

Intra-abdominal adhesions in horses: A retrospective evaluation of repeat laparotomy in 99 horses with acute gastrointestinal disease

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Abstract

The objectives of this study were (1) to determine the prevalence of pathological abdominal adhesion formation following exploratory laparotomy; (2) to establish the site of adhesion formation and its relationship to the initial lesion; (3) to ascertain whether the development of intra-abdominal adhesions decreases long-term survival and (4) to identify risk factors for adhesion formation. Of 1014 horses treated surgically for acute gastrointestinal disease, 113 (10.1%) were subjected to repeat laparotomy, with surgical records available for 99 of these cases. Pathological adhesions were the most common diagnosis at repeat laparotomy (28%), followed by complications associated with the anastomosis (16%). Adhesions were not associated with the site of the primary lesion, resection, or endotoxaemia, consistent with the hypothesis that surgical trauma is the most important stimulus in adhesion formation. Together these findings strongly support the need for pan-abdominal, rather than site-specific adhesion prevention measures in all horses undergoing exploratory laparotomy.

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1. Introduction

In people, adhesions commonly occur after surgical trauma, developing in >90% of patients undergoing laparotomy (Menzies and Ellis, 1990). A third of intestinal obstructions and nearly a quarter of female infertility cases are a consequence of adhesion formation, with surgical lysis resulting in a high recurrence rate (Ellis, 1997). Although adhesion formation is thought to be a major complication following equine abdominal surgery, it is impossible to determine accurately the true prevalence or their precise role in post-operative morbidity or mortality. This is because so many animals that suffer recurrent colic are managed medically or are euthanased without necropsy. However, it has been proposed that adhesions are second only to intestinal ischaemia as the cause of repeat laparotomy (Parker et al., 1989), and are the reason for

euthanasia in 26% of cases following small intestinal resection and anastomosis (Macdonald et al., 1989).

Current adhesion prevention is based on careful surgery and the occasional use of physical barriers that have a debatable efficacy. Until adhesion prevalence can be determined accurately, the impact of routine intervention to prevent adhesion formation in horses is open to question. The objectives of this study were (1) to determine the prevalence of pathological adhesion formation based on findings at repeat laparotomy; (2) to establish the site of adhesion formation and its relationship to the initial lesion; (3) to ascertain whether the development of intra-abdominal adhesions decreases long-term survival and (4) to identify risk factors for adhesion formation.

2. Materials and methods

2.1. Study population and data collection

We reviewed the records of all horses that recovered from exploratory laparotomy between April 1998 and September 2004 at the University of

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Liverpool Veterinary Teaching Hospital. Recovery from general anaesthesia was defined as the horse walking out of the anaesthetic box post-operatively. Customised case history and clinical data recording forms were completed by the attending veterinary surgeon on admission to the hospital. Anaesthetic record charts were maintained throughout each surgical procedure and a comprehensive surgical report completed by the surgeon. No specific anti-adhesive measures were utilised in any of the first or subsequent surgeries. Data from these records were entered into our ongoing colic survival database (Proudman et al., 2002a), including the presence and site of adhesion tissue. For horses that did not survive or were euthanased at surgery, a full post-mortem examination was performed if the diagnosis was unclear.

Although all laparotomies subsequent to the first were identified, only the first and second were used in the statistical analyses. All recruited horses remained on the study until they died or were lost to further follow up, such as if a new owner was unprepared to participate in the study.

Cases were placed into one of four groups based on the intra-operative findings at second surgery: (1) *sequelae* – the lesion at second surgery occurred as a result of the initial lesion or surgical procedure; (2) *progression* – the lesion at second surgery was the result of progression of a lesion unresolved at the initial procedure; (3) *recurrence* – the lesion at the second surgery was the same lesion corrected at the first surgery; (4) *unrelated* – no apparent association between lesions at first and second surgery.

Post-operative intra-abdominal adhesions were considered pathological if they were deemed to have contributed to or were the primary reason for the second surgery.

2.2. Data analysis

The association between adhesion formation, lesion at first surgery, and resection of bowel was evaluated using the chi-square test. A Cox proportional-hazards model (Insightful Corporation) was used to analyse post-operative survival following first surgery and life table methods used to construct a Kaplan–Meier plot of cumulative probability of survival (Kaplan and Meier, 1958). The shape of the relationship between continuous variables (e.g. heart rate, PCV, and total protein at admission) and adhesion formation at second surgery was explored using penalised Cox regression models (Insightful Corporation) (Therneau and Grambsch, 1998). These are extensions of Cox regression models that fit non-parametric functions (p-spline smoothers) to estimate the relationships between outcome and explanatory variables (Anon, 2001). The influence of surgeon on post-operative adhesion formation was addressed using a random effects model (Aalen, 1988). A critical probability of 0.05 was used to determine significant effects.

3. Results

3.1. Repeat laparotomy

Descriptive results

During the study period, 1014 horses underwent exploratory laparotomy for the treatment of acute gastrointestinal disease. Of these, 113 (10.1%) were subjected to repeat laparotomy with a total of 115 procedures performed (two horses underwent a third laparotomy). The breed distribution reflected the hospitals' referral population, with Thoroughbreds and Thoroughbred-crosses comprising 52% of the group, ponies 12%, Warmbloods 10%, Arabs or Arab-crosses 8%, and other breeds representing an additional 12%. There were 65 (58%) geldings, 45 (39%) mares, and 3 (3%) stallions. Horses ranged in age from 6 months to 27 years (mean $\pm$ SD 11.8 $\pm$ 5.7 years).

Due to incomplete records, 14 of the repeat laparotomy cases were excluded from further analysis.

Time interval between primary and repeat laparotomy

The interval between laparotomies varied from <24 h up to 9 years (mean = 206 days, median = 7 days), with 77% of cases presenting within 2 months of the first surgery (Fig. 1). In 58% of cases, the second surgery was performed prior to discharge from the hospital following the first laparotomy.

Long-term post-operative survival

Fig. 2 illustrates the pattern of survival for horses undergoing single or repeat laparotomy. Although it appeared that repeat laparotomy was associated with a higher rate of post-operative mortality, this association was not significant ($P = 0.1$; Cox proportional hazards model). For both cohorts, there was a marked mortality in the days immediately following surgery, with a cumulative probability of survival of 0.78 by 50 days. For horses following a single laparotomy however, the curve then had a less steep gradient beyond 50 days, demonstrating a steady decline in the probability of survival throughout the remainder of the observation period. After a second surgery, the sharp decline in survival persisted up to 100 days (cumulative probability of survival 0.64), thereafter following a similar steady decline to the single laparotomy group. Median survival time after a single surgery was approximately 2000 days, whereas the survival time after a second surgery was approximately 1200 days.

At the end of the study period, 47% (477) of the 1014 horses that underwent exploratory laparotomy had died. Of the horses subjected to a single surgery (419), 86% of the deaths were colic related, whilst the cause of death was colic related in all horses undergoing repeat laparotomy (56).

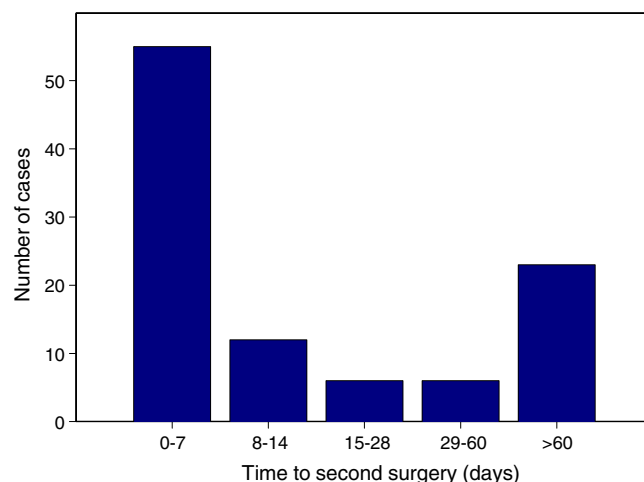


Fig. 1. Time to second surgery. Histogram representing the time interval (days) between surgeries for 99 horses undergoing a second laparotomy. The interval between celiotomies varied from <24 h up to 9 years (mean = 206 days, median = 7 days), with 77% of cases presenting within 2 months of the first surgery.

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