can be treated with exercise and/or phenylephrine, at times anaesthesia and a rolling procedure must be performed to correct the condition medically. This condition can be diagnosed on rectal examination or through ultrasonography by a veterinarian. Surgery is also indicated in cases of LDDLC.

Right dorsal displacement of large colon (RDDLC): Right dorsal displacement is another displacement of part of the large bowel. Although signs of colic may not be very severe, surgery is usually the only available treatment. The prognosis in delayed cases is usually unfavourable.

Torsion: Torsion is common after foaling in mares but can occur spontaneously. Various parts of the horse's gastrointestinal tract may twist upon themselves. It is most likely to be either small intestine or part of the colon. Occlusion of the blood supply means that it is a painful condition causing rapid deterioration and requiring emergency surgery.

Intussusception: Intussusception is a form of colic in which a piece of intestine "telescopes" within a portion of itself. It most commonly happens in the small intestine of young horses and requires urgent surgery. Ileo-cecal intussusception is also seen in horses.

Epiploic foramen entrapment: On rare occasions, a piece of small intestine can become trapped through the epiploic foramen. The blood supply to this piece of intestine is immediately occluded. The intestine becomes trapped and surgery is the only available treatment.

Strangulating lipoma (Peduculated lipoma): Mostly seen in old horses, benign fatty tumors known as lipomas can form on the mesentery. As the tumor enlarges, it stretches the connective tissue into a stalk which can wrap around a segment of bowel, typically small intestine, cutting off its blood supply. The tumor forms a button that latches onto the stalk of the tumor, locking it on place, and requiring surgery for resolution.

Mesenteric rent entrapment: The mesentery is a thin sheet attached to the entire length of intestine, enclosing blood vessels, lymph nodes, and nerves. Occasionally, a small rent (hole) can form in the mesentery, through which a segment of bowel can occasionally enter. As in epiploic foramen entrapment, the bowel first enlarges, since

arteries do not occlude as easily as veins, which causes edema (fluid build up). As the bowel enlarges, it becomes less and less likely to be able to exit the site of entrapment. This problem also requires surgical correction.

***Gastric ulceration*: Gastric ulceration of** the stomach fairly commonly in young horses. Risk factors include confinement, infrequent feedings, a high proportion of concentrate feeds, excessive non-steroidal anti-inflammatory drug use, and the stress of shipping and showing. Most ulcers are treatable with medications that inhibit the acid producing cells of the stomach. Antacids are less effective in horses than in humans, because horses produce stomach acid almost constantly, while humans produce acid mainly when eating. Dietary management is critical. Bleeding ulcers leading to stomach rupture are rare.

Other causes that may show clinical symptoms of colic: Strictly speaking colic refers only to signs originating from the gastrointestinal tract of the horse. Signs of colic may be caused by problems other than the GI-tract e.g. problems in the kidneys, ovaries, spleen, testicular torsion, pleuritis, or pleuropneumonia. Diseases which sometimes cause symptoms which appear similar to colic include laminitis and exertional rhabdomyolysis.

Pathophysiology of equine colic: This can be divided broadly into simple obstructions, strangulating obstructions, and non-strangulating infarctions.

Simple Obstruction

This is characterised by a physical obstruction of the intestine, which can be due to impacted food material, stricture formation, or foreign bodies. The primary pathophysiological abnormality caused by this obstruction is related to the trapping of fluid within the intestine oral to the obstruction. This is due to the large amount of fluid produced in the upper gastro-intestinal tract (around 125l daily), and the fact that this is primarily reabsorbed in parts of the intestine downstream from the obstruction. The first problem with this degree of fluid loss from circulation is one of decreased plasma volume, leading to a reduced cardiac output, and acid-base disturbances. There also occur serious effects on the intestine itself, which becomes distended due to the trapped fluid, and by gas production from bacteria. It is this distension, and subsequent activation of stretch receptors within the intestinal wall, that leads to the associated pain. With progressive distension of the intestinal wall, there is occlusion of blood vessels, firstly veins, then arteries. The difference in time to onset of occlusion is due to the relatively

more rigid walls of arteries compared with veins. This impairment of blood supply leads firstly to hyperaemia and congestion, and ultimately to ischaemic necrosis and cellular death. The poor blood supply also has effects on the vascular endothelium, leading to an increased permeability. This results initially in leakage of plasma, and eventually blood into the intestinal lumen. In the opposite fashion, gram-negative bacteria and endotoxins can enter the bloodstream, leading to further systemic effects.

Strangulating Obstruction

Strangulating obstructions have all the same pathological features as a simple obstruction, but the blood supply is immediately affected. Both arteries and veins may be affected immediately, or progressively as in simple obstruction. Common causes of strangulating obstruction are intussusceptions, volvulus and displacement of intestine through a hole, such as a hernia, a mesenteric rent, or the epiploic foramen.

Non-strangulating Infarction

In a non-strangulating infarction, blood supply to a section of intestine is occluded, without any obstruction to ingesta present within the intestinal lumen. The most common cause is infection with*Strongylus vulgaris* larvae, which develop within the (primarily cranial) mesenteric artery.

Diagnosis: Many different diagnostic tests can be used to diagnose the cause of equine colic, which may have greater or lesser value in certain situations. The most important distinction to make is whether the condition should be managed medically or surgically. If surgery is indicated, then it must be performed with utmost haste, as delay is a dire prognostic indicator.

History

A thorough history is always taken, including age, sex, recent activity, diet, any recent dietary changes, and routine anthelmintic treatment. However, the most important factor is time elapsed since onset of clinical signs, as this has a profound impact on prognosis, and the type of treatment that will be undertaken.

Cardiovascular Parameters (Main prognostic factor)

Heart rate rises with progression of colic, in part due to pain, but mainly due to decreased circulating volume, decreased preload, and endotoxemia. The rate should be measured over time, and its response to analgesic therapy ascertained. A pulse that continues to rise in the face of adequate analgesia is considered a surgical indication.

Mucous membrane colour can be assessed to appreciate the severity of haemodynamic compromise. Reddening of membranes reflects worse prognosis, and cyanotic membranes indicate a very poor chance of a positive outcome.

Laboratory tests can be performed to assess the cardiovascular status of the patient. Packed Cell Volume (PCV) is a measure of hydration status, with a value 45% being considered significant. Increasing values over repeated examination are also considered significant. The total protein (TP) of blood may also be measured, as an aid in estimating the amount of protein loss into the intestine. Its value must be interpreted along with the PCV, to take into account the hydration status.

Rectal Examination

Repeated rectal examinations are a cornerstone of colic diagnosis, as many large intestinal conditions can be definitively diagnosed by this method alone. Other non-specific findings, such as dilated small intestinal loops, may also be detected, and can play a major part in determining if surgery is necessary.

Nasogastric Intubation

Passing a nasogastric Tube (NGT) is useful both diagnostically and therapeutically. Fluid is refluxed from the stomach, and any more than 2 litres of fluid is considered to be significant. Increased fluid is generally as a result of backing up of fluid through the intestinal tract, due to a downstream obstruction. This finding is important as it represents a relatively advanced stage of colic, and is often a surgical indication. Therapeutically, gastric decompression is important, as if fluid build up occurs, gastric rupture may occur, which is inevitably fatal.

Abdominocentesis

The extraction of fluid from the peritoneum can be useful in assessing the state of the intestines. A sanguinous fluid represents an infarction, and usually indicates surgery is necessary. A cloudy fluid is suggestive of an increased number of white blood cells, which indicates the disease is relatively advanced. The protein level of abdominal fluid can be analysed, and may also give information as to the integrity of intestinal blood vessels.

Abdominal Distension

Any degree of abdominal distension is usually indicative of a condition affecting the large intestines, as distension of structures upstream of here would not be large enough to be visible externally.

Auscultation

Auscultation of the abdomen, usually performed in a four quadrant approach, can be a useful tool. Increased gut sounds may be indicative of spasmodic colic. A decreased amount of sound, or no sound, may be suggestive of serious changes.

Faecal Examination

The amount of faeces produced, and its character can be helpful, although as changes often occur relatively distant to the anus, changes may not be seen for some time. In areas where sand colic is known to be common, or if the history suggests it may be a possibility, faeces can be examined for the presence of sand, often by immersion in water, or simply by its texture.

Clinical signs

Pawing and/or scraping, stretching, frequent attempts to urinate, flank watching: turning of the head to watch the stomach and/or hind quarters, biting/nipping the stomach, pacing, repeated flehmen response, repeated lying down and rising, rolling, groaning, bruxism, excess salivation, loss of appetite, decreased fecal output, increased pulse rate, dark mucous membranes etc.

Dealing with a colicy horse: (Steps involved in management of a colic case)

Step I: Detailed history, General physical examination (Temperature, Heart rate, Pulse rate, Mucous membranes, Capillary refill time, Respiration rate and character, Dehydration, Behaviour) Auscultation of intestine, Rectal examination, Peritoneal fluid collection. ***Laboratory test:*** Blood; TLC and DLC, PCV, total proteins, Electrolyte analysis, Blood gas and acid base analysis, Lactate, Peritoneal fluid examination (total cell count, blood, proteins, Microbes).

Step II: Intravenous fluid administration, Gastric intubation, Analgesics etc. (Xylazine, Opoid derivatives eg butophanol, Flunixinin, Non steroidal analgesics) Decompression of intestine if required.

Step III: Decision making: Based on history, clinical signs, Laboratory data and various parameters evaluated and re-evaluated at different intervals and then decision to continue with medical treatment or refer for surgery is reached

Step IV: Treatment

Surgical management:

Requirements: Equine surgical table, Facility of hoist, large animal anaesthesia machine with ventilator, suction apparatus, colon tray, surgical instruments, sleeves etc.

Anaesthesia: General anaesthesia induced with intravenous agents and maintained with halothane/isofluorane etc is indicated. Where muscle relaxants are used, positive pressure ventilation is mandatory.

Positioning : Dorsal recumbency with adequate protection for head and limbs to avoid post operative complications.

Surgical approach: Ventral celiotomy through midventral incision is standard surgical approach. Other approaches such as flank approach is also used for some conditions. After opening of abdomen, the gas from the intestine must be removed by suction needle making a valve at the band or the mucosal surface. Systematically the intestine should be explored to locate the obstruction. It is preferred to open the cecum and drain the contents. The obstructing mass or fecolith can be removed. The intestine may be sutured with inversion sutures with synthetic absorbable suture material. The small intestine can be resected and end to end anastomosis or side to side anastomosis to give more lumen for passage of intestinal contents may be preferred. The LDDLC or RDDLC can be corrected by bringing the colon to its normal anatomical position. The abdomen can be closed by continuous sutures in two or more parts or interrupted sutures. Intestine should be thoroughly washed with saline and abdomen lavaged adequately before closure of abdomen. The horse should be placed in a well padded stall with soft bedding during recovery and monitored for smooth recovery. Antibiotic cover and NSAIDs should be administered. A foley,s catheter is left in abdomen upto 72 hours to facilitate drainage of peritoneal fluids. The abdominal cavity can be lavaged with saline through this catheter.

Post operative management: Post operative management includes regular monitoring of vital parameters, administration of fluids (balanced solution without lactate), antibiotics, NSAIDs, padded bedding. Use of lignocain to stimulate the motility of intestine is recommended. Exercise as walk should be started after 24 hours of surgery. Combination of B-complex, Vitamin C, Vitamin E, Zinc and blood thinners may

be administered orally to boost immune response and prevent post operative complications. A secure abdominal bandage is mandatory to prevent wound related complications. Ultrasound examination of abdomen for peritoneal fluid accumulation is recommended. Concentrates may be avoided during recovery, however greens prefrablly grass hay can be given. Major complications of equine colic surgery include pertonotis, recurrence, laminitis and complications related with wound and recovery of animal from anaesthesia.

Suggested Readings:

Pascoe, P.J., McDonell, W.N., Trim,C. M. And Gorder, V. 1983. Mortality rates and associated factors in equine colic operations- A retrospective study of 341 operations. *Candian Vet J.* 24:76-85.

Baxter, G.M. 1992. The steps i assessing a colicky horse. *Vet. Med.* 1012-1018.

Baxter, G.M. 1992. Recognizing and managing the post operative complications of equine abdominal surgery.. *Vet. Med.* 1012-1018

Giffen, James M. and Tom Gore. "Horse Owner's Veterinary Handbook., 2nd ed. New York: Howell Book House, 1989, 1998. ISBN 0876056060.

K.J. Chandler, M.C.Collins, S.Love. Efficacy of a five-day course of fenbendazole in benzimidazole- resistant cyathostomes. *Vet. Rec.* (2000) 147, 661-662.

Proudman, C.J., Smith, J.E., Edwards, G.B. and French, N.P. 2002. Long tern survival of equine surgical colic cases. Parl: Pattern of mortality and morbidity. *Equine Vet. J.* 34(5): 432-437.

Oke, Stacy. "Research Ongoing for Tapeworm, Colic Link." *The Horse* July 2008: 20.

Blikslager, A. "Avoiding Colic Through Management." *The Horse* July 2008: 47-54.

Morton, A.J.. 2009. Advances in management of large intestinal colic.. Proceedings of 55th Annual Convention of the American Association of equine practitioners. Las Vegas, Nevada, USA. 212-217.

Blikslager, A. 2009. Critical decisions in in colic. Proceedings of 55th Annual Convention of the American Association of equine practitioners. Las Vegas, Nevada, USA.25:201-206.

Blikslager, A. 2009. Advances in management of small intestinal diseases causing colic. Proceedings of 55th Annual Convention of the American Association of equine practitioners. Las Vegas, Nevada, USA. 207-211.

Kelmer, G. 2009. Update on recent advances in equine abdominal surgery. *Vet. Clin North Am.(equine)* 25:271-282.

Plummer, A.E. 2009. Impactions of the small and large intestines. *Vet Clin North Am. (equine)* 25:317-327.

Pierce, R.L. 2009. Enteroliths and other foreign bodies. *Vet Clin North Am. (equine)* 25:329-340.

Klohnen, A. 2009.New perspectives in post operative complications after abdominal surgery. *Vet Clin North Am. (equine)* 25:341-450.