

Clinical assessment and outcome of three techniques for jejunal resection and anastomosis in horses: 59 cases (1989–2000)

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Objective—To compare postoperative complications, short- and long-term survival, and surgical times for hand-sewn end-to-end (EE), stapled functional end-to-end (FEE), and stapled side-to-side (SS) anastomotic techniques for jejunal resection in horses.

Design—Retrospective study.

Animals—59 horses.

Procedure—Medical records were reviewed to obtain signalment, diagnosis, treatment, and outcome for horses that underwent jejunojejunostomy in our hospital. Only horses that recovered from anesthesia were included in the study.

Results—Among the 59 horses, there were 33 EE, 15 FEE, and 11 SS anastomoses. No difference was found in duration of surgery among the 3 techniques. The most common postoperative complications were colic episodes (56%), ileus (53%), diarrhea (20%), and adhesions (15%). Horses with SS anastomosis had a significantly shorter duration of postoperative ileus than the EE group did. No significant difference in duration of postoperative ileus was found among the other groups. No difference was found among the 3 anastomotic techniques in regard to survival rate at the time of discharge, 6 months after surgery, or 1 year after surgery. Overall survival rates after jejunal anastomosis were 88% at the time of discharge, 65% at 6 months after surgery, and 57% at ≥ 1 year after surgery.

Conclusions and Clinical Relevance—The hand-sewn EE, stapled FEE, and stapled SS anastomotic techniques should be considered equivalent methods for small intestinal anastomosis in the horse. However, the stapled SS technique may be preferred because of possible decreased duration of postoperative ileus. (*J Am Vet Med Assoc* 2002;220:215–218)

Small intestinal strangulation in horses is a challenging disorder to treat because of complications following jejunal resection and anastomosis, with high mortality (51%) and morbidity rates.¹ However, results of recent studies^{2,4} indicate better survival rates (91%) following small intestinal resection and anastomosis, possibly attributable to improved surgical and anesthetic techniques and control of ileus and endotoxemia

after surgery. Presently, surgeon preference dictates the surgical technique for small intestinal anastomosis, without supporting evidence in clinical cases that compare differences in postoperative morbidity rates and survival among techniques. Techniques described for small intestinal anastomosis in large animals include hand-sewn end-to-end (EE), stapled EE, stapled side-to-side (SS), stapled functional end-to-end (FEE), and biofragmentable ring anastomosis. Previous studies^{3,5} have compared different experimental small intestinal anastomotic techniques in horses but not in a clinical setting with a large number of horses.

In experiments using horses,³ smaller stomal areas and higher adhesion scores in hand-sewn EE anastomoses were detected, compared with stapled SS anastomoses. Other studies have also revealed increased adhesion formation with hand-sewn EE anastomoses that used interrupted Lembert,⁴ Gambee, or crushing suture patterns,⁵ everting stapled EE anastomoses that used triangulated stapled lines,⁶ and an EE anastomosis that used a biofragmentable ring.^{7,8} In addition to adhesion formation, other complications attributable to anastomotic technique have included incisional leakage,^{9,10} intussusception,^{11,12} and altered intestinal motility.¹³ In previous studies,^{1,2,14} repeat celiotomies were necessary in 10 to 19% of horses after jejunal resection and anastomosis and were most commonly attributable to adhesions.

The purpose of the study reported here was to compare surgical times, postoperative complications, and survival rates for hand-sewn EE, stapled FEE, and stapled SS anastomotic techniques for jejunal resection in the horse. The hypothesis was that stapled anastomoses would have decreased surgical duration, reduced postoperative ileus, and similar survival rates, compared with hand-sewn anastomoses.

Criteria for Selection of Cases

From Jan 1, 1989 to Feb 21, 2000, 59 horses admitted to the Equine Hospital underwent jejunojejunostomy and were recovered from anesthesia. Medical records were evaluated for signalment, diagnosis, surgical technique and duration, length of intestine removed, postoperative treatment, in-hospital complications, and long-term outcome. Owners and referring veterinarians were contacted for long-term follow-up information on survival and complications of colic episodes, incisional infection, or hernia formation.

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Procedures

Surgical techniques—Criteria for selection of a surgical anastomotic technique were based on clinician preference. All procedures were performed by faculty surgeons or surgical residents under faculty supervision.

Hand-sewn EE anastomoses—Hand-sewn EE anastomoses were performed, using 2-0 polyglactin 910^b or polydioxanone^c suture in a simple interrupted, simple continuous, Lembert, or Connell pattern, as described.¹⁴ Continuous patterns were either interrupted halfway at the mesenteric and antimesenteric borders or at quarterly intervals. Some anastomoses were then oversewn with a continuous Lembert or Cushing pattern.

Stapled FEE anastomoses—Stapled FEE anastomoses were performed by first closing the proximal and distal jejunal ends by use of a stapling instrument^d and then oversewing the ends with 2-0 polyglactin 910^b in a continuous Lembert or Cushing pattern. Segments were aligned in antiperistaltic fashion on the antimesenteric border, and sutures were placed as interrupted stay sutures or as a continuous pattern along this border. A 90-mm stoma was created along the apposing antimesenteric surfaces with a stapling instrument^e by placing the instrument through stab incisions made into each segment near the transected ends. The stab incisions were closed with 2-0 polyglactin 910^b in a simple continuous pattern and oversewn with a Cushing pattern. The anastomosis site was either oversewn with a continuous pattern, or further interrupted sutures were placed near the ends of the staple lines to prevent tension on the anastomotic site. The mesentery was closed with 2-0 polyglactin 910^b in a simple continuous pattern and sutured to the serosa of the oversewn jejunal ends.

Stapled SS anastomoses—Stapled SS anastomoses were performed as described for the FEE anastomoses, except that the segments were aligned in an isoperistaltic fashion on the antimesenteric border.

Statistical analyses—A χ^2 or Fisher exact test was performed to determine whether there were differences among the anastomotic groups in age and lesion distribution, survival proportions, and occurrence of postoperative complications, including ileus, colic episodes, repeat laparotomy, incisional complications, and diarrhea. Quantitative comparisons among the 3 groups for resected length of intestine, surgical duration, and duration of postoperative ileus were compared by use of a Kruskal-Wallis test. Survival analysis was performed by use of Kaplan-Meier survival estimates and the Gehan-Wilcoxon test. Significance was set at $P < 0.05$ for all comparisons.

Results

Fifty-nine horses, including 25 castrated males, 12 sexually intact males, and 22 sexually intact females with ages ranging from 2 months to 28 years (median, 14 years), had jejunojunal anastomoses performed during the study period. No difference in age distribution was found among anastomotic groups ($P = 0.663$). There were

14 Thoroughbreds, 10 Quarter Horses, 6 Appaloosas, 6 Arabians, 4 Standardbreds, and 4 mixed-breed horses, with other breeds represented in small numbers. The most common reasons for small intestinal obstruction were strangulating lipoma ($n = 24$), jejunal volvulus (7), adhesions (6), inguinal hernia (4), and mesenteric hernia (3). No difference in frequency of lesion types was found among anastomotic groups ($P = 0.472$).

Among the 59 horses, there were 33 EE, 15 FEE, and 11 SS anastomoses. No difference was found in the length of resected intestine among the EE, FEE, and SS groups ($P = 0.827$). Similarly, no difference was found in duration of surgery among the 3 anastomotic techniques ($P = 0.790$); surgical duration ranged from 2 to 5.5 hours (median, 2.75 hours).

The most common postoperative complications included colic episodes ($n = 33$ [56%]), ileus of 1 to 7 days' duration (26 [53%]), diarrhea (12 [20%]), adhesions (9 [15%]), fever (7 [12%]), tachycardia (4 [7%]), incisional infection (4 [7%]), and peritonitis (4 [7%]). One horse with a FEE anastomosis developed a jejunal intussusception at the anastomosis site 8 months after surgery. Seven (12%) horses with colic or protracted ileus after surgery required a second exploratory celiotomy. No difference was found among anastomotic groups in frequency of horses that developed signs of colic after surgery ($P = 0.280$) or required a second surgery ($P = 0.945$).

Mean duration of ileus after jejunal anastomosis for each group was 2.7 (EE), 1.7 (FEE), and 0.5 days (SS). Horses with SS anastomosis had a significantly ($P = 0.014$) shorter duration of postoperative ileus than the EE group did. No significant difference in duration of postoperative ileus was found between the FEE and EE groups ($P = 0.062$) or the FEE and SS groups ($P = 0.604$).

Overall survival proportions were determined at the time of discharge (52/59 [88%]), 6 months after surgery (31/48 [65%]), and 1 year after surgery (27/47 [57%]). No difference was found among the 3 anastomotic techniques in survival proportions at the time of discharge ($P = 0.396$), 6 months after surgery ($P = 0.324$), or 1 year after surgery ($P = 0.843$). Long-term survival after surgery was estimated for the 3 groups by use of the Kaplan-Meier method (Fig 1). No

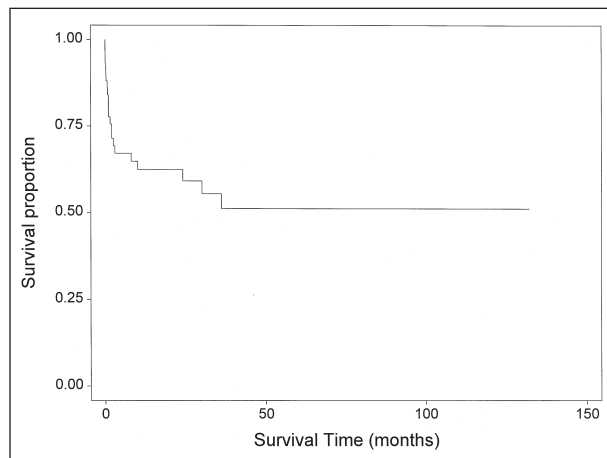


Figure 1—Combined Kaplan-Meier estimated survival rates for horses that underwent a jejunojunostomy ($n = 59$).

significant difference ($P = 0.907$) was found among groups for long-term survival. Similarly, survival outcome for horses that had repeat laparotomies was not significantly different ($P = 0.553$) from that for horses that had only 1 surgery. In addition, the complication of postoperative ileus did not appear to significantly affect survival rates ($P = 0.317$).

Discussion

The hand-sewn EE, stapled FEE, and stapled SS anastomotic techniques resulted in similar surgical duration, postoperative complications, and survival rates. Baxter et al² also found no difference in surgical times between the sutured EE and stapled SS anastomoses, although previous studies^{6,15} have touted decreased surgical times as an advantage for stapled anastomoses. Oversewing the jejunal ends and the anastomosis site may have contributed to longer surgery times in the stapled anastomoses.

The most common postoperative complications found in the horses of this study (colic, ileus, diarrhea, and adhesions) as well as the number of horses needing repeat laparotomy were similar to those reported after small intestinal resection and anastomosis.^{1,2,14,a} However, the ventral midline incisional infection rate, reported in as many as 23% of horses after small intestinal resection, was lower in our study (7%). This lower infection rate may be attributable to improved antimicrobials, suture material, or surgical aseptic techniques since the earlier study. Alternatively, the retrospective determination of incisional infections in our study may have underestimated the actual infection rate.

Despite similar complication rates among the 3 anastomotic techniques, the SS technique appeared to result in decreased duration of postoperative ileus, compared with the hand-sewn EE technique. However, because of the small number of horses in the SS group, this difference requires further investigation to be conclusive. Differences in the duration of postoperative ileus may be attributable to increased stoma size in stapled anastomoses, compared with EE anastomoses. However, in our study, the FEE anastomosis did not have as substantial an effect on postoperative ileus as the SS anastomosis did, despite having the same stapled-stoma size as the SS anastomosis. Conceivably, isoperistaltic orientation of the SS, compared with the antiperistaltic orientation of the FEE, may be contributory to this finding. In another study,² shorter duration of postoperative ileus after hand-sewn EE anastomosis was reported. It is possible that our data were biased by surgeon experience, and results may suggest that stapled anastomoses were less likely to be associated with surgical errors than hand-sewn anastomoses were. This potential for surgical bias is certainly a limitation of this type of study, in which surgeon experience and number of surgeons have not been controlled.

Other complications after stapled FEE, stapled SS, and hand-sewn EE anastomoses have been reported,^{9,11-13} including jejunal intussusception, anastomotic leakage, and altered bacterial flora. Jejunojejunal intussusception has been reported in 2 ponies after FEE anastomosis, which was attributed to the oversewn inverted end of the jejunum acting as a lead point for the intussuscep-

tion¹¹; this complication was also found in a horse in our study 8 months after the FEE anastomosis. That horse had intermittent bouts of colic after surgery and was finally euthanized after a severe episode. We have modified our FEE anastomosis by no longer oversewing the transected end and, instead, covering the everted stapled mucosa with a mesenteric fold. An alternate technique for FEE anastomosis has been described, which may prevent intussusception at the anastomosis site by eliminating the jejunal stump and creating a circular stoma.¹⁰ In that technique, the stapled anastomosis is performed first, followed by linear stapling and resection across the end of the anastomosis, resulting in everted mucosa and no jejunal stumps. Although no important adhesions or strictures were found after surgery, 1 horse had failure of the anastomotic staple line along the antimesenteric border of the FEE anastomosis.

The overall survival rate at the time of discharge from our hospital (88%) was similar to recently reported survival rates (91%) for clinical cases involving horses with stapled SS and hand-sewn EE jejunal anastomoses.^{2,a} Our long-term survival rate (57%) was also comparable to those reported recently (47 to 68%).^{2,16} Results of these studies confirm a better short- and long-term prognosis after jejunal anastomoses than previously reported (49 and 24%, respectively).¹ In that study, horses with stapled SS anastomoses appeared to have better survival times (median, 136 days) than those with hand-sutured anastomoses (median, 14 days). Unfortunately, those data were confounded by being performed prior to 1980 (hand-sutured EE) or after 1980 (stapled SS), leading to potential differences in survival times attributable to other factors (eg, improved anesthetic and surgical techniques, earlier referral, better postoperative supportive care).¹ Our data did not support a difference in survival times between stapled and hand-sewn techniques. We also did not detect a significant effect of repeat laparotomy on survival rate, as has been reported.² This may be attributable to the choice of euthanasia rather than a second laparotomy, resulting in fewer repeat laparotomies in our study.

^aDoran RE, Allen D, Baxter GJ, et al. Clinical results of a stapled side-to-side jejunojejunostomy in 22 horses (abstr). *Vet Surg* 1990;19:62.

^bVicryl, Ethicon Inc, Somerville, NJ.

^cPDS, Ethicon Inc, Somerville, NJ.

^dTA Premium 90, US Surgical Corp, Norwalk, Conn.

^eGIA 90 Premium, US Surgical Corp, Norwalk, Conn.

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