

## Long-term survival and complications of colic surgery in horses: analysis of 331 cases

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**ABSTRACT:** Three hundred and thirty-one (331) horses out of 371 cases (i.e. 351 individuals discharged from the clinic) were followed up in order to evaluate long-term survival rate and complications after colic surgery. Twenty horses were subjected to surgery twice during the period of this study. Out of the sample of 331 patients, 302 animals (91.2%) survived at least 11 months after the operation. Twenty-nine horses (8.8%) died or had to be euthanized. Colic episode was considered to be the cause of death in 23 (79.3%) out of 29 patients. Seven colic patients had to be reoperated. The remaining six patients died of a cause unrelated to the gastrointestinal disease. Seven out of 302 long-term surviving patients needed the second operation within the first 11 months after the first surgery. Colic episode was reoperated in another 15 patients after 12 months to 4 years after the first operation. Conservative treatment was necessary in another 10 long-term surviving horses. In eight long-term surviving horses and in one patient that did not survive 11 months, incision hernias were identified as the postoperative complication. Twenty-one horses out of 331 were subjected to relaparotomy during their first hospitalization. Eighteen out of these (85.7%) survived 11 months after the surgery; the remaining three were euthanized within six months due to colic.

**Keywords:** horse; colic; laparotomy; long-term survival rate; complications

The survival rate of colic surgery is usually evaluated by the number of patients discharged home against the total number of operated animals. From the owner's point of view, the prognosis should be based rather on long-term survival and return to previous performance than merely on short-term survival during the recovery period. Long-term survival of colic patients and complications occurring during the recovery period have been studied in several clinical trials (Siebke et al., 1995; Freeman et al., 2000; van den Boom and van der Velden, 2001; Mair and Smith, 2005). The most frequent complications observed by owners include recurrent colic episodes (Mair and Smith, 2005). Generally, these episodes are caused by intestinal adhesions which represent the predominant cause of poor long-term survival rate (Gerhards, 1990; Freeman

et al., 2000; van den Boom and van der Velden, 2001, and others). Other common health problems associated with colic surgery include infections of laparotomic wounds, incision hernias and septic thrombophlebitis (Wilson et al., 1995; Honnas and Cohen, 1997; Mair and Smith, 2005).

The aim of the present study is to evaluate long-term results of surgeries performed in a large sample of colic patients as well as complications that resulted in death or poor performance of the animals.

### MATERIAL AND METHODS

From the sample of horses that underwent colic surgery between October 1, 1994 and December 31,

2005 and were subsequently discharged home, we selected patients whose state of health was followed up for at least 11 months after the surgery. Requested information was obtained via phone calls with owners or local veterinary surgeons. Animals that survived 11 months after the operation were classified as long-term surviving patients. The owners of surviving horses were inquired about the overall state of health and the occurrence of colic episodes and other health problems associated with the surgery. In horses that died or were euthanized, the cause of death and its connection with the surgery were determined. In patients that required colic surgery repeatedly (twice or thrice), the cause of colic during each hospitalization, the scope of surgery and possible interconnection were analysed. Horses subjected to relaparotomy during their first hospitalization due to postoperative complications were identified and their long-term survival rate was evaluated.

## RESULTS

### Analysis of the long-term survival rate after colic surgery

A total of 371 patients were discharged home after surgery performed between October 1, 1994 and December 31, 2005. The sample of 371 recovered horses represented 351 individual animals as

20 horses were operated repeatedly and discharged home twice. 20 horses could not be used for the evaluation of the long-term survival rate; the remaining 331 animals were successfully enrolled in the study. Out of 331 horses discharged home, at least 302 patients survived 11 months (91.2%). The remaining 29 animals (8.8%) died or were euthanized.

### Analysis of horses that did not survive in the long-term

**Recurrent colics.** A total of 29 horses died or were euthanized within 11 months after surgery. Twenty-three (79.3%) of them died of colic, i.e. constantly poor nutritional state. Colic was the cause of death in 23 out of 331 (6.9%) horses that were discharged home.

**Surgically treated recurrent colics.** Seven horses were subjected to another colic surgery within two weeks to 10 months after the first operation (Table 1 and 2). In two animals, the surgical treatment due to abdominal synechia was performed two or four weeks after the first operation. The first animal was euthanized during the surgery, the second during the recovery period. In the third patient, the relapse of the left dorsal displacement occurred three weeks after the first operation. This horse was treated by a reposition of the displaced colon. In the recovery period, the animal was subjected to laparoscopic

Table 1. Summary of surgical diagnoses and surgeries in animals that did not survive in the long-term and were operated twice

Surgical diagnosis 1 <sup>st</sup> operation	Surgery	Surgical diagnosis 2 <sup>nd</sup> operation	Surgery	Result of 2 <sup>nd</sup> operation	Interval between 1 <sup>st</sup> and 2 <sup>nd</sup> operation
SI – hernia inguinialis incarcerata	resection, JIA	SI – synechia	resection, JJA	euthanasia after surgery	2 weeks
LC – left dorsal dis- placement	enterotomy LC	LC – left dorsal displacement	enterotomy LC, laparoscopy	euthanasia after laparoscopy	3 weeks
LC – colitis	enterotomy LC	SI – synechia	revision	euthanasia during surgery	1 month
SC – focal obstopa- tion/obstruction	enterotomy SC	C – acute obstopa- tion/obstruc- tion	enterotomy C	recovery and euthanasia after discharge	6 months
LC – displacement	reposition	LC – colitis	–	death during anaesthesia	7 months
SI – h. ligamentosa	resection, JJA	SI – h. foraminis omentalis	revision	euthanasia during surgery	10 months

C – caecum, JJA – jejunoojejunal anastomosis, SC – small colon, RDC – right dorsal colon, SI – small intestine, LC – large colon

Table 2. Summary of surgical diagnoses and surgeries in the animal that did not survive in the long-term and was operated three times

Surgical diagnosis 1 <sup>st</sup> operation	Surgery	Surgical diagnosis 2 <sup>nd</sup> operation	Surgery	Surgical diagnosis 3 <sup>rd</sup> operation	Surgery 3 <sup>rd</sup> operation	Result of 3 <sup>rd</sup> operation
LC obstipation RDC	enterotomy LC	LC obstipation RDC	enterotomy LC	LC obstipation RDC	bypass LDC and SC <i>relaparotomy</i>	euthanasia during <i>relaparotomy</i>
Interval between 1 <sup>st</sup> and 2 <sup>nd</sup> operation		4 months		Interval between 2 <sup>nd</sup> and 3 <sup>rd</sup> operation		6 months

LDC – left dorsal colon, SC – small colon, RDC – right dorsal colon, LC – large colon

ablation of the renosplenic area, which was complicated by peritonitis and synechiae. At last, the horse had to be euthanized. Another horse operated due to ileus of the small intestine was re-hospitalized with the same problems 10 months after the first surgery. During the second surgery, the horse had to be euthanized due to irreversible damage of almost the whole small intestine incarcerated in the *foramen omentale*. No intra-abdominal synechiae or other alterations connected with the first operation were diagnosed. In the fifth horse with recurrent problems, no link was seen between focal obstipation of the small colon and acute obstipation and dysfunction of the caecum observed four months after the first surgery. Several days after the horse was discharged home, caecal impaction was diagnosed by a local veterinarian and the animal was euthanized. One mare gave birth to a healthy foal after the surgery of the large colon displacement. After seven months, the mare was re-hospitalized with colic and died under anaesthesia induced due to surgical treatment of colitis. The last horse (Table 2) with chronic obstipation of the right dorsal colon was reoperated due to the same problem after four months. After the surgery, the animal recovered and was discharged home. However, it was re-hospitalized with colic after six months. During the third operation, a bypass between the left dorsal colon and the small colon was created. In the recovery period, this animal showed signs of obstipation relapse and was euthanized during relaparotomy.

**Nonsurgically treated colics.** In one horse, peritonitis was diagnosed during surgery. However, its cause was not diagnosed. After it was discharged home, the animal suffered from mild episodes of abdominal discomfort. One month after the surgery, the horse was hospitalized with severe colic and serious alteration of the overall state of health. Mesenteric volvulus was diagnosed during the dissection of the animal.

A total of 14 horses died in the field or were euthanized due to colic. In one of these animals, operated for inguinal hernia and castrated unilaterally, contralateral inguinal hernia occurred 40 days after the surgery. The horse was euthanized. The sudden death of another horse was connected with pyloric stenosis, which was later confirmed by laparotomy and gastroscopy. The exact causes of deaths of other animals were not determined.

One of the mares miscarried soon after she was discharged home and had to be euthanized due to the poor nutritional state 1 month after the surgery.

**Causes of deaths unrelated to gastrointestinal system.** The death of six out of 29 horses (20.7%) was not associated with gastrointestinal disease. Two horses were euthanized after orthopaedic problems and three animals died of trauma. One horse had to be euthanized due to septic thrombophlebitis of the jugular vein. After the surgery of left dorsal displacement of the large colon, the condition of this horse was complicated by severe colitis, infection of surgical wound and thrombophlebitis. The infection of surgical wound led to the development of incision hernia which was reduced successfully six months after the operation. Although no problems with the jugular vein were observed during the second hospitalization, the owner reported that they led to euthanasia later.

#### Analysis of long-term surviving horses

**Surgically treated recurrent colics.** A total of 302 horses survived at least 11 months after colic surgery. However, seven of these were re-hospitalized due to colic within the first 11 months after the surgery. These animals were subjected to surgery again (Table 3 and 4). Six out of seven horses operated twice survived 13 months to six

years after the second operation. In the first three horses, displacement or torsion of the large colon was diagnosed during both operations. The case of another horse operated for strangulation of the small colon was complicated by colitis, which was observed the day after the animal was discharged home. In other two horses, both the first and second operations were needed to treat small intestine ileus. In the first of these animals, stenosis of the intestinal loop previously strangulated in inguinal hernia was the cause of recurrent abdominal pains and the reason for the second operation. In the second animal, no alterations in abdominal cavity possibly associated with the first operation were found. The owner of only one out of six twice operated horses (the mare with right displacement and torsion of the large colon operated within three weeks) observed occasional diarrhoea after high performances and recurrent colic pain during the first months after the surgery.

One horse, originally operated due to colic, was re-hospitalized with the large colon torsion after nine months, and after another 12 months again. The third operation led to irreversible damage of the intestinal wall and euthanasia (Table 4).

A total of 15 horses were hospitalized after 12 months to four years since the first surgery in order to treat colic surgically (Table 3). Four of these were euthanized due to inoperable findings; the remaining eleven were discharged home.

In seven out of 15 horses reoperated later than 11 months after the first operation, the reason for both surgeries was ileus of the small intestine. Inguinal hernia was diagnosed in three horses during both hospitalizations. Hernia foraminis omentalis was found twice in one patient. In three horses, there was a connection between the second ileus finding and the first operation. One of these suffered from strangulation of the small intestine in poorly adapted mesenteric rupture caused by previous enterectomy. Another two horses had synechia and hernia pseudoligamentosa.

Hernia foraminis omentalis was the reason for the second operation of a horse previously operated due to focal oedema. No intra-abdominal synechia were found during the second operation.

In seven out of 15 horses reoperated later than 11 months after the first operation, the reason for both surgeries was the large colon problem. In two of them, both the first and the second surgery confirmed massive obstipation of the right dorsal colon and its displacement.

Four of 15 twice operated horses were euthanized during surgery due to an inoperable finding. The remaining 11 animals recovered and were discharged home. One of the recovered horses, originally operated for the large colon displacement, was reoperated after four years due to repair distension and obstipation of the large colon. The owner of this horse reported that the animal was subjected to another two abdominal surgeries at foreign clinics. Both these operations had to be performed approximately six months after our surgeries. They were indicated due to displacement and obstipation of the large colon. Other animals survived without any gastrointestinal problems at least 1 year after they were discharged home.

**Nonsurgically treated recurrent colics.** Another 10 horses surviving for more than 11 months after the operation suffered from recurrent colics. The owners reported that five of these animals had more than three colic episodes which resolved spontaneously or thanks to administration of analgesics. One horse whose left dorsal displacement of the large colon was treated surgically was re-hospitalized with the same problem after nine months. The problem was resolved by rolling the animal under anaesthesia. The horse did not suffer from colics for another 10 years.

**Incision hernias.** Eight (2.6%) out of 302 long-term surviving patients had incision hernia which was later successfully reconstructed in seven animals. The owner of the last horse did not want to treat the hernia surgically. In two out of eight horses with incision hernia, the postoperative complications were resolved by relaparotomy.

**Other complications.** In one horse with incision hernia, the extirpation of infected jugular vein had to be performed. The condition of another horse was complicated by laminitis which developed soon after the animal was discharged home. The penile prolapse had to be treated surgically in another horse with inguinal hernia and severe oedema of the surgical wound.

#### Analysis of horses subjected to relaparotomy during their first hospitalization

Postoperative complications of 21 discharged horses were resolved by relaparotomy. Eighteen animals (85.7%) survived at least 11 months after they were discharged home. One of these horses was operated 19 months after the first surgery and had to be euthanized due to irreversible changes

Table 3. Summary of surgical diagnoses and surgeries in long-term surviving, twice operated horses

Surgical diagnosis 1 <sup>st</sup> operation	Surgery	Surgical diagnosis 2 <sup>nd</sup> operation	Surgery	Result of 2 <sup>nd</sup> operation	Interval between 1 <sup>st</sup> and 2 <sup>nd</sup> operation
<b>Interval between 1<sup>st</sup> and 2<sup>nd</sup> operation (less than 11 months)</b>					
SC – hernia mesocolic- ca coli descendentis	enterotomy LC	LC – colitis	enterotomy LC	recovery	10 days
LC – right displace- ment	enterotomy LC	LC – torsion	enterotomy LC	recovery	3 weeks
SI – hernia inguinalis incarcerata	without resection, castration sin	SI – jejunal stenosis	resection, JIA	recovery	7 weeks
SI – hernia pseudoliga- mentosa	without resection, enterotomy LC	SI – volvulus nodosus	without resection, enterotomy LC	recovery	2 months
LC – displacement	enterotomy LC	LC – displacement	enterotomy LC	recovery	4.5 months
LC – torsion	enterotomy LC	LC – torsion	enterotomy LC	recovery	6 months
<b>Interval between 1<sup>st</sup> and 2<sup>nd</sup> operation (more than 11 months)</b>					
LC – right displace- ment	enterotomy LC	LC – torsion	enterotomy LC	recovery	12 months
SI – hernia foraminis omentalis	without resection, enterotomy LC	SI – hernia foraminis omentalis	without resection, enterotomy LC	recovery	13 months
SI – hernia inguinalis incarcerata dx	without resection, castration dx	SI – hernia inguinalis incarcerata dx	without resection, castration sin	recovery	14 months
LC – right displace- ment	enterotomy LC	LC – distension and oedema, peritonitis	revision	euthanasia during surgery	15 months
LC – right displace- ment and obsti- pation RDC	enterotomy LC	LC – displacement and obstipation RDC	enterotomy LC	recovery	15 months
LC – displacement	enterotomy LC	LC – distension and obstipation	enterotomy LC	recovery	16 months
SI – hernia pseudoliga- mentosa	without resection	SI – synechia	revision	euthanasia during surgery	18 months
SI – hernia foraminis omentalis	resection, JIA relaparotomy, JCA	SI – hernia mesenterialis	revision	euthanasia during surgery	19 months
LC – focal oedema	enterotomy LC	SI – hernia foraminis omentalis	revision	euthanasia during surgery	19 months
SI – hernia inguinalis incarcerata dx	without resection	SI – hernia inguinalis incarcerata dx	without resection	recovery	21 months
SI – hernia inguinalis incarcerata	resection, JJA, JJA relaparotomy	SI – hernia inguinalis incarcerata	without resection, castration	recovery	22 months
LC – torsion	enterotomy LC	LC – displacement and obstipation RDC	enterotomy LC	recovery	22 months
SI – hernia umbilicalis incarcerata	resection, JCA	SI – hernia pseudoliga- mentosa	resection, JJA	recovery	2.5 years
LC – right displace- ment and obstipa- tion RDC	enterotomy LC	LC – right displacement and obstipation RDC	enterotomy LC	recovery	4 years
LC – displacement	enterotomy LC	LC – distension and obstipation	enterotomy LC, enterotomy C	recovery	4 years

C – caecum, JCA – jejunocaecal anastomosis, JIA – jejunoleal anastomosis, JJA – jejunojejunal anastomosis, SC – small colon, RDC – right dorsal colon, SI – small intestine, LC – large colon

Table 4. Summary of surgical diagnoses and surgeries in the long-term surviving horse subjected to three operations

Surgical diagnosis 1 <sup>st</sup> operation	Surgery	Surgical diagnosis 2 <sup>nd</sup> operation	Surgery	Surgical diagnosis 3 <sup>rd</sup> operation	Surgery 3 <sup>rd</sup> operation	Result of 3 <sup>rd</sup> operation
LC colitis	enteroto- my LC	LC torsion	enterotomy LC	LC torsion	revision	euthanasia during surgery
Interval between 1 <sup>st</sup> and 2 <sup>nd</sup> operation		9 months		Interval between 2 <sup>nd</sup> and 3 <sup>rd</sup> operation		12 months

LC – large colon

diagnosed during the surgery. Three horses (14.3%) did not survive the first 11 months. Two animals were euthanized in the field after six months due to unspecified colic. One horse was euthanized 40 days after the surgery due to contralateral inguinal hernia.

## DISCUSSION

The study analyses a set of 331 horses in which the health status could be followed up for at least 11 months after colic surgery. The remaining 20 out of total 351 discharged patients could not be traced down for the analytical purposes. A long-term surviving horse was a designation for a horse that survived a minimum of 11 months after the surgery. However, since the set also consists of patients that have been operated on more than eleven years ago, a multiple year survival rate was included in the analysis. Out of 331 assessed horses, 91.2% patients survived a minimum of 11 months after the surgery. This percentage includes patients that underwent only one surgery in the course of one hospitalization, horses in which relaparotomy was used to deal with their postoperative complications as well as animals that were discharged for home care and that required further colic surgeries within 11 months after the first surgery. The obtained results match literature data. Mair and Smith (2005) reported the survival of a minimum of 11 months in 91.5% of horses that were discharged after one colic surgery and that did not come back for more colic surgeries. The long-term survival rate of horses discharged after one or more laparotomies in the given set was 83%. Freeman et al. (2000), who evaluated patients after small intestine surgery, reached a survival rate more than seven months in 75% and survival rate more than 12 months in 68% horses.

Van den Boom and van der Velden (2001) detected a survival rate one year after the surgery in 84% of horses operated on due to the strangulation of the small intestine.

The most common health complications in horses after acute abdominal surgery are thought to be frequent colic episodes which can lead to death or indicate euthanasia or additional surgery, surgical wound infection that contribute to the development of incision herniations and septic thrombophlebitis (Siebke et al., 1995; Wilson et al., 1995; Honnas and Cohen, 1997; Freeman et al., 2000; van den Boom and van der Velden, 2001; Mair and Smith, 2005). Some authors also notice whether and at what time the horses recovered to their presurgical condition and the nutritional status and whether they were capable of the previous work load (Siebke et al., 1995; van den Boom and van der Velden, 2001).

Postoperative complications described in international studies were confirmed also in our set of patients. Colic episodes were diagnosed both in long-term surviving animals and in horses that died or were euthanized within 11 months after the surgery. In 79.3% of horses that did not survive for a long time or in 6.9% of horses discharged from the clinic after colic surgery, the cause of death could be seen in the colic or, in one case, in poor nutrition. The euthanasia of the latter patient was, however, necessary due to the fact that the mare underwent a premature miscarriage and due to other foreseen problems, and the owner had no further interest in the horse's use. Colics are considered to be the most common cause of death after clinical discharge also in other authors' sets. Siebke et al. (1995) found that 7% of horses died of colic after clinical discharge in the course of 13 months. In the set of patients with strangulation of the small intestine that were available for a long-term analysis done by van den Boom and van der Velden (2001), 14% of animals died or

had been euthanized because of colic in the course of one year. Mair and Smith (2005) reported sporadic, recurrent or serious colic episodes in 28.4% of horses discharged for home care after the colic surgery, and colic was the cause of death in 60% of horses already dead at the moment of detecting the long-term survival.

Surgical treatment of an additional colic was also necessary in 22 long-term surviving horses in our set. In seven of them, the second surgery was needed earlier than 11 months after the first one. In other 10 discharged horses, occasional colic episodes were noted, which was the case with other authors as well. Van den Boom and van der Velden (2001) witnessed occasional colics in 16% of patients with the small intestine strangulation that survived a minimum of one year after the surgery. Mair and Smith (2005) noted at least one more colic episode in 35.1% of horses discharged after one laparotomy.

Peritonitis and intra-abdominal synechia are considered the most common causes of colic after gastrointestinal surgery (MacDonald et al., 1989; Gerhards, 1990; van den Boom and van der Velden, 2001; Mair and Smith, 2005). Adhesions that were confirmed to cause colics were found in 8.9% of horses in a set analysed by Mair and Smith (2005). The same authors showed synechia in 16.5% of animals with small intestine obstructions.

The incidence of clinically significant adhesions and other phenomena connected with previous abdominal intervention in our patients could be evaluated in horses subjected to an additional surgery or necropsy. Seven of our horses that did not survive for the long term underwent surgical treatments of another colic episode and one horse was euthanized with no surgery prospect at the clinic. In two of them, which were back due to colic episode in two to four weeks after the first surgery, serious abdominal synechia were the causes of their newly developed complications. The following colic can thus be unanimously linked to the first surgery in cases like these. It is stated in literature that this relatively fast onset of colic is due to synechia. Gerhards (1990) reported clinical manifestation of synechia between week 3 and 6 after the surgery in 50% of patients. At the end of week 6 after the surgery, 91.7% of horses with clinically significant adhesion had symptoms of abdominal pains. Freeman et al. (2000) also considered adhesion-related complications to be more likely in the first three weeks after the surgery. The same

authors viewed death caused by synechia as less likely with more time elapsed from the surgery.

In two horses of ours that were classified as long-term surviving patients, postoperative synechia caused conditions requiring a surgical intervention only after a longer period of time. In one of these horses, adhesions were the cause of the first colic during which there was a strangulation of the small intestine with a newly formed fibrous band. Eighteen months later, an additional surgery discovered extensive synechia impossible to deal with surgically; in the other horse, the first surgery was indicated by incarcerated umbilical herniation. During the surgery, there was a perforation of the irreversibly altered ileum and contamination of the abdominal cavity. The foal was treated with resection, jejunocaecostomy, the abdominal cavity was flushed and the abdominal wall was reconstructed. Until the following colic, which took place two and a half year later, the horse had no health problems. The cause of the colic was the jejunum strangulation around a thin fibrous band coming out of the antimesenteric portion of the small intestine. Gerhards (1990) also described two patients with postoperative adhesion manifestations only after one or three years after the surgery.

Intra-abdominal synechia need not be the only complication of abdominal surgeries which require an additional surgical intervention. In a twice hospitalized horse during the first surgery, a small intestine loop that was strangulated in the inguinal canal was evaluated as grade two viable as categorized by Freeman et al. (2001). The horse recovered easily after the surgery but after being discharged for home care, it suffered from repeated colic episodes. When hospitalized again, the originally strangulated section of the intestine was found to be enlarged and in stenosis. Another horse was diagnosed with mesenteric herniation at its second surgery caused by an acute colic that took place in 19 months. Because the defect was situated in the area formerly affected by an intestinal anastomosis, it was considered as the result of a poorly adapted mesenterium. The herniation of the small intestine via a mesenteric defect in the jejunocaecostomic area was described as the cause of relaparotomy also by Vachon and Fischer (1995) and van den Boom and van der Velden (2001).

However, in most of our patients repeatedly hospitalized with colic, it was not possible to consider the second condition as a complication of the first surgery. While in some horses various sections of

the gastrointestinal tract were affected or at least there were various pathological processes, in the majority of the animals the reason for the development of the condition was the same section of the intestine and the same cause of the colic. These findings support the fact that some animals can be susceptible to a certain type of colic condition or that some colic conditions can recur.

In three out of five stallions with inguinal herniation, incarcerated ipsilateral and contralateral inguinal herniation was diagnosed and treated. Another horse was destroyed due to contralateral inguinal herniation in the field. These results are in agreement with some authors' opinions (Schneider et al., 1982; Rijkenhuizen and van der Valden, 1994) that a horse with inguinal herniation should be castrated after the surgery.

In two patients operated on due to the left dorsal displacement of the large colon, there was a recurrent development in nine months or three weeks, respectively, after the surgery. The tendency to recur in this condition is well known in some horses (Huskamp and Kopf, 1980; Baird et al., 1991; Hardy et al., 2000; Roecken et al., 2005). In one patient, the second colic was managed by rolling, the other was operated on. In the second postoperative period, this horse was subjected to a laparoscopic ablation of the renosplenic area but it had to be euthanized due to complications. Laparoscopic closure of the renosplenic area is nowadays considered to be the safe method of preventing the left dorsal displacement of the large colon (Farstvedt and Hendrickson, 2005; Roecken et al., 2005). Lethal complications which developed in our patient can be due to the inexperience with the surgical technique and probably also to the short interval between the surgeries.

Another form of displacement or distension accompanied by the large colon obstipation was diagnosed at both hospitalizations in other 10 twice-operated horses. Moreover, one of them was subjected to other two colic surgeries abroad. In another horse, the surgical intervention was indicated three times. During the first hospitalization, colitis was the problem and in the other two ones, there was a diagnosis of the large intestine torsion. Repeated colic requiring a surgery in these cases cannot be viewed as the first surgery complication, either. Rather, it is a piece of evidence of some horses' susceptibility to colic conditions.

An interesting case in the monitored set of patients was a horse which was brought for care

with massive obstipation of the right dorsal colon three times. Just as before the second, also before the third laparotomy, the horse was subjected to a very demanding medication and infusion treatment. Based on this experience, we can agree with the statement that German authors (Huskamp et al., 1999) made: chronically recurring obstipation cannot be managed conservatively and a repeated surgery consisting of the removal of the large colon contents brings only a temporary solution to the problem. At the third surgery, the horse was provided with a bypass between the dorsal and the small colon which was described by Andrews and Robertson (1988). Neither did this procedure however prevent the accumulation of the intestinal contents in the right dorsal colon and the horse had to be euthanized at relaparotomy. A bypass between the right dorsal and small colon was performed also in another patient with chronic obstipation of the right dorsal colon. This horse was released for home care after a smooth postoperative period but in several months it was euthanized due to a colic episode in the field. Because necropsy was not carried out, it must be assumed that the cause of death could be a bypass related problem. In a case which was described by Andrews and Robertson (1988), the pathological condition had the form of a contracted and corrugated segment which led to the disruption of the intestinal content passage and it was neither obstipation nor intestinal hypertrophy related. The differences between these and our patients could clarify the surgical failure in the cases we have described.

In one twice operated horse in our set, *h. foraminis omentalis* was diagnosed at both hospitalizations within 13 months. Although this is a case of a common cause of the small intestine ileus which was studied separately (Engelbert et al., 1993; Vachon and Fischer, 1995), recurrent development is not frequent. A repeated incarceration in *foramen omentale* was described in one patient by Vachon and Fischer (1995).

An individual evaluation is usually done in horses which have undergone relaparotomy at one hospitalization. Van den Boom and van der Velden (2001) lost four out of seven patients discharged after laparotomy within one year. Mair and Smith (2005) considered adhesions to be more frequent in horses that had undergone repeated laparotomy. Freeman et al. (2000) proved in patients that went for relaparotomy after a small intestine surgery the long-term survival rate of 36%. Proudman et al.

(2005), who monitored the factors of long-term survival rate of horses after a small intestine surgery, also showed a significantly higher mortality in patients subjected to relaparotomy.

In our set, 21 of horses discharged for home care were treated with laparotomy in order to manage postoperative complications. Eighteen of them (85.7%) survived with no gastrointestinal problems at least 11 months after discharge from the clinic. One of the three colic-related euthaniasias was operated at the first surgery for incarcerated inguinal herniation and the reason for relaparotomy was an obstruction of the jejunocaecal anastomosis. The cause of the second colic was recurrent contralateral inguinal herniation which cannot be considered as a result of previous surgeries. Our results thus confirm the importance of laparotomy for the postoperative complication management because long-term problem-free life can be counted on.

Laparotomy wounds related complications belong to frequently mentioned postoperative problems (Wilson et al., 1995; Honnas and Cohen, 1997; van den Boom and van der Velden, 2001). Wilson et al. (1995) detected incision complications in 40% of horses operated with a colic. Van den Boom and van der Velden (2001) reported wound-related issues in 12% of horses that survived a minimum of one year after the surgery. Surgery wound infection, which is the most common complication, leads to the formation of incision herniation in a number of cases (van den Boom and van der Velden, 2001). Wound oedema and inflammation in the laparotomic area cause a significant weakening of the tissue which predisposes it for hernia formation. Sutures cut through tissues and/or *linea alba* are strained or weakened (van den Boom and van der Velden, 2001). Honnas and Cohen (1997) identified the large colon enterotomy, fibrinogen concentration in the peritoneal liquid before the surgery and they used polyglactin 910 *linea alba* closure as factors significantly related to the postoperative infection. Wilson et al. (1995) proved a higher frequency of incision complications in adult horses as compared to foals and in horses operated on longer than two hours.

In our set, we found patients with incision herniations only. We assume that the cause of herniations was the infection of the abdominal wall in all cases. But it is evident from the records in the histories of individual patients that horses with secernation and surgical wound infection were much more frequent in our set. Incision herniation developed in 2.6% of long-term surviving horses and in another animal

that was euthanized after its successful reduction due to other problems. Van den Boom and van der Velden (2001) found an incision hernia formation in 8.1% of horses discharged after the colic surgery. A relatively low incidence of postoperative hernias in our set could be attributed also to the fact that in some animals small incision herniations were been recognized by their owners or local veterinarians.

Septic thrombophlebitis is another common complication in acute abdominal horse surgery. Van den Boom and van der Velden (2001) confirmed thrombosis of the jugular vein in 4% of horses surviving a minimum of one year. Oedema in the jugular region, secernation at the injection site and thrombophlebitis were the most common diagnoses in our patients' histories as health problems requiring conservative treatment during a hospitalization in horses with long-term infusion therapy. Only one of the discharged horses was brought for a repeated extirpation of the infected jugular vein and in another patient septic thrombophlebitis was the cause of euthanasia several months after the surgery, the owner said.

The analysis of the long-term survival rate in colic patients confirmed the importance of the surgical treatment of colic conditions because of a sheer majority of horses that can lead good-quality lives after the operation. After overcoming the critical period of hospitalization at the clinic, the incidence of serious complications is low. Despite the fact that another colic episode is a relatively common problem, it cannot be seen as being connected with the current abdominal surgery in most patients.

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