Analysis of therapeutic results and complications after colic surgery in 434 horses

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ABSTRACT: Out of the total number of 434 horses that underwent colic surgery, small intestine was operated in 195 (44.9%) patients, caecum in 10 (2.3%) horses, large colon surgery was performed in 196 (45.2%) cases and small colon surgery in 14 (3.2%) horses. In 12 patients (2.8%) two different parts of the gastrointestinal tract were affected simultaneously, one horse suffered from peritonitis, torsion of the uterus developed in two mares and three animals had negative surgical findings. Of 434 horses, 371 (85.5%) survived. After small intestinal surgery, 159 patients (81.5%) recovered from anaesthesia and were discharged home as well as seven horses (70%) after caecal surgery, 175 horses (89.3%) after large colon surgery and 14 horses (100%) following small colon surgery. 75 out of 103 horses (72.8%) were discharged home after the small intestinal resection and 89 of 98 horses (90.8%) with small intestinal problems where no resection was needed. In total, 43 of the patients that underwent one surgery did not survive the immediate postoperative period. The most frequent lethal complications in horses following the small intestinal surgery included peritonitis (five horses) and paralytic ileus (four horses) and in horses with large colon problems it was typhlocolitis (six cases). Relaparotomy was indicated in 41 of 434 horses (9.4%) that recovered from colic surgery. 21 out of the 41 (51.2%) relaparotomised colic patients were released from the clinic. All successfully repeated surgeries were carried out to overcome primary small intestine ileus problems, and in 14 of these cases (66.7%) resection and anastomosis were performed. The most common finding, diagnosed in 9 of 21 reoperated horses, was paralytic ileus. Of 20 relaparotomised horses that did not survive, three animals were lost after the introduction of anaesthesia, nine horses were euthanised after the abdominal cavity revision, one horse did not recover after the surgical procedure and seven horses did not survive the postoperative period. In 15 of 20 dead horses, the cause of the first surgical intervention was small intestinal ileus, in other four horses there was a large colon problem and in the last patient, it was a stomach disease. In 13 of 15 (86.7%) horses with small intestinal problems and in three of four (75%) patients with large colon disease, either resection or bypass was performed. In the remaining four non-surviving horses of 20 relaparotomised ones, peritonitis and/or adhesion formation was diagnosed at the second surgery, in three horses anastomosis complications were the main problem. Peritonitis or paralytic ileus led to death or euthanasia in four of seven horses that recovered after relaparotomy.

Keywords: horse; colic; surgical diagnosis; postoperative complications; relaparotomy; prognosis

Surgical treatment of a patient with colic does not end with surgery and recovery from anaesthesia. There are numerous factors that negatively affect recovery, increase the treatment expenses and aggravate the prognosis. The probability of occurrence of post-surgical complications is related to the seriousness of alteration of the general health condition of horses, colic cause, lesion location and the scope of surgery (Freeman et al., 2000; van den Boom and van der Velden, 2001; Mair and Smith, 2005a,b, and others). Problems that appear in the post-surgical period become more important due to

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the increasing success rate of surgeries and growing number of patients with finished surgery (Freeman et al., 2000). Independent studies have been devoted to individual surgical techniques of enterectomy that may influence the prognosis and occurrence of post-surgical complications (Huskamp, 1973; Freeman, 1997; Hughes and Slone, 1998; Loesch et al., 2002; Rendle et al., 2005). The occurrence and importance of adhesions (Gerhards, 1990) and post-surgical ileus (Blikslager et al., 1994; Cohen et al., 2004) that substantially increase mortality in the post-surgical period are also studied. Relaparotomy is one of the optional methods in treating post-surgical problems in colic patients. A repeated surgical intervention in the abdominal cavity may correct technical errors that occurred during the first surgery, solve conservatively unsolvable motility disorders as well as pathological conditions that occur in the post-surgical period without a clear relation to the first intervention (Huskamp and Bonfig, 1987; Mair and Smith, 2005c).

The goal of the presented paper is to assess the results of surgical treatment in patients recovered from total anaesthesia after colic surgery and to assess complications that led to their death or euthanizing in the post-surgical period. A special attention is devoted to horses whose post-surgical complications were solved by a repeated surgical intervention.

MATERIAL AND METHODS

From the set of horses operated for a colic disease between October 1, 1994 and December 31, 2005, we chose patients that recovered from anaesthesia and underwent a post-surgical care. The horses were divided into a group that recovered and was discharged home, and a group that was euthanized or died due to post-surgical complications. In both groups we analyzed the causes of the disease and the scope of surgical intervention; in animals that did not survive we assessed post-surgical complications that led to euthanasia or death loss. In both the healthy group and the dead horses group we identified animals in which, to treat post-surgical complications, we indicated relaparotomy and assessed surgical findings and interventions at the second surgery.

For the first surgery laparotomy in the *linea alba* was performed in all horses, excluding several patients with inguinal hernia. In stallions with inguinal hernia or in horses with intestinal prolapse after castration, we preferred either medial or inguinal approach, or their combination. With relaparotomy, the abdominal cavity was mostly opened through the original surgical lesion; occasionally we chose a lateral approach in the flank or in the last rib socket. In horses with small intestine disease in which no resection and anastomosis were indicated, the decompression of distended small intestine was performed by massage of the intestinal content to caecum. In horses with the resection of small intestine, the decompression of small intestine was performed in the same way or by content evacuation through the place of resection. All intestinal anastomoses were double-layered and stitched by hand; stapling was used only for the closing of ileal stub in some patients with jejunocaecal anastomosis. Enterotomy on the large colon was performed in the pelvic flexure and closed with triple-layer suture, while enterotomies on the small colon and small intestine were performed on the antimesenteric edge and closed with double-layer suture. Small intestine enterotomies were performed close to the caecal apex and closed with triple-layer suture. Omentectomy was a routine part of surgical intervention in horses operated in recent years. Omentectomy and decompression of distended intestines by enterocentesis were not taken into account in the assessment of the scope of surgical intervention.

RESULTS

Analysis of surgical treatment results

Between October 1, 1994 and December 12, 2005, 576 patients with colic were surgically treated. The set of 576 horses included 545 individuals since 27 horses were operated twice and two horses were operated three times during the monitored period. A total of 434 horses recovered from anaesthesia and underwent post-surgical treatment. 63 of them (14.5%) suffered from complications resulting in euthanasia or death, 371 animals (85.5%) were discharged home. 43 dead horses suffered from complications leading to death or euthanasia after a single laparotomy, while relaparotomy was indicated for treating post-surgical complications in 20 lost horses. Relaparotomy was also carried out in 21 out of 371 recovered horses.

Analysis of surgical findings

Out of the total number of 434 horses recovered from a colic surgery, 195 horses (44.9%) underwent small intestine surgery, 10 horses (2.3%) caecal surgery, 196 horses (45.2%) large colon surgery and 14 horses (3.2%) small colon procedure. 12 horses (2.8%) suffered from two different simultaneously affected sections of the gastrointestinal tract, one horse suffered from peritonitis, two mares developed uterine torsion and three animals had negative surgical findings.

A total of 159 patients (81.5%) recovered from anaesthesia after a small intestine surgery, while seven horses (70%) with caecum problems, 175 horses (89.3%) with a large colon disease and 14 horses (100%) with a small colon disorder were discharged home. The treatment success of the most frequent diseases in the small intestine area was 85.1% (40 out of 47 horses recovered) in patients with incarcerated inguinal hernia, 80% (16 out of 20 horses) in patients with hernia foraminis omentalis and 88.9% (16 out of 18 horses recovered) in patients with ileal obstipation. Success of acute caecal obstipation/dysfunction, which was the most frequent caecal disease, was 80% (four out of five horses recovered). The disease of large colon was treated with 84.4% success (38 out of 45 horses recovered) in patients with torsion, 91.2% (31 out of 34 horses recovered) in patients with left dorsal displacement and 96% (24 out of 25 horses recovered) in patients with right dorsal displacement. The most frequent small colon disease was focal obstruction/obstipation, successfully treated in all seven patients. 100% success was also achieved in four horses with concurrent small colon and right dorsal colon obstipation. The most frequent causes of a colic disease diagnosed in all operated horses, recovered horses and euthanized horses in the post-surgery period and the results of treatment are shown in Table 1.

Analysis of surgical interventions

In 101 out of 195 (51.8%) patients with small intestine disease we performed intestinal resection and anastomosis, in the remaining 94 (48.2%) horses enterectomy was not carried out. Three horses required the resection of two different sections of small intestine. Enterectomy on the small intestine was indicated in one patient with concurrent small intestine and large colon disorders, and in another horse with small colon disorder in which a serious synechia in the area of the small intestine was found as an accidental finding. In 51 (49.5%) out of 103 horses with the small intestine resection we carried out jejunojejunal end-to-end anastomosis, in 34 (33%) horses jejunocaecal side-to-side anastomosis and in 9 (8.7%) horses jejunoileal end-to-end anastomosis. Three horses had an ileocaecal and one horse had a jejunocaecal bypass. In horses with two resections we chose a combination of jejunojejunal and jejunoileal end-to-end anastomoses in two cases, and a combination of jejunojejunal end-to-end and jejunocaecal side-to-side anastomoses in the third patient. In 10 cases we performed, apart from the resection of small intestine, also an evacuation of the large colon after pelvic flexure enterotomy whereas the caecum was emptied by enterotomy in seven cases. The enterotomy of large colon was also chosen in horses with a concurrent disease of small intestine, requiring resection, and of large colon.

There was no need of intestinal resection in 94 out of 195 (48.2%) patients with a small intestine disease and in four out of five (80%) patients with concurrent small intestine and large or small colon disorders. Surgical intervention consisted in the repositioning or releasing of obstruction by massaging and in the decompression of distended intestine by massaging the content into the caecum. In 40 out of 94 horses with small intestine disease we also carried out the enterotomy of large colon, caecum or both, in two cases we indicated the enterotomy of small intestine. Enterotomy of large colon was necessary in three out of four horses with concurrent diseases of small intestine and of large or small colon.

In patients with small intestine resection the success rate was 72.3% (73 out of 101 horses with small intestine disease recovered) and 72.8% (75 out of 103 horses with small intestine resection recovered). In horses that did not need any resection of small intestine, the success rate was 91.5% (86 out of 94 horses recovered) and 90.8% (89 out of 98 horses recovered). In horses with one anastomosis, the success rate was 78.8% (39 out of 50 horses with small intestine disease and two horses with a concurrent disease of small and large intestine recovered) for jejunojejunal end-to-end anastomosis, 55.6% for jejunoileal end-to-end anastomosis and 67.6% for jejunocaecal side-to-side anastomosis. All horses with two resections recovered.

Table 1. Causes of disease and treatment results in recovered and deceased/euthanized horses

Surgical diagnosis	Operated horses	Recovered		Euthanasia/death loss	
		number	%	number	%
Stomach obstipation	1	0	0	1	100
Small intestine	195	159	81.5	36	18.5
hernia inguinalis incarcerata	47	40	85.1	7	14.9
intestinal prolapse after castration	4	4	100	–	0
hernia foraminis omentalis	20	16	80	4	20
ileal constipation	18	16	88.9	2	11.1
ileal constipation and hypertrophy	4	2	50	2	50
proximal enteritis	16	14	87.5	2	12.5
poststrangulation ileus	14	10	71.4	4	28.6
hernia pseudoligamentosa	9	6	66.7	3	33.3
volvulus mesenterialis	8	7	87.5	1	12.5
volvulus nodosus	7	6	85.7	1	14.3
jejunal constipation	6	6	100	–	0
jejunal stenosis	6	5	83.3	1	16.7
hernia mesenterialis	5	4	80	1	20
ileocaecal invagination	5	3	60	2	40
synechia	4	3	75	1	25
jejunitis	4	2	50	2	50
other	18	15	83.3	3	16.7
Caecum	10	7	70	3	30
acute constipation/dysfunction	5	4	80	1	20
caecoceacal, caecocolical invagination	3	1	33.3	2	66.7
other	2	2	100	0	0
Large colon	196	175	89.3	21	10.7
torsion, torsion and constipation RDC	45	38	84.4	7	15.6
LDDC	34	31	91.2	3	8.8
RDDC, RDDC with torsion, RDDC with RDC constipation	25	24	96	1	4
displacement	21	19	90.5	2	9.5
constipation RDC, sand obstruction RDC	15	14	93.3	1	6.7
constipation RDC and displacement/distension LC	13	13	100	–	0
focal oedema, ischemic necrosis	11	9	81.8	2	18.2
impaction colic of ventral colon	10	8	80	2	20
distension and constipation of ventral colon	6	6	100	–	0
colitis	5	4	80	1	20
other	11	9	81.8	2	18.2
Small colon	14	14	100	–	0
focal obstruction /constipation	7	7	100	–	0
diffuse constipation	3	3	100	–	0
other	4	4	100	–	0
Two various GIT sections	12	10	83.3	–	16.7
focal/diffuse constipation SC and constipation RDC	4	4	100	–	0
other	8	6	75	–	25
Peritonitis	1	1	100	–	0
Torsion of the uterus	2	2	100	–	0
Negative finding	3	3	100	–	0
Total	434	371	85.5	63	14.5

GIT – gastrointestinal tract, LDDC – left dorsal displacement of large colon, SC – small colon, RDC – right dorsal colon, RDDC – right dorsal displacement of large colon, LC – large colon

In four out of 10 (40%) horses with caecal disorder we carried out partial enterectomy, in the remaining seven animals the treatment consisted in the evacuation of contents after enterotomy. In four cases we indicated, apart from caecal intervention, the evacuation of the contents of large colon by enterotomy. In horses with partial caecal amputation the success rate was 50%, the success rate in animals for which enterotomy was sufficient to solve the problem was 83.3%.

In 177 out of 196 (90.3%) horses with a disease of large colon the surgery involved the evacuation of intestinal contents by enterotomy in the pelvic flexure of large colon. In 18 animals, we simultaneously indicated caecal enterotomy and evacuation. In 12 out of 196 (6.1%) patients it was necessary to remove an irreversibly damaged section of the large colon. In nine of these animals we carried out partial resection and end-to-end anastomosis in the area of left colon and in three horses we performed partial resection and side-to-side anastomosis. In other two horses we carried out a bypass between the left dorsal colon and the small colon, and the evacuation of intestinal contents after the enterotomy of pelvic flexure. In the remaining horses, the treatment consisted only in the repositioning of dislocated colon. The success rate in patients that required the enterotomy of large colon and/or caecum was 92.1%. 50% of animals in the group of horses with resection or bypass of large colon recovered.

In eight out of 14 (57.1%) horses with a small colon disorder we carried out enterotomy, other two horses required resection and end-to-end anastomosis and in one horse we performed, in addition to resection of small colon and end-to-end anastomosis, the resection of small intestine and jejunojejunal anastomosis for an managing of synechia in the area of small intestine. In nine out of 14 horses (64.2%) we evacuated the large colon through enterotomy. In three out of six horses with a concurrent disease of small and large colon we carried out the enterotomy of the small colon, in five cases we had to evacuate the large colon through enterotomy.

In horses with diffuse peritonitis the abdominal cavity was treated by lavage. In two mares with precervical uterine torsion by 360 degrees we carried out reposition and foetus delivery by Caesarian section. In three recovered horses with negative surgical finding the intervention consisted in the revision of abdominal cavity, in one horse we carried out the evacuation of large colon contents through enterotomy. The scope of surgical interventions in recovered and euthanized/deceased horses at the first surgery is shown in Table 2.

Analysis of surgical findings, interventions and complications in dead/euthanized horses after first surgery

In the post-surgery period, 43 horses that underwent only one surgery were euthanized or died. In 21 horses this was due to small intestine disease, in two patients it was due to the concurrent disease of small intestine and of large or small colon, in three animals due to caecal disease and in 17 horses the cause of colic was localized in the large colon. A total of nine horses died, 33 animals were euthanized for health reasons and one horse was euthanized on its owner's order for financial reasons. In three euthanized horses, the cause of death was not related to the colic disease. The most frequent complications leading to euthanasia or death in patients with small intestine disease or concurrent disease of small intestine and of large colon included peritonitis with synechia (five patients) and paralytic ileus (four patients), and in horses with the afflicted large colon it was colitis or typhlocolitis (six patients). The causes of colic, surgical interventions and death causes, as well as principal pathological findings are summed up in Table 3.

Analysis of surgical findings, interventions and complications in horses that underwent relaparotomy

In 41 out of 434 (9.4%) horses that recovered from a colic surgery we chose relaparotomy for the treatment of post-surgery complications. 21 animals were discharged home (51.2%).

Out of 20 lost horses, three animals died after having been laid due to relaparotomy, nine horses were euthanized during relaparotomy, one did not recover from the second surgery and seven horses did not survive the post-surgery period after the second surgery. In 15 out of 20 lost horses the cause of the first surgical intervention was small intestine ileus, in four horses it was a disease of the large colon and in the last patient it was a stomach disorder. In 13 out of 15 (86.7%) horses with small

Table 2. The scope of surgical interventions at the first surgery in recovered and euthanized/dead horses

Surgical intervention	Operated horses	Recovered	Euthanasia/death loss
Stomach	1	0	1
enterotomy VK	1	–	1
Small intestine	195	159	36
resection/anastomosis	101	73	28
– jejunojejunal end-to-end	50	39	11
– jejunoileal end-to-end	9	5	4
– ileoileal end-to-end	1	1	–
– ileocaecal bypass	3	2	1
– jejunocaecal bypass	1	–	1
– jejunocaecal side-to-side	34	23	11
– jejunojejunal end-to-end and jejunoileal end-to-end	2	2	–
– jejunojejunal end-to-end and jejunocaecal side-to-side	1	1	–
– caecal enterotomy	4	3	1
– enterotomy LC	10	8	2
without resection	94	86	8
– caecal enterotomy	12	11	1
– enterotomy LC	23	21	2
– caecal enterotomy and enterotomy LC	4	3	1
– enterotomy SI	1	1	–
– enterotomy SI and enterotomy LC	1	1	–
Small intestine and large colon or small colon	5	3	2
enterotomy LC	3	3	–
resection SI and jejunojejunal end-to-end anastomosis, enterotomy LC	1	–	1
Caecum	10	7	3
partial enterectomy	4	2	2
enterotomy C	6	5	1
enterotomy LC	4	3	1
Large colon	196	175	21
enterotomy LC	177	163	14
enterotomy C	18	18	–
partial resection and end-to-end anastomosis LC	9	5	4
partial resection and side-to-side anastomosis LC	3	1	2
bypass between LDC and SC, enterotomy LC	2	1	1
Large colon and stomach	1	1	–
enterotomy LC	1	1	–
Small colon	14	14	–
enterotomy SC	8	8	–
enterotomy LC	9	9	–
resection and end-to-end anastomosis SC	2	2	–
resection and end-to-end anastomosis SC, resection SI and jejunojejunal end-to-end anastomosis	1	1	–
Small colon and large colon	6	6	–
enterotomy SC	3	3	–
enterotomy LC	5	5	–
Peritonitis	1	1	–
lavage	1	1	–
Uterus	2	2	–
reposition of torsion and hysterotomy	2	2	–
Negative finding	3	3	–
revision	3	3	–
enterotomy LC	1	1	–

LDC – left dorsal colon, SC – small colon, LC – large colon, SI – small intestine, C – caecum

Table 3. Causes of colic, surgical interventions and death causes in horses deceased/euthanized after a single surgery

Diagnosis	Surgical intervention	Cause of euthanasia/death loss
Small intestine (21 horses)		
hernia inguinalis incarcerata (5)	resection, JJA (5)	peritonitis, synechia (4)
hernia foraminis omentalis (3)	resection, JJA, enterotomy LC (1)	peritonitis, perforation SC (1)
post-strangulation ileus (2)	resection, JIA (2)	paralytic ileus (4)
volvulus nodosus/mesenterialis (2)	resection, JCA (7)	stomach rupture (2)
hernia pseudoligamentosa (1)	decompression by massage (3)	stomach empting disorder (2)
ileocaecal invagination (1)	decompression by massage, enterotomy LC (2)	necrotic enteritis (1)
synechia (1)	decompression by massage, enterotomy LC and C (1)	colitis (1)
ileal obstipation (1)		epiphyseolisis of femoral head (1)
ascaridial intestinal obstruction (1)		unknown (5)
gastroduodenojejunitis (2)		
enteritis (2)		
Small intestine and large colon (1 horse)		
ischemic necrosis SI, colitis (1)	resection, JJA, enterotomy LC (1)	peritonitis (1)
Small intestine and small colon (1 horse)		
enteritis and faecal impaction SC	decompression by massage (1)	unknown (1)
Caecum (3 horses)		
caecoceacal invagination (1)	resection (1)	peritonitis (1)
caecocolic invagination (1)	resection, enterotomy LC (1)	circular failure (1)
acute dysfunction (1)	enterotomy LC (1)	complications with osteosynthesis (1)
Large colon (17 horses)		
torsion (7)	enterotomy LC (12)	typhlocolitis, colitis, typhlitis (6)
LDDC (2)	enterectomy, end-to-end (2)	osteomyelitis and acute colitis (1)
right dorsal displacement with torsion (1)	enterectomy, side-to-side (2)	peritonitis (2)
displacement (1)	reposition (1)	hemoperitoneum (3)
hernia inguinalis incarcerata coli ascendentis (1)		torsion and rupture LC (1)
obstipation (2)		partial obstruction of anastomosis and peritonitis (1)
focal oedema/ischemic necrosis (2)		relapse of inguinal hernia and strangulation SI (1)
colitis (1)		unknown (2)

JCA – jejunocaecal side-to-side anastomosis, JIA – jejunoileal end-to-end anastomosis, JJA – jejunojejunal end-to-end anastomosis, C – caecum, LDDC – left dorsal displacement of large colon, SC – small colon, SI – small intestine, LC – large colon

intestine disease and in three out of four (75%) patients with large colon disease we performed resection or bypass during the first surgery. Four out of 20 horses that did not survive relaparotomy were diagnosed with peritonitis and/or synechia during the second surgery, in three horses the main problem consisted in complications with anastomosis, and in two animals in paralytic ileus. In two horses with ileal obstipation we diagnosed torsion and rupture of large colon during relaparotomy.

The horse operated due to left dorsal displacement of the large colon underwent laparoscopic ablation of the splenorenal space to prevent the recurrence of the disease. Peritonitis or paralytic ileus resulted in death/euthanasia in four out of seven horses that recovered from relaparotomy. One horse euthanized after relaparotomy had a problem with orchitis and was euthanized by his owner. A survey of surgical diagnoses, interventions and findings related to relaparotomy in horses euthanized or dead during the second surgery is in Table 4. A survey of surgical diagnoses, interventions and findings related to relaparotomy and death causes in horses with finished relaparotomy is in Table 5.

A total of 21 horses that had their post-surgical complications solved by relaparotomy recovered from anaesthesia and were discharged home. In all animals we solved small intestine ileus during the first surgery, in 14 animal (66.7%) we carried out resection and intestinal anastomosis. The most frequent indication for relaparotomy was paralytic ileus diagnosed in nine out of 21 reoperated animals. Four horses had complications with anastomosis which required its widening or resection. Resection was necessary in another horse that developed subserosal haematoma compressing the intestinal lumen. Two horses with inguinal hernia that were not castrated during surgery suffered from recurrence. In three horses, the cause of relaparotomy was a disease of the large intestine. A survey of surgical diagnoses and interventions at the first surgery and at relaparotomy in recovered horses is in Table 6.

DISCUSSION

The presented paper assesses a set of 434 horses operated with colic that recovered from anaesthesia and were able to undergo a post-surgery treatment. A total of 85.5% of our patients were discharged home, which corresponds approximately to 83.1% or 77.4% success achieved by Mair and Smith (2005a) and Brodowski et al. (2000). Siebke et al. (1995) and Johnson and Keller (2005) assessed the success rate of treatment in horses that recovered from anaesthesia and survived the first 24 hours after surgery. With this analysis method they achieved

Table 4. Survey of surgical diagnoses, interventions and findings related to relaparotomy in horses euthanized or deceased during second surgery

Surgical diagnosis at first surgery	Surgical intervention	Surgical diagnosis at relaparotomy
Euthanasia at relaparotomy (9 horses)		
SI – ileal obstipation	decompression by massage, enterotomy C	torsion LC of 360 degrees, rupture LC
SI – ileal obstipation and hypertrophy	ileocaecal bypass	torsion LC of 360 degrees, obstipation and rupture RDC
SI – ileal obstipation and hypertrophy	jejunocaecal bypass	failure of anastomosis, peritonitis
SI – ileocaecal invagination	resection, JCA	synechia
SI – hernia mesenterialis	resection, JJA	peritonitis
SI – hernia foraminis omentalis	resection, JCA, enterotomy LC	ischemic necrosis LC
SI – jejunal stenosis	resection, JJA	stomach rupture
LC – recurrent obstipation RDC	bypass between LDC and SC	obstipation RDC
LC – synechia	resection, end-to-end anastomosis	synechia LC, C
Death loss during anaesthesia after relaparotomy (3 horses)		
SI – hernia pseudoligamentosa	resection, JJA	hernia diaphragmatica
SI – post–strangulation ileus	resection, JCA	hemoperitoneum
S – stomach obstipation	enterotomy LC	aspiration pneumonia, hemoperitoneum

C – caecum, JCA – jejunocaecal side-to-side anastomosis, JJA – jejunojejunal end-to-end anastomosis, LDC – left dorsal colon, RDC – right dorsal colon, SC – small colon, SI – small intestine, LC – large colon, S – stomach

Table 5. Survey of surgical diagnoses, interventions and findings related to relaparotomy and death causes in euthanized/dead horses with finished second surgery

Surgical diagnosis at first surgery	Surgical intervention	Surgical diagnosis at relaparotomy	Surgical intervention at relaparotomy	Complications/ cause of death
Euthanasia during recovery from relaparotomy (1 horse)				
SI – hernia inguinalis incarcerata	reposition, decompression by massage	ischemic necrosis, synechia	2× resection, JJA, JIA	myopathy
Euthanasia after relaparotomy (7 horses)				
SI – hernia pseudoligamentosa	resection, JCA	paralytic ileus	decompression by massage, enterotomy C	paralytic ileus, peritonitis, diarrhea
SI – post-strangulation ileus	resection, JJA	obstruction of anastomosis	resection, JJA	purulent orchitis
SI – hernia inguinalis incarcerata	resection, JJA	paralytic ileus	decompression by massage	paralytic ileus
SI – strangulation by pedunculated lipoma	resection, JIA	ileal hypertrophy	resection, JCA	circular failure
SI – ischemic necrosis	resection, JIA, enterotomy C	peritonitis, obstruction of anastomosis	resection, JCA	peritonitis
LC – displacement	resection, part. end-to-end anastomosis	omental synechia	disruption of adhesions	incarceration of small intestine in incision hernia
LC – LDDC	enterotomy LC	–	laparoscopic ablation of splenorenal space	peritonitis, synechia

C – caecum, SI – small intestine, LC – large colon, JCA – jejunocaecal side-to-side anastomosis, JJA – jejunojejunal end-to-end anastomosis, JIA – jejunoileal end-to-end anastomosis, LDDC – left-hand dorsal displacement of large colon

the recovery rate of 82% or 87.5% of horses. In our study we did not analyze the period between waking up from anaesthesia and the time of death or euthanasia in patients that had fatal complications in the post-surgery period. However, many horses that did not survive the post-surgery period died or had to be euthanized during the first day after surgery, and this is why the success of treatment would be significantly higher if assessed as proposed by the aforementioned authors.

In 44.9% of horses we performed the surgical treatment of small intestine ileus and 81.5% of patients recovered. Freeman et al. (2000) discharged home 85% of patients that recovered after a small intestine surgery. 45.2% of horses that recovered after surgery suffered from a disease of the large colon and 89.3% of them were discharged home. The much higher occurrence of lethal complications after small intestine surgeries in the post-surgery period in our patients corresponds with the results reported by other authors (Hunt et al., 1986).

The success of treatment of the most frequent nosologic units in the area of small intestine was 85.1% in patients with incarcerated inguinal hernia, 80% in horses with hernia foraminis omentalis and 88.9% in animals with ileal obstipation. The lowest occurrence of post-surgery complications related to ileal faecal impaction can be explained by the nature of the disease, characterized as non-strangulating obstruction requiring no intestinal resection. A short-term survival of 91.7% of patients with ileal faecal impaction recovered from anaesthesia was proved by Hanson et al. (1998). Like in our study, van den Boom and van der Velden (2001) established a worse prognosis in patients with hernia foraminis omentalis (49%) compared to horses suffering from inguinal hernia (85%). This phenomenon may be explained by later surgical indication due to non-constant clinical symptoms and by the frequently larger affected intestine area, causing more serious alterations of general health during surgery.

Table 6. Survey of surgical diagnoses and interventions at first surgery and at relaparotomy in recovered horses

Surgical diagnosis at first surgery	Surgical intervention	Surgical diagnosis at relaparotomy	Surgical intervention at relaparotomy
Recovered after relaparotomy (21 horses)			
SI – hernia foraminis omentalis	resection, JIA	compression of anastomosis by hematoma	resection, JCA
SI – hernia foraminis omentalis	resection, JIA	paralytic ileus	decompression by massage
SI – hernia pseudoligamentosa	resection, JJA, enterotomy LC	paralytic ileus, hemoperitoneum	decompression by massage
SI – hernia inguinalis incarcerata	reposition, massage	hernia relapse	reposition, castration
SI – hernia inguinalis incarcerata	reposition, massage	obstipation in the place of incarceration	decompression by massage
SI – hernia inguinalis incarcerata	reposition, massage	paralytic ileus	decompression by massage, enterotomy LC
SI – hernia inguinalis incarcerata	reposition, massage	hernia relapse	reposition, castration
SI – hernia inguinalis incarcerata	resection, JCA, enterotomy LC	partial obstruction of anastomosis	expansion of anastomosis, enterotomy C
SI – hernia inguinalis incarcerata	resection, JJA	paralytic ileus	decompression by massage
SI – hernia inguinalis incarcerata	resection, JJA	compression of anastomosis by hematoma	resection, JCA
SI – hernia inguinalis incarcerata	2× resection, JJA, JIA	paralytic ileus	decompression by massage
SI – ileocaecal invagination	2× resection, JJA, JCA	paralytic ileus	decompression by massage, enterotomy C
SI – compression by intramural hematoma	resection, JJA, enterotomy LC	caecal obstipation	enterotomy LC, enterotomy C
SI – ileal obstipation	massage	paralytic ileus	decompression by massage
SI – ileal obstipation	enterotomy C	torsion LC, obstipation RDC	enterotomy LC
SI – ileal obstipation and hypertrophy	resection, JCA	displacement LC	reposition
SI – jejunal obstipation	enterotomy LC	compression SI by subserosal hematoma	resection, JJA, enterotomy LC, enterotomy C
SI – stenosis	resection, JJA	paralytic ileus, obstipation before anastomosis	decompression by massage, enterotomy C
SI – intestinal prolapse after castration	resection, JJA	ileal obstipation	decompression by massage
SI – volvulus nodosus	resection, JCA	obstipation of anastomosis	expansion of anastomosis
SI – volvulus nodosus	resection, JIA	paralytic ileus, obstipation in front of anastomosis	decompression by massage

SI – small intestine, LC – large colon, C – caecum, RDC – right dorsal colon, JCA – jejunocaecal side-to-side anastomosis, JJA – jejunojejunal end-to-end anastomosis, JIA – jejunoileal end-to-end anastomosis

A disease of the large colon was treated with 84.4% success in patients with torsion, 91.2% in patients with left dorsal displacement and 96% in patients with right dorsal displacement. The higher survival rate of patients with left and righ dorsal displacement compared to horses suffering from torsion corresponds with other studies and is explainable by a different nature of the disease (Johnston and Freeman, 1997). While the first two nosologic units represent a non-strangulating obstruction in most patients, in the case of torsion we often deal with strangulation with a worse prognosis and higher occurrence of post-surgery complications. A total of 3.2% of horses recovered after a colic surgery underwent an intervention due to a small colon disease and all were discharged to their owners. The most frequent small colon disease was focal obstruction/obstipation, which corresponds with the literature (Dart et al., 1992; Edwards, 1992). Enteroliths, the most frequent reason of surgical intervention in patients assessed by Dart et al. (1992), are very rare in our conditions. Although a small colon surgery is being linked (for various reasons) with a higher number of post-surgery complications (Keller and Horney, 1985; Edwards, 1992), our results do not corroborate such statements.

The result of surgical treatment in patients recovered after a colic surgery is influenced, apart from the cause of the disease and overall health, also by the scope of surgical intervention required for the treatment of a pathological lesion. Although this aspect is missing in some studies assessing large numbers of horses (Hunt et al., 1986; Brodowski et al., 2000), other papers deal with the differences in prognosis in patients with intestinal resection and in horses that did not require enterectomy. Siebke et al. (1995) and Mair and Smith (2005a) determined a better success rate in patients that did not require intestinal resection compared to horses with anastomosis. Van den Boom and van der Velden (2001), however, did not corroborate a better prognosis in horses without resection compared to animals with a small intestine resection. In our cases, we proved much better results in patients without resection. In patients with small intestine ileus, the success rate was 72.8% in cases with resection and 90.8% in horses without resection. In horses with caecal disease, 50% of animals with resection and 83.3% with enterotomy survived. In the group of patients with a large colon disease, only 50% of horses with resection or bypass and 92.1% of animals with enterotomy of the large colon and/or caecum were discharged home.

Resection and anastomosis are performed most frequently while solving pathological findings on the small intestine. Enterectomy was necessary for the treatment of 51.8% of patients with small intestine disease we assessed. A similar result was quoted by Mair and Smith (2005a), who indicated resection in 50.3% of patients with small intestine ileus. Three horses from our set required the resection of two distant sections of the small intestine. Enterectomy on the small intestine was also indicated in one patient with concurrent small intestine and large colon disorders, and in another horse with a small colon disorder, in which we found a serious synechia in the area of the small intestine as an accidental finding. These patients confirm the necessity of careful revisions of the abdominal cavity which should not end after a single pathological finding. Removal of an irreversibly damaged section of the large colon was required only in 6.1% of horses, and resection due to caecal and small colon diseases was also required in isolated cases only.

The optimum method of intestinal resection and of anastomosis on the small intestine is the subject of numerous clinical and experimental studies and the opinions differ (MacDonald et al., 1989; Freeman, 1997; Brodowski et al., 2000; van den Boom and van der Velden, 2001; Johnson and Keller, 2005; Mair and Smith, 2005a). Many claim that jejunocaecal anastomosis is often accompanied by lower short-term survival and higher occurrence of complications compared to other techniques (MacDonald et al., 1989; Freeman et al., 2000; van den Boom and van der Velden, 2001; Mair and Smith, 2005a). A tendency to post-surgery complications is explained by the bypass of ileocaecal valve and creation of sharp transition between intestinal segments with different functions. The jejunum must overcome an intra-caecal pressure without the ileal coordination mechanism and ileocaecal valves (Huskamp, 1973; Ross et al., 1990; Freeman, 1997). A tendency to mechanical complications requiring relaparotomy in patients with jejunocaecostomy was proved by Pankowski (1987) and Freeman et al. (2000). Reduced survival is also associated with the inability to excise the entire ileum, which leads to the maintenance of devitalized intestine in the abdominal cavity in some horses and to increased occurrence of post-surgery ileus (MacDonald et al., 1989; Freeman et al., 2000;

Mair and Smith, 2005a). Mair and Smith (2005a) discharged home 76.7% of horses with jejunojejunal end-to-end anastomosis, 69.2% of horses with jejunojejunal side-to-side anastomosis, 75% of horses with jejunoileal end-to-end anastomosis, 66.7% of animals with hand sutured jejunocaecal side-to-side anastomosis and 69.7% of patients with jejunocaecal side-to-side anastomosis using stapling. Van den Boom and van der Velden (2001) achieved 70% success for end-to-end jejunojejunal anastomosis, 45% for side-to-side jejunocaecostomy and 80% for jejunocaecal bypass.

In the set we assessed, in horses with a single anastomosis we achieved 78.8% success for jejunojejunal end-to-end anastomosis, 55.6% for jejunoileal end-to-end anastomosis and 67.6% for jejunocaecal side-to-side anastomosis. All horses with two resections recovered. The achieved results correspond with foreign studies and corroborate a lower survival in patients with jejunocaecostomy compared to jejunojejunostomy. On the other hand, only two out of 35 horses with jejunocaecostomy suffered from mechanical complications in the form of a partial obstruction of anastomosis due to its "curving". Although we had to leave a nonviable ileal stub in the abdominal cavity in several horses with jejunocaecostomy, peritonitis and synechia did not represent a typical complication due to jejunocaecostomy. Therefore it seems that the seriousness of the disease and the scope of lesion in patients that require jejunocaecostomy will play an important role. This potential reason for a lower success rate was also mentioned by Freeman et al. (2000). During relaparotomy Van den Boom and van der Velden (2001) found the incarceration of small intestine into a mesenterial defect in a patient with jejunocaecostomy, and this is why they preferred only ileocaecal bypass in patients with viable ileus. On the other hand, two of our four patients with jejunocaecal or ileocaecal bypass did not survive and the failure of anastomosis with subsequent peritonitis was the reason for euthanasia in one of them.

The worst complications in our set were associated with jejunoileal end-to-end anastomosis, which was chosen in nine horses with one resection and in another two patients with two resections. Three of them suffered for various reasons from the obstruction of anastomosis, which had to be solved by another resection and jejunocaecostomy. In another patient we had to massage the obstipation at the place of anastomosis. Freeman (1997) warned against the tendency of jejunoileal anastomosis to obstruction and explained it by different thicknesses of jejunum and ileum walls. On the other hand, these results do not correspond with the results obtained with jejunoileal anastomosis by Loesch et al. (2002) and Rendle et al. (2005). All patients quoted by the aforementioned authors recovered without any problems. The obstruction of anastomosis was also a cause of relaparotomy in three out of 53 horses with jejunojejunal-end-to-end anastomosis. In two horses we had to do another resection and jejunojejunal or jejunocaecal anastomosis, in the last horse we solved the obstipation by massage. Huskamp and Bonfig (1987) considered the obstipation of anastomosis as a complication that may occur even in the case of optimally created anastomosis and correct post-surgery regimen. They explained it by the swelling and contraction of the wound causing a reduction of the intestine lumen, and by the absence of grumous sliding substances in intestine contents. Surface damage to the epithelium and temporary loss of mucosa lubricity occurring after incarceration in the stenostenotic intestine noose also contribute to later emergence of obstruction.

In 94 (48.2%) patients with small intestine disease and in four (80%) patients with concurrent small intestine and large/small colon disorder the intestinal resection was not necessary for treatment. The surgical intervention consisted in the repositioning or releasing of obstruction by massage and in the decompression of distended intestine by the massage of contents to the caecum. The importance of decompression of small intestine distended nooses as a prevention of paralytic ileus is repeatedly stressed by foreign research (Freeman et al., 2000). In 40 out of 94 horses with small intestine disease we also carried out the enterotomy of large colon, caecum or both, in two cases we indicated the enterotomy of small intestine. The enterotomy of large colon was necessary in three out of four horses with concurrent disease of small intestine and of large or small colon. According to some authors (Roussel et al., 2001; Mair and Smith, 2005b) the evacuation of large colon through enterotomy in the pelvic flexure reduces the risk of post-surgery ileus in patients with small intestine disease. In our patients we did not use it as a regularly performed intervention for the treatment of ileal status on the small intestine, and we rather indicated it in cases of massive dehydration and increased content of large intestines.

Enterectomies in the area of caecum, large and small colon are indicated much less frequently compared to small intestine (Hughes and Slone, 1998; Johnson and Keller, 2005; Mair and Smith, 2005a). We carried out partial enterectomy in 40% of horses with caecal disorder; in the remaining animals the treatment consisted in the evacuation of contents after enterotomy. In 90.3% of horses with large colon disease the surgery involved the evacuation of intestinal contents through enterotomy in the pelvic flexure of large colon. Only 6.1% of patients required the removal of an irreversibly damaged section of large colon. Like with the small intestine, several surgical techniques are available. The selection of an optimum method largely depends on the localization and length of an irreversibly changed section of the ascendant colon. In nine patients requiring resection we carried out partial resection and end-to-end anastomosis in the area of left colon, and in one horse we performed partial resection and side-to-side anastomosis. End-to-end anastomosis was preferred in horses with less widespread lesion localized in the area of pelvic flexure; side-to-side connection was used in horses with longer non-viable section. In other two horses we performed a bypass between the left dorsal colon and the small colon and evacuation of intestine contents after the enterotomy of pelvic flexure. The purpose of the intervention was to prevent chronic recurrence and recurrent faecal impaction of the right dorsal colon. The technique for functional obstruction of the right dorsal colon was described by Andrews and Robertson (1988). In the remaining horses, the treatment consisted in the reposition of the dislocated colon. In patients that required the enterotomy of large colon and/or caecum, the success rate of treatment was 92.1%. In the group of horses with resection or bypass of the large colon, 50% of animals recovered. Hughes and Slone (1998) achieved 57% of recovered animals with the finished subtotal resection of the large colon. They justified this fairly high success by their use of stapling to ligate mesocolon vessels, which saves time, and by using a modified end-to-end technique during the resection of a large section of the large colon. During surgical treatment of the small colon it is possible to use a combination of massage and lavage per rectum to free the obstruction, evacuation of intestine contents through enterotomy and resection in the case of irreversible damage to the intestine wall (Ruggles and Ross, 1991; Dart et al., 1992; Edwards, 1992). In 57.1% of horses with a small colon disorder we carried out enterotomy on the antimesenterial edge, other two horses required resection and end-to-end anastomosis and one horse required, apart from resection of small colon and end-to-end anastomosis, resection of the small intestine and jejunojejunal anastomosis for an examination of synechia in the area of the small intestine. Evacuation of the large colon is recommended in patients with enterotomy and enterectomy of the small colon due to a lower risk of impaction (Ruggles and Ross, 1991; Dart et al., 1992) and was chosen in 64.2% of horses for the same reason.

In the post-surgery period, horses after a colic surgery are threatened with numerous complications, prolonging recovery, increasing expenses and possibly causing death, and indicating euthanasia or relaparotomy. In the patients we monitored, we analyzed only the complications that were considered to be the cause of death or that led to relaparotomy. 63 horses did not survive the post-surgery period and 43 of them underwent just one surgery. Like in the sets studied by other authors (Brodowski et al., 2000; Mair and Smith, 2005b), the group of horses with one surgery included patients whose owners did not agree with relaparotomy for financial reasons. A total of 21 once operated horses underwent surgical treatment due to small intestine ileus and the most frequent complications that led to euthanasia or death in these patients were peritonitis with synechia and paralytic ileus. Mair and Smith (2005b) defined post-surgery ileus as a functional surgery complication in horses that had a reflux higher than 2 l and did not have any mechanical obstruction. We used the same characteristic for our patients. Post-surgery ileus is a serious and frequently fatal complication in patients with both strangulating and non-strangulating obstruction of the small intestine emphasized in other studies as well (Hunt et al., 1986; Blikslager et al., 1994; Siebke et al., 1995; Brodowski et al., 2000; Roussel et al., 2001; Cohen et al., 2004; Mair and Smith, 2005b). Freeman et al. (2000) diagnosed post-surgery ileus in 10% of horses after a small intestine surgery due to other problems than proximal enteritis. Mair and Smith (2005b) confirmed post-surgery ileus in 31.9% of patients after a small intestine surgery excluding animals with proximal gastroduodenojejunitis and found lower short-term survival in horses suffering from post-surgery ileus compared to horses without this complication. Extreme intestine distension before surgery and disrupted blood

supply (Hunt et al., 1986; Blikslager et al., 1994) as well as the length of anaesthesia and surgical intervention (Cohen et al., 2004) play an important role in the development of paralytic ileus.

Peritonitis and/or synechia may be caused by numerous factors, including intestine ischemia, endotoxemia, contamination during surgery, trauma of the intestine wall due to inadequate manipulation during intervention or infiltration of anastomosis, and represent frequent lethal complications in abdominal surgery (Gerhards, 1990; van den Boom and van der Velden, 2001). MacDonald et al. (1989) considered a leakage of anastomosis to be the most frequent fatal complication of intestinal resection. Although we did not encounter this problem in our patients that died or were euthanized after one surgery, peritonitis and/or synechia were considered to be the cause of death in four horses with a small intestine disease and in one horse with a concurrent small intestine and large colon disorder. In other horses, peritonitis was related to the perforation of terminal small colon which originated before the surgical treatment of ileocaecal invagination and was not recognized in time. The seriousness of post-surgery peritoneal adhesions was assessed by Gerhards (1990), who considered them to be the cause of death or re-surgery in 28.2% horses that survived the first three days after intervention. 92% of them did not survive.

In 17 horses operated with a large colon disorder, the most frequent lethal complication was acute typhlocolitis. Acute diarrhoea was also a frequent complication in patients described by other authors (Hunt et al., 1986). Mair and Smith (2005b) diagnosed colitis in 3.2% of horses that recovered after a colic surgery, but 75% of them did not survive.

Three out of 43 horses that did not survive the post-surgery period after one surgery were euthanized due to problems localized outside the intestinal tract. In a several-months-old foal that could not undergo an orthopaedic examination before surgery due to string colic pains, femoral head epiphyseolitis was diagnosed as the cause of chronic limping. Two horses were hospitalized due to orthopaedic problems. One of them developed an acute caecal dysfunction after two surgeries that treated a fracture of the third metatarsal bone. The evacuation of caecum prevented its rupture, but the horse had to be later euthanized due to complications with osteosynthesis. The second horse was hospitalized with osteomyelitis of proximal sesamoid bone and trauma of the pastern joint. After several days the patient developed total torsion of the large colon. He recovered from an abdominal surgery, but after several days the owner decided, due to unsatisfactory healing of the wound and uncertain outlooks of further racing career, for euthanasia. Both horses after surgery developed a profuse diarrhoea which lasted for two days in the first horse and until euthanasia in the other. It is disputable to what extent the acute colitis affected the healing of orthopaedic wounds. The origination of a colic disease after a planned surgery is not unknown and especially caecal obstipation and rupture are related to total anaesthesia (Campbell et al., 1984; Hilbert et al., 1987; Edwards and Ruoff, 1991).

Relaparotomy is an alternative to the conservative treatment of some post-surgery complications and the only choice for some other problems. Relaparotomy is defined by Huskamp and Bonfig (1987) as the second surgical intervention in the abdominal cavity carried out within 12 days after the first surgery. In our patients and in other studies (Mair and Smith, 2005c) we defined relaparotomy as a re-surgery carried out during a single hospitalization. In the set we assessed, relaparotomy was chosen as a treatment of post-surgery complications in 9.4% of horses that recovered from a colic surgery, which corresponds with the published data. In the published studies, relaparotomy was indicated in 10.6% to 13% of horses that recovered from anaesthesia (Huskamp and Bonfig, 1987; Brodowski et al., 2000; Mair and Smith, 2005c). Higher 19% occurrence of re-operated patients was reported by authors who assessed only diseases of small intestine (MacDonald et al., 1989; Freeman et al., 2000). The more frequent indication of relaparotomy to solve the ileal condition in the small intestine corresponds with our experience, because in the monitored set the second surgical intervention was chosen mostly in patients with a primary small intestine disorder.

The most frequent indications of relaparotomy include conservatively implacable colic pains, paralytic ileus, obstipation and other complications of anastomosis, intestinal necrosis, peritonitis and adhesions (Huskamp and Bonfig, 1987; Gerhards, 1990; Siebke et al., 1995; Brodovski et al., 2000; Freeman et al., 2000; Johnson and Keller, 2005; Mair and Smith, 2005c). These research data are confirmed by our own experience. In the group of recovered animals, the most frequent indication was relaparotomy of paralytic ileus diagnosed

in nine out of 21 reoperated animals. Four horses developed complications with anastomosis, which required its widening or resection. Resection was necessary in another horse that developed a subserosal hematoma compressing the intestine lumen. In two horses with inguinal hernia that were not castrated at surgery suffered from recurrence shortly after surgery. These findings support the importance of castration in stallions suffering from inguinal hernia, recommended by some authors (Schneider et al., 1982; Rijkenhuizen and van der Velden, 1994). In four out of 20 horses who did not survive relaparotomy, peritonitis and/or synechia were diagnosed at the second surgery, in three horses the main problem consisted in complications with anastomosis and in two animals it was paralytic ileus.

Apart from the solving of post-surgical problems, relaparotomy enables quick termination of hopeless cases (Huskamp and Bonfig, 1987; Freeman et al., 2000; Mair and Smith, 2005c). Peritonitis and adhesion, unstoppable bleeding, intestine rupture, intestinal necroses and post-surgery ileus are considered to be the most frequent causes of euthanasia at relaparotomy (Huskamp and Bonfig, 1987; Siebke et al., 1995; Brodovski et al., 2000; van den Boom and van der Velden, 2001; Mair and Smith, 2005c). Synechia, peritonitis, stomach or intestine rupture and massive bleeding were diagnosed also in our patients that were euthanized or died early after the initiation of anaesthesia during relaparotomy. An interesting patient in this group was a horse that died during laying for relaparotomy and in which we diagnosed, after opening the abdominal cavity, diaphragmatic hernia connected with the relocation of stomach and small intestine into thorax. At the first surgery, the patient was diagnosed with the strangulation of small intestine by a ligamentous strap in the dorsal section of abdomen in the stomach area. As the area is not surgically approachable, the intestine was released without visual control and the irreversibly changed section was removed. The horse recovered from narcosis easily, but his condition deteriorated rapidly after several hours. It is possible that the diaphragm rupture occurred when the horse was standing up after anaesthesia. On the other hand, we cannot exclude that the real primary cause of a colic disease was the incarceration of small intestine in the diaphragm defect, which was not correctly diagnosed during surgery. After the incarcerated loop was released, the small opening was initially blocked by the organs of abdominal cavity and the horse managed anaesthesia without controlled ventilation. An aggravation of the defect in the post-surgery period and subsequent stomach and intestine hernia then caused a fatal complication. In another patient euthanized at relaparotomy, the recurrent obstipation of right dorsal colon was solved by the technique described by Andrews and Robertson (1988) at the first surgery. Obstipation recurred even after the creation of a bypass between the left dorsal and small colon.

Peritonitis and paralytic ileus are considered to be the most frequent causes of death or euthanasia in animals also in the post-surgery period (Siebke et al., 1995). The same complications led to death in four out of seven horses in our set that recovered from relaparotomy. One horse developed bilateral orchitis after relaparotomy indicated due to the obstruction of anastomosis. Although the overall condition of the stallion was not disrupted and the inflammation process was insulated from the abdominal cavity, the owner wished the animal to be euthanized for insurance reasons. In another horse that underwent partial resection of large colon at the first surgery, disruption of synechia occurred between the omentum and the place of anastomosis as well as incarceration of small intestine in the incision hernia at the second surgery. Due to the infection of surgery wound and anticipated difficult healing, the second laparotomy was not indicated. Complications with the healing of relaparotomic wound were also previously described (Freeman et al., 2000; Mair and Smith, 2005c).

In five horses (from the set we analyzed) that underwent the first surgery due to an ileal condition on the small intestine, the indication for relaparotomy consisted in a conservatively badly managed disease of large intestine. Three horses with obstipation or obstipation combined with ileal hypertrophy got complicated due to the torsion of large colon by 360 degrees. In two of them the torsion was accompanied by the rupture of intestine wall. The fourth horse with ileal obstipation and hypertrophy also suffered from a displacement of large colon in the post-surgery period. The torsion or displacement of ascending colon was diagnosed both after a surgery of small intestine and after a surgery of large intestine soon after waking up from anaesthesia by Huskamp and Bonfig (1987), and they considered Neostigmin to be a causative factor. Neostigmin is used in our patients within post-surgery care almost routinely for speeding up of

large intestine evacuation and peristaltic support. However, the relation between the origination of large colon torsion and non-strangulating ileal obstruction in our patients remains unclear. In the last horse operated due to intramural hematoma on the small intestine we had to use relaparotomy to solve the small intestine obstipation. This horse was one of the few patients who had not been medicated with Neostigmin, and at his first surgery his large colon was evacuated through enterotomy. Caecal obstipation in the post-surgery period can be ascribed to the intestine activity. The case may also justify the preventive application of a prokinetic drug.

51.2% of patients that underwent relaparotomy were discharged home, which correlates with the short-term survival of 26.9% to 64% reported by other authors (Huskamp and Bonfig, 1987; Siebke et al., 1995; Brodowski et al., 2000; Freeman et al., 2000; van den Boom and van der Velden, 2001; Mair and Smith, 2005c). The achieved results thus suggest that relaparotomy is a good alternative to solve some post-surgery complications in colic patients.

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