

Survival and complication rates in 300 horses undergoing surgical treatment of colic. Part 4: Early (acute) relaparotomy

T. S. MAIR* and L. J. SMITH

Bell Equine Veterinary Clinic, Mereworth, Maidstone, Kent ME18 5GS, UK.

Keywords: horse; colic; laparotomy; acute; complications; survival; relaparotomy

Summary

Reasons for performing study: Early (acute) relaparotomy after surgery for equine colic is widely considered to be an acceptable treatment option for management of certain post operative complications. However, there is relatively little published information about resulting complication rates and short- and long-term outcomes.

Objectives: To document the proportions, indications, complication rates and survival rates of horses undergoing acute relaparotomy following colic surgery.

Methods: History, clinical findings, surgical findings and procedures, post operative treatments and outcome of 300 consecutive surgical colic cases (1994–2001) were reviewed. Long-term follow-up information was retrieved from case records and telephone enquiries from owners.

Results: Acute relaparotomy was performed in 27/254 horses (10.6%) that recovered from initial general anaesthesia. The indications for relaparotomy included persistent pain, persistent ileus, peritonitis and wound breakdown. Of these 27 horses, 21 (77.8%) recovered from the second surgery, of which 8 (29.6%) died during the immediate post operative period. Thirteen of the 27 horses (48.2%) were discharged. Of these 13 horses, 5 (38.5%) were re-admitted to the hospital for surgical treatment of a subsequent bout of colic. The long-term survival rate for the 27 horses that underwent relaparotomy was 22.2%. Colic following discharge after relaparotomy was recorded in 69.2% of cases.

Conclusions: Relaparotomy is necessary in approximately 10% of horses undergoing surgery for acute colic. Persistent pain and post operative ileus were the most common indications. The short-term survival rate for horses requiring relaparotomy was approximately 50% and the long-term survival rate 22%. Nearly 40% of horses surviving relaparotomy developed episodes of acute colic that necessitated further surgery.

Potential relevance: Owners of horses requiring early (acute) relaparotomy should be advised of the high complication rates for this procedure.

Introduction

Early (acute) relaparotomy after surgery for equine colic (i.e. repeat laparotomy prior to discharge from the hospital) is

widely considered to be an acceptable treatment option for the management of certain post operative complications (Huskamp and Bonfig 1985). In particular, early relaparotomy permits the correction of surgical errors and allows repeated assessment of intestinal viability (Huskamp and Bonfig 1985; Parker *et al.* 1989). More recently, early relaparotomy has been advocated for the management of persistent post operative ileus (Ducharme 2002). The procedure has been reported by a number of authors (Huskamp and Bonfig 1985; Pankowski 1987; Parker *et al.* 1989; Scheidemann 1989; Vachon and Fischer 1995; Freeman *et al.* 2002; Proudman *et al.* 2002), although some of these studies related to particular conditions or treatments. There is relatively little published information about the outcome, both in the short and long term, and complication rates of horses undergoing relaparotomy.

The purpose of this study was to record the number and describe indications for relaparotomy among 300 consecutive surgical colic cases. The surgical findings, complications and outcomes of these cases were recorded.

Materials and methods

Case records of 300 horses that had exploratory laparotomies at the Bell Equine Veterinary Clinic for acute colic between 1994 and 2001 were reviewed. Details of the horses and anaesthetic protocols have been reported elsewhere (Mair and Smith 2005a). Details of short- and long-term complications and methods of data retrieval have also been reported elsewhere (Mair and Smith 2005a–c). Data recorded included clinical details, time until second surgery, time until first feed/water, complications and outcomes.

Post operative ileus was defined as a functional complication of surgery in horses that had reflux >2 l through a nasogastric tube and that did not have a mechanical obstruction. A mechanical obstruction was diagnosed at necropsy or at a repeat surgery.

Data were entered into a statistics programme (Minitab for Windows Release 13)¹. Descriptive statistics (mean \pm s.d., median and range) were generated for continuous data. The evaluation of differences between survivors and nonsurvivors was undertaken using a Student's *t* test for continuous variables and a chi-squared test for categorical variables. Significance was set at $P < 0.05$, and odds ratios (OR) and 95% confidence intervals (95% CI) were calculated for categorical data.

*Author to whom correspondence should be addressed.

TABLE 1: Prevalence of lesions identified at relaparotomy in 27 horses

Lesion	No.	%
Ileus	7	25.9
Obstruction/impaction at anastomosis	6	22.2
Secondary intestinal ischemia	3	11.1
Colon volvulus or displacement	3	11.1
Gastric rupture	2	7.4
Small intestinal obstruction by mesenteric adhesion	1	3.7
Caecocolic intussusception	1	3.7
Large colon entrapment in ventral hernia	1	3.7
Colonic sand impaction	1	3.7
Colitis	1	3.7
Strangulation of small colon by pedunculated lipoma	1	3.7

Results

Clinical features

Relaparotomies were performed prior to discharge in 27/254 horses (10.6%); 26 had a single relaparotomy while one horse had 2 relaparotomies. The reasons for the relaparotomy were persistent pain (n = 18), persistent ileus (n = 7), peritonitis (n = 1) and colic associated with wound breakdown (n = 1). The reason for the second relaparotomy in one horse was persistent pain. Relaparotomy was performed at mean and median times of 2.5 ± 2.7 and 2.0 days (range 0.5–14.0 days), respectively, after the first surgery.

Surgery

The surgical approach was through the original laparotomy wound in 24 cases and through a new paramedian incision in 3 cases. In the horse that had 2 relaparotomies, one surgery was performed through the original midline laparotomy wound and one through a paramedian incision.

The most common site of gastrointestinal obstruction identified at relaparotomy was the small intestine (17/27, 63.0%), followed by the caecum (6/27, 22.2%). Simple obstructions were identified in 17/27 (63.0%) and strangulating obstructions in 6/27 cases (22.2%).

The prevalence of lesions identified at relaparotomy is summarised in Table 1. The most common lesion found on relaparotomy was small intestinal ileus (7/27, 25.9%). Six of these cases had small intestinal obstruction and distension at the first surgery, of which 4 had strangulating lesions that necessitated resection and anastomosis; 2 cases had ileocaecal obstructions that were treated by jejunocaecostomy and 1 case had a simple focal obstruction caused by inflammatory bowel disease. In addition to the 7 cases of small intestinal ileus, 2 horses were found to have gastric rupture at the second surgery (despite intermittent passage of a nasogastric tube), which was believed to have resulted from post operative ileus.

Ischaemic damage (secondary) to intestine that had not been observed at the initial surgery and had apparently developed subsequent to the first surgery was found in 3/27 horses (11.1%), all of which had had strangulating obstructions at the first surgery; entrapment of intestine in an inguinal rupture (n = 1) and epiploic foramen (n = 1) and strangulation by a pedunculated lipoma (n = 1). The precise cause of the secondary ischaemia was not determined, but surgical error (i.e. failure to resect sufficient intestine at the initial surgery) could not be discounted.

TABLE 2: Rates of short-term post operative complications in 21 horses following 2 exploratory laparotomies for colic

Complication	No.	%
Colic/pain	14	66.7
Incisional complications	12	57.1
Ileus	13	61.9
Severe endotoxaemic shock	7	33.3
Jugular thrombophlebitis	4	19.0
Septic peritonitis	2	9.5
Colitis	3	14.3

Problems involving an anastomosis were present in 6/27 cases (22.2%): impaction at the anastomosis site (4/27, 14.8%) and intestinal kinking at the anastomosis (2/27, 7.4%). Of the 4 horses with impaction of the anastomosis, 3 (75.0%) had had end-to-end jejunojejunostomies, and one (25.0%) an end-to-end jejunio-ileostomy performed at the initial surgery. The 2 cases of kinking at the anastomosis both involved side-to-side jejunocaecostomies.

In 8/27 horses (29.6%), a 'new' lesion was found at relaparotomy. These included single cases of large colon entrapment in a partial breakdown of the abdominal wound, sand impaction of the large colon and strangulation of small colon by a pedunculated lipoma; in the latter 2 cases, the lesion identified at relaparotomy was believed to have been overlooked at the first surgery, and colic recurred within 4 h of the initial surgery. In 5 horses, a new lesion or recurrence of the original lesion was believed to have developed after the first surgery; these included 2 horses with large colon volvulus (one occurring following a similar lesion at the first surgery, and one following right dorsal displacement of the large colon corrected at the initial surgery), one horse with right dorsal displacement of the large colon and one horse with colitis. One horse was found to have obstruction of small intestine by mesenteric adhesions on relaparotomy.

One horse that had ileus following small intestinal strangulation and resection died during anaesthesia. Intraoperative euthanasia was performed in 5 horses at relaparotomy (2 with gastric rupture and 3 with ileus, at the owner's request because of very poor prognosis).

Post operative complications

Mean \pm s.d. and median duration of hospitalisation for the 21 horses that recovered from anaesthesia were 10.5 ± 4.9 and 12.0 days (range 0–21 days), respectively. Rates of post operative complications following relaparotomy in these 21 horses are shown in Table 2. Post operative ileus was recorded in 13/21 cases (61.9%). Mean and median duration of gastric reflux in these cases was 3.5 ± 2.9 days and 3.0 days (range 1.0–12.0 days), respectively. Incisional complications were classified as drainage in 9/21 (42.9%) and wound infection in 3/21 horses (14.3%). Aseptic jugular vein thrombophlebitis developed in 4/21 cases (19.0%).

Short-term survival

Of the 27 horses, 13 survived to discharge from the hospital, giving a short-term survival rate of 48.1% for all horses that underwent relaparotomy. The single horse that had a total of 3 laparotomies survived to discharge. The reasons for death/euthanasia of 8 horses in the post operative period included

post operative ileus (n = 3), persistent colic (n = 2), grass sickness (n = 1), severe endotoxaemic shock (n = 1) and colitis (n = 1). *Post mortem* examination was performed in 6 horses; this identified ileus with no ischaemic/necrotic bowel (n = 4), grass sickness (n = 1) and colitis (n = 1).

Long-term survival and complications

Follow-up information was obtained from all of the horses at mean \pm s.d. and median times of 24.2 ± 19.7 and 18.0 months (range 12–48 months), respectively. Of the 13 horses discharged home after relaparotomy, 5 (38.5%) were re-admitted to the hospital for surgical treatment of a subsequent bout of colic (including the single horse that had had 3 laparotomies) before the time of follow-up (late repeat laparotomies, not evaluated in this study). Four of these 5 horses (80.0%) had small intestinal strangulating obstructions at the initial surgery and one (20.0%) had a right dorsal displacement of the large colon. Eight horses were discharged from the hospital following 2 laparotomies and were not re-admitted for further surgery. Five of these 8 horses (62.5%) were alive at the time of the enquiry. A history of colic episodes after discharge from the hospital was recorded in 4/8 horses (50.0%); 'recurrent mild colics' (3 or more colic episodes in 6 months) were reported in 3 horses, and 'severe colic' in one horse (resulting in euthanasia). Weight loss after discharge from the hospital was recorded in 1/8 horses cases (12.5%) and ventral hernia formation in 2/8 (25.0%). Of the 5 horses that were readmitted for a further surgery, only one (20.0%) was alive at the time of follow-up. The long-term survival rate for the 27 horses that underwent relaparotomy was 6/27 (22.2%). Colic following discharge after relaparotomy was recorded in 9/13 horses (69.2%).

Details of *post mortem* examinations were available in 2/3 horses that died after discharge. The major findings were extensive intra-abdominal adhesions (n = 1) and right dorsal displacement of the large colon (n = 1).

Discussion

Twenty-seven horses in this series (10.6%) underwent an early repeat laparotomy within a few days of the initial surgery. This figure is comparable to previously recorded rates of early relaparotomy of 6.3% (Parker *et al.* 1989), 9.6% (Proudman *et al.* 2002), 12.5% (Huskamp and Bonfig 1985), 15% (small intestinal herniation through the epiploic foramen only; Scheidemann 1989), 19% (small intestinal obstruction only; Freeman *et al.* 2002), 27% (small intestinal herniation through the epiploic foramen only; Vachon and Fischer 1995) and 28% (jejunocecostomy only; Pankowski 1987). These widely varying rates of relaparotomy probably relate to differences in the prevalence of the initial surgical lesions in different studies, and to other potential confounding factors. Repeat laparotomy is now widely accepted as a treatment option in the management of post operative colic (Huskamp and Bonfig 1985; Parker *et al.* 1989) and persistent post operative ileus (Ducharme 2002). These were the major indications for performing the procedure in our series. Both post operative ileus and epiploic foramen entrapment were found to be significant risk factors associated with relaparotomy in the study by French *et al.* (2002). It is interesting to note that 45% of the horses in the present study that had entrapment of small intestine in the epiploic foramen required a repeat laparotomy. This was the highest rate of primary lesions in the

horses that required relaparotomy. The reason for this observation is uncertain, but it might partly reflect the younger mean age of horses with epiploic foramen entrapment compared with horses with strangulating lipomas; owners may be more willing to cover the cost of relaparotomy in younger than in old horses.

Ducharme (2002) recently listed the following abnormalities after laparotomy as potential reasons for considering an early relaparotomy: persistence of elevated packed cell volume (PCV) (>50%) after 24 h; heart rate elevation (>80 beats/min) for more than 48 h; clinical signs of persistent endotoxaemia for more than 48 h; divergence in the changes in PCV (increasing) and total plasma protein concentration (decreasing); elevation in rectal temperature; dullness/depression for more than 48 h; abdominal distension; severe abdominal pain; persistent ileus after 72 h; haematological changes consistent with degenerative left shift; and appearance of mixed bacterial contamination in previously 'aseptic' peritoneal fluid. Similar features were used in the present study to determine the need for an early relaparotomy. However, in the author's clinic, relaparotomy is considered when post operative ileus and nasogastric reflux persists for more than 48 h rather than 72 h as suggested by Ducharme (2002). It should also be noted that some of the abnormalities listed by Ducharme (2002), such as persistently elevated PCV, persistent signs of endotoxaemia, divergence of changes in PCV and total plasma protein, and pyrexia, may arise as a result of colitis or peritonitis that could be managed medically. In the present series, persistent pain and persistent ileus were the most common indications for early relaparotomy.

All horses affected by persistent post operative ileus received medical treatment with prokinetic agents (lignocaine hydrochloride, erythromycin, lactobionate, cisapride or metoclopramide hydrochloride); however, the precise treatment regime was not consistent between cases, and no attempt was made to compare the relative efficacies of different treatments. Similarly, comparisons between this and other published studies in relation to treatment of post operative ileus and the requirement for repeat laparotomy are not possible.

Technical errors during the primary surgery may influence the need for early relaparotomy. In a review of 55 horses undergoing early relaparotomy, Sinha *et al.* (1995) concluded that a technical error had occurred during the initial surgery in 14%, and that there was a presumption of error in a further 31% of these cases. In the present series, 2 horses (7.4%) were found at relaparotomy to have kinking of an anastomosis, which was considered to be a technical error. It is noteworthy that, in both horses, the anastomosis was a side-to-side jejunocecostomy. This particular form of anastomosis has previously been associated with a tendency to mechanical complications that require early repeat laparotomy (Pankowski 1987). Four other horses in this series were found to have impaction at the anastomosis (despite a 'satisfactory appearing' anastomosis in all cases at relaparotomy) and 3 horses had secondary ischaemia of bowel adjacent to the anastomosis site, all of which might have been associated with technical errors during the initial surgery. Technical errors may, therefore, have been involved in up to 9 of the 27 horses (33.3%) that underwent early relaparotomy. Close attention to surgical technique is therefore an essential aspect of the treatment of horses with surgical colic at the first laparotomy.

In the study of Proudman *et al.* (2002), 53% of the horses that underwent early relaparotomy died or were subjected to euthanasia within the study period, with a median time to death of 11 days.

Median survival time in that study was 77 days, and the incidence of post operative colic was 0.65 episodes/horse year at risk. In the present series, only 13 of 27 horses (48.1%) that underwent relaparotomy survived to discharge. This figure is comparable to previously reported short-term survival rates of 64% (Freeman *et al.* 2002), 56% (Huskamp and Bonfig 1985), 50% (Vachon and Fischer 1995), 41% (Parker *et al.* 1989) and 36.4% (Morton and Blikslager 2002). Financial considerations may contribute to some of the differences in survival rates reported in these studies. Morton and Blikslager (2002) showed that the need for repeat laparotomy was associated with an 18-fold increased risk of mortality in the post operative period. Although the short-term survival rate of horses following relaparotomy is close to 50%, the long-term survival rate is significantly poorer. In our study, the long-term survival rate for the 27 horses that had relaparotomy was only 22.2%. Colic following discharge after relaparotomy was very common, being recorded in 69.2% of cases.

Reasons for the increased mortality rate of horses that recovered from early relaparotomy partly relate to the development of abdominal adhesions and colic. In the series of 300 surgical colic cases described in our study, confirmed abdominal adhesions (i.e. confirmed at a subsequent laparotomy or at *post mortem* examination) were recorded in 17/190 horses (8.9%) for which long-term follow-up information was available (Mair and Smith 2005c). Seven of these 17 horses (41%) had undergone relaparotomy. The rate of confirmed adhesions was significantly higher in horses that had had relaparotomy (50%) compared to those that had had a single laparotomy (5.7%).

Early repeat laparotomies were associated with an increased rate of wound complications, as has been observed previously (Phillips and Walmsley 1993; Freeman *et al.* 2000). It has been proposed that incisional infection after repeat laparotomy is caused by transfer of bacteria from the raw edges of the wound and diminished resistance in the friable and oedematous tissues (Freeman *et al.* 2002). Ventral hernias were recorded in 2 of 8 horses (25%) that were discharged after early relaparotomy and not re-admitted for further surgery prior to the time of follow-up. This rate of hernia formation was higher than that recorded in horses after a single laparotomy (7.2%) (Mair and Smith 2005c).

In conclusion, the most common indications for early repeat laparotomy in this series of horses were post operative ileus and potential technical problems resulting in obstruction at an anastomosis site or secondary ischaemia of remaining bowel. The short-term survival rate of these horses was close to 50%, but the long-term survival rate was poor (22%). One major potential reason for the low long-term survival rate was the presence of abdominal adhesions. This study did not assess late repeat laparotomies (i.e. horses that were discharged following surgical treatment of colic, but which subsequently underwent a further surgery due to recurrent colic).

Acknowledgements

The authors thank colleagues at the Bell Equine Veterinary Clinic for assistance with the management of these cases. T.S.M. was in receipt of a Specialist Clinical Award from The Home of Rest for Horses. L.J.S. receives funding from the John Crawford Scholarship, and holds the Gerald Leigh Scholarship in equine evidence-based medicine funded by the Beaufort Cottage Educational Trust.

Manufacturer's address

¹Minitab Inc., State College, Pennsylvania, USA.

References

- Ducharme, N.G. (2002) Repeat laparotomy. In: *Manual of Equine Gastroenterology*, Eds: T. Mair, T. Divers and N. Ducharme, W.B. Saunders Co., London. pp 184-187.
- Freeman, D.E., Hammock, P., Baker, G.J., Foreman, J.H., Schaeffer, D.J., Richter, R.-A., Inoue, O. and Magid, J.H. (2000) Short- and long-term survival and prevalence of post operative ileus after small intestinal surgery in the horse. *Equine vet. J., Suppl.* **32**, 42-51.
- Freeman, D.E., Rotting, A.K. and Inoue, O.J. (2002) Abdominal closure and complications. *Clin. Tech. Equine Pract.* **1**, 174-187.
- French, N.P., Smith, J., Edwards, G.B. and Proudman, C.J. (2002) Equine surgical colic: risk factors for post operative complications. *Equine vet. J.* **34**, 444-449.
- Huskamp, B. and Bonfig, H. (1985) Relaparotomy as a therapeutic principle in postoperative complication of horses with colic. In: *Proceedings of the 2nd Equine Colic Research Symposium*, University of Georgia. pp 317-321
- Mair, T.S. and Smith, L.J. (2005a) Survival and complication rates of 300 horses undergoing surgical treatment of colic. Part 1: Short-term survival. *Equine vet. J.* **37**, 296-302.
- Mair, T.S. and Smith, L.J. (2005b) Survival and complication rates of 300 horses undergoing surgical treatment of colic. Part 2: Short-term complications. *Equine vet. J.* **37**, 303-309.
- Mair, T.S. and Smith, L.J. (2005c) Survival and complication rates of 300 horses undergoing surgical treatment of colic. Part 3: Long-term complications and survival. *Equine vet. J.* **37**, 310-314.
- Morton, A.J. and Blikslager, A.T. (2002) Surgical and postoperative factors influencing short-term survival of horses following small intestinal resection: 92 cases (1994-2001). *Equine vet. J.* **34**, 450-454.
- Pankowski, R.L. (1987) Small intestinal surgery in the horse: a review of ileo and jejunocostomy. *J. Am. vet. med. Ass.* **190**, 1609.
- Parker, J.E., Fubini, S.L. and Todhunter, R.J. (1989) Retrospective evaluation of repeat celiotomy in 53 horses with acute gastrointestinal disease. *Vet. Surg.* **18**, 424-431.
- Phillips, T.J. and Walmsley, J.P. (1993) Retrospective analysis of the results of 151 exploratory laparotomies in horses with gastrointestinal disease. *Equine vet. J.* **25**, 427-431.
- Proudman, C.J., Smith, J.E., Edwards, G.B. and French, N.P. (2002) Long-term survival of equine surgical colic cases. Part 1: Patterns of mortality and morbidity. *Equine vet. J.* **34**, 432-437.
- Scheidemann, W. (1989) *Beitrag zur Diagnostik und Therapie der Kolik des Pferdes. Die Hernia Foraminis Omentalis*. DMV Thesis, Mönich.
- Sinha, A.K., Robertson, J.T. and Reeves, M.J. (1995) The role of surgical technique in the need for early relaparotomy in the horse. *Vet. Surg.* **24**, 440.
- Vachon, A.M. and Fischer, A.T. (1995) Small intestinal herniation through the epiploic foramen: 53 cases (1987-1993). *Equine vet. J.* **27**, 373-380.