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**Original Scientific Paper**

**RETROSPECTIVE EXAMINATION OF SMALL  
COLON PATHOLOGY IN 72 HORSES**

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**Abstract**

The paper retrospectively presents diagnostics, conservative and surgical treatment of various small colon pathologies in 72 horses, which were admitted with abdominal pain (colic) to the Veterinary clinic "Novi Vek" of the Moscow State Academy of Veterinary Medicine and Biotechnology (named Skrabina). Examinations were performed from the year 2007 to 2019, when 1810 colic horses were received and examined, of which 72 horses, i.e. 3.97% of all cases, were diagnosed with a small colon pathology. The most frequent cause of a small colon pathology was constipation that was diagnosed in 49 cases. Out of 72 hospitalized and treated horses, 62 horses, i.e. 86.1%, were successfully cured.

**Key words:** small colon, horses, constipation, abdominal colic

**INTRODUCTION**

The small or descending colon of horses (lat. *colon descendens*) represents the final part of the intestinal tract, which in horses reaches a length of 2 meters. The mentioned colon is relatively mobile inside the caudal abdomen and passes into the fixed rectum at the level of the pelvic bones. The small colon of horses has a relatively long mesentery, which, in addition to blood vessels, contains numerous nerve and lymphatic vessels. In this part of the intestinal tract of horses, the final resorption of water occurs and the characteristic structures of the feces are formed (Kovač, 2010).

Diagnosis and treatment of various pathologies of this part of the intestinal tract of horses have been rarely examined (Ruggles and Ross, 1991; Bont et al., 2013). The main diagnostic methods are rectal and ultrasound examination of the horse's abdomen (Freeman et al., 2001; Kovač et al., 2018). When small colon enterolites are suspected, an X-ray examination is used (Yarbrough et al., 1994). The aim of this retrospective study is to determine the frequency of occurrence of small colon pathology in the general population of equine gastrointestinal diseases, to clarify optimal treatment methods, as well as to determine the possible prognosis of cure.

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## MATERIALS AND METHODS

One thousand eight hundred ten horses with various pathologies of the gastrointestinal tract that showed different degrees of abdominal pain (colic), were admitted to be treated, at the Veterinary clinic "Novi Vek" of the Moscow State Academy of Veterinary Medicine and Biotechnology (named Skrabina). All horses were clinically examined on admission to the clinic, through measurement of heart and respiratory rate, body temperature, and auscultation of peristaltic murmurs. Laboratory testing of blood parameters was performed in all horses: hematocrit, total protein concentration, leukocyte count, and acid-base blood status (pH, hydrocarbonate concentration, the partial pressure of O<sub>2</sub> and CO<sub>2</sub>). These blood parameters were tested on a Medicon CA620 (Dublin, Ireland). Besides, all horses underwent rectal and ultrasound examination of the abdomen, as well as gastric sounding. If necessary, where the diagnosis was not clear, other diagnostic procedures were performed, such as abdominocentesis, laparoscopic examination, and diagnostic laparotomy.

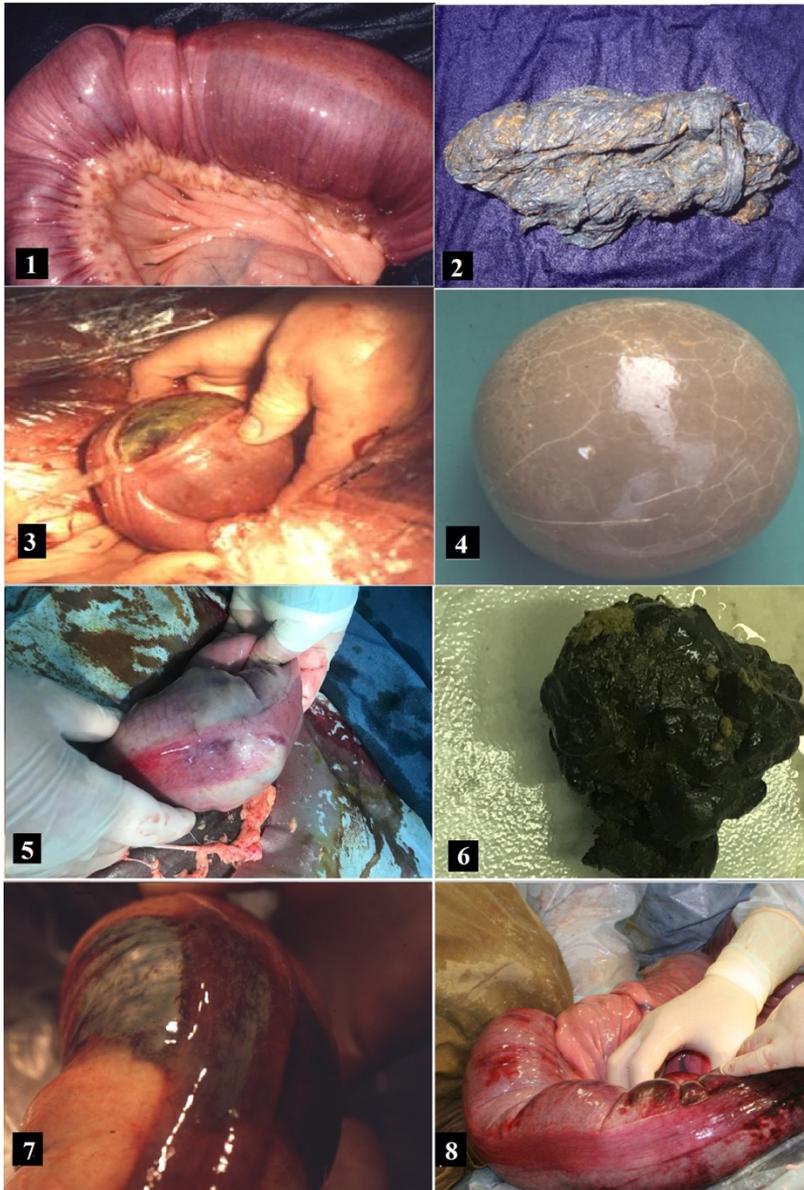
After the diagnosis of colic disease, the method of conservative or surgical treatment was chosen. Three hundred ninety horses were selected for the surgical method of treatment in general inhalation anesthesia, the other horses were treated with conservative methods of treatment.

Statistical analysis clinical and laboratory parameters were performed on the software "Statistics Analysis System (SAS)". Quantitative parameters were compared using the Student's t-test. Qualitative parameters were compared with the Chi-square test. Multivariate logistic regression was used to determine the influence of disease duration on the survival factor of diseased animals.

## RESULTS

In seventy-two horses, out of 1810 colic horses, small colon pathology was found (3.97% of all cases). Pathologies included constipation of the small colon with feces (49 cases), constipation of the small colon with plastic (1 case) (figure 1. and 2.) constipation of the small colon with enterolite (4 cases) (figure 3., 4., 5. and 6.), parasitic thromboembolism (necrotic infarction) of the small colon wall (6 cases) (figure 7. and 8.), cleft mesentery of the small colon (4 cases), trauma (perforation) of the small colon wall after foaling or rectal examination (4 cases), invagination of the small colon (2 cases) and lipoma strangulation (2 cases). Multiple pathologies on a small colon (such as constipation with mesenteric injury) was found in 8 horses. Chemical analysis of the composition of enteroliths (by IR spectrometry), done in one horse in which such a test was performed, showed that it was formed on 80% of struvite (MgNH<sub>4</sub>PO<sub>4</sub> · 6H<sub>2</sub>O) and on 20% of carbonate apatite (Ca<sub>10</sub>(PO<sub>4</sub>)<sub>6</sub>CO<sub>3</sub>CH<sub>6</sub>(OH)<sub>2</sub>).

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**Figure 1-8.** Intraoperative small colon pathologies in horses

**Figure 1. and 2.** – Small colon constipation with plastic

**Figure 3., 4., 5. and 6.** – Small colon constipation with plastic with enteroliths

**Figure 7. and 8.** – Tromboembolic changes (necrosis) of the small colon wall

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The dependence of a small colon pathology on animal gender was not determined. Younger Oryol or Arabian horses (as well as other miniature breeds of horses) suffer from small colon constipation more often than other horses. Especially newborn foals often had small colon constipation in the form of meconium constipation (18 animals).

Table 1. presents the data of clinical and laboratory blood tests at the time of admission of horses to the veterinary clinic before they were treated.

**Table 1.** Clinical and blood laboratory parameters in horses with small colon disease

Pathology	Heart rate (beats/min)	Temperature (°C)	Plasma proteins (g/l)	Hematocrit (l/l)	Leucocyte concentration (10 <sup>9</sup> /l)	Bicarbonate concentration (mmol/l)
Small colon constipation with feces (n=51)	58.43 ± 5.67	37.12 ± 0.28	69.56 ± 7.23	0.42 ± 0.03	5.61 ± 2.06	25.18 ± 3.97
Small colon constipation with enterolith (n=3)	54.43 ± 3.17	37.91 ± 0.38	72.16 ± 5.73	0.44 ± 0.02	6.92 ± 4.14	23.16 ± 4.03
Parasitic thromboembolism of the small colon wall (n=6)	43.14 ± 5.40	38.95 ± 0.51	58.34 ± 8.17	0.46 ± 0.05	10.40 ± 0.75	25.07 ± 7.62
Injury of the mesentery of the small colon (n=4)	44.92 ± 5.32	37.29 ± 0.25	66.34 ± 12.40	0.30 ± 0.04	5.37 ± 1.02	27.79 ± 6.35
Perforation of the wall of the small colon and rectum (n=4)	94.91 ± 12.25	38.54 ± 0.55	42.12 ± 11.34	0.62 ± 0.05	4.80 ± 0.64	19.68 ± 3.20
Small colon intussusception (n=2)	66.42 ± 16.38	38.53 ± 0.53	78.48 ± 10.50	0.46 ± 0.04	9.97 ± 2.50	27.06 ± 6.52
Strangulation of small colon lipoma (n=2)	80.44 ± 10.36	38.02 ± 0.45	54.32 ± 9.80	0.54 ± 0.01	9.31 ± 2.65	21.09 ± 6.30

Clinical and blood laboratory parameters results depended on the specific pathology and especially on the time between the onset of the disease and the arrival at the veterinary clinic. If more time elapsed since the onset of colic, horses had a higher degree of endotoxic

shock, and thus the greater changes in the examined clinical and laboratory parameters were observed. As can be seen from the table, the increase in heart rate and hematocrit was particularly pronounced in horses with perforation of the wall of the small colon and with strangulation lipoma. The reason for this phenomenon was related to the high degree of peritonitis. Leukocyte concentration evaluation and higher temperature were found only in horses with parasitic thromboembolism of the small colon wall and intussusception of the small colon.

Horses that had a small colon pathology showed different degrees of abdominal pain (colic), which was directly dependent on the specific pathology, the duration of the colic disease, and also on previously used analgesic preparations before admission to the veterinary clinic. The greatest degree of pain was shown by horses that had small colon strangulation with pendulating lipoma. Gastric reflux was not observed in any of the examined horses with small colon pathology.

Specific treatment methods have been undertaken for various small colon pathologies. Small colon constipation with fecal masses could in most cases be successfully treated by oral administration of laxative preparations (paraffin oil and 4% sodium sulfate solution) and rectal lavage (enema). This method cured 34 of the 49 animals. In case the conservative methods did not succeed within 24-36 hours, surgical treatment was performed under general anesthesia. During the medial laparotomy, a small colon was extracted and a manual massage of a part of the small colon was performed, with simultaneous rectal rinsing with water through a long probe that was inserted through the rectum into the small colon.

Other pathologies of the small colon were treated exclusively by surgery through medial laparotomy. The chosen surgical method depended on the specific pathology of the small colon. Obstruction of the small colon with enteroliths or other foreign bodies was treated by the incision of the small colon at the site of obstruction, strictly antimesenteric at the site of transverse tenion followed by careful extraction of enterolith. Afterward, the incision on the small colon was sutured using Schmiden and Lembert pattern. The closure was usually performed with a synthetic monofilament polydioxanone or vicryl (2-0). In case of major injuries of the mesentery and thromboembolism of the colon wall in two horses, resection and anastomosis of the small colon were performed. One horse with a high degree of injury of the mesentery of the small colon suffered bleeding and died during the operative process.

During the strangulation of the small colon strangulation by the lipoma, at the beginning, a part of the lipoma tree was dissected, which automatically "released" the affected part of the small colon. In one such horse, the pathological process did not last long, and as necrosis of the wall of the small colon did not occur, a simple manual massage of the intestinal contents was performed. In the second case of small colon strangulation by lipoma in a horse that was admitted to the clinic with a delay, a high degree of ischemic necrosis of the small colon wall was found. Due to the impossibility of resection,

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intraoperative euthanasia of the diseased animal was performed. Horses with perforation of the wall of the small colon and rectum were also euthanized intraoperatively (4 cases), because the affected animals had a high degree of peritonitis due to feces falling into the abdomen.

In our material for surgery, there were two animals with small colon invagination. In one such animal, rectal prolapse (*invaginatio rectalis*) occurred as a consequence of a high degree of cleft in the mesentery of the small colon, and animal was euthanized. In another horse with intussusception, a small colon intussusception was able to be manually corrected intraoperatively.

All postoperative horses underwent standard postoperative therapy (infusion therapy, antibiotics, nonsteroidal anti-inflammatory drugs, and prokinetics) (Kovač et al., 2020). During postoperative hospitalization, 3 horses were euthanized or died due to septic peritonitis, endotoxemia, and adhesive ileus. Other postoperative complications such as fever, transient diarrhea, and the infection of the surgical incision of the abdominal have been successfully treated. Thus, out of the total number of horses with small colon pathology, 62 animals were cured and discharged as healthy from the clinic (86.1%).

## DISCUSSION

Until today, 72 pathologies of the gastrointestinal tract in horses have been described (Kovač, 2010). Small colon diseases of horses rarely occur, as according to our research out of the total number of recorded horses with colic, the small colon pathology accounts for about 3.97% of all cases. The most common disease of the small colon is constipation, which can be caused by pure fecal masses, as well as a "foreign" body, such as intestinal concretions (stones) and plastics (Keller and Horney, 1985). In our examined material, we could not find phytobezoars and tumors that can also cause small colon obstruction (Dart et al., 1992). Very often, constipation occurs in the first feces of newborn foals, the so-called "meconium constipation". Factors that lead to constipation of the small colon with feces in adult horses are different: impaired innervation of the small colon, insufficient water intake (winter), tooth caries (poor chewing of hay), and prolonged use of antiparasitic drugs (Edwards, 1997).

The small colon constipation with enteroliths is a well-documented cause of intestinal obstruction in horses. Risk factors associated with the development of enteroliths include geographical location (most common in horses grazing in meadows with a high abundance of sand, such as horses in California and Florida) (Hassel et al., 1999). It occurs most often in foals of the Arabian breed, which are fed with alfalfa hay and drink water with a high content of magnesium and other heavy metals (Hassel et al., 2004). Based on our examination, the prognosis of surgical cure of enteroliths and other forms of small colon constipation in horses is good (compared to other small intestine pathologies) in case of rapid diagnosis and timely treatment of such horses (Kovač et al., 2015; Kovač et al., 2018; Kovač et al., 2019). Based on our long-term examination, postoperative (paralytic) ileus in

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the small colon pathology practically does not occur in horses, compared to small intestine pathologies (Kovač et al., 2020). However, if intestinal necrosis has occurred due to the prolonged presence of enteroliths, small colon resection is required (in addition to removal of enteroliths). In such a case, the prognosis of healing deteriorates rapidly, due to the possible development of peritonitis and re-obstruction by fecal masses at the site of the new anastomosis (Prange et al., 2010). For that reason, when setting up an anastomosis, it is important not to reduce the transverse size of the small colon too much.

In our cases of colic horses, necrosis of the small colon wall (thromboembolic colic) caused by arthritis was relatively often detected, as a result of the larva *Strongylus vulgaris* migration (Dart et al., 1992). Such diseased horses have mild symptoms of colic, fever and leukocytosis, and very often, according to our experience, are brought to the clinic very late.

The most severe, and very often a deadly disease of the small colon is extensive injuries (splints) of the mesentery and especially a complete rupture of the wall of the small colon and rectum, which leads to the rapid development of deadly peritonitis. Usually, such pathology occurs during the careless rectal examination of colic horses, i.e. is caused by the veterinary intervention.

## CONCLUSION

According to our examinations, small colon diseases rarely occur, since, out of the total number of horses brought to the clinic with colic (1810 animals) the small colon diseases accounted for 72 cases (3.97%). The most common small colon pathologies in horses are small colon constipations combined with parasitic thromboembolism and perforation of the intestinal wall, cleavage of the mesentery, intussusception, and strangulation of small colon lipoma. Small colon diseases in horses have a good prognosis if they are diagnosed in time and timely conservative and surgical methods of treatment are undertaken.

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