Transrectal Stapling for Colonic Resection and Anastomosis (10 Cases)

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Abstract

The purpose of this retrospective study was to determine the feasibility of using the end-to-end anastomosis (EEA) stapling device transrectally for managing distal colonic disease in clinical veterinary cases. Ten animals met the criteria of having distal colonic or rectal resection and anastomosis with the EEA stapling device. The only complications seen after discharge from the hospital were colonic stricture at the anastomosis site in two animals and transient colitis in two animals. The stapled anastomosis has good success when properly applied, and the incidences of stricture formation, leakage, and other potential complications can be kept to a minimum.

Introduction

Surgical stapling has been used as a technique since the early 1900s. In the 1950s, major advancements were made by the Soviet Union with the development of a broad range of surgical stapling devices.[1,2] These devices served as models for the wide array of lightweight, presterilized, and preloaded devices used today.[1,2] They are now available with disposable and easy-load cartridges and are currently used in veterinary and human medicine.[1,2] Surgical stapling provides a high level of consistency when compared to conventional hand-sewn techniques, although a learning curve is involved in their successful application.[1,2]

The end-to-end anastomosis (EEA)[a] stapler is one example of a surgical stapling device. The EEA stapler is a long, tubular instrument that performs a circular anastomosis of hollow viscus. It contains a circular cartridge and places a circumferential double row of staples that creates an inverting anastomosis. A circular blade excises a ring of tissue from each end, creating a new lumen.[3] The EEA stapler is produced in 21-, 25-, 28-, and 31-mm diameter sizes to facilitate its application in most sizes of dogs and cats.[4] The most common applications in human and veterinary patients are colorectal anastomosis, end-to-side gastroduodenostomy (Billroth I), end-to-side gastroesophageal anastomosis, esophageal anastomosis, and colonic anastomosis.[3] To the authors' knowledge, the EEA stapler has not been reported for clinical use in resection and transrectal anastomosis in dogs and cats. The purpose of this study was to evaluate a stapling technique, commonly used in human medicine, for its feasibility of managing diseases of the distal colon and proximal rectum in veterinary cases.

Materials and Methods

Medical records from the Veterinary Specialty Hospital of San Diego from 1990 to 2003 were reviewed for animals undergoing distal colonic or rectal resection and anastomoses with the EEA stapling device. Ten animals met the criteria of having caudal colonic or proximal rectal resection and anastomosis with the EEA stapler. All animals were presented to the surgical service for excision of abnormal tissue located in the distal colon or proximal rectum. These animals either had masses too distal in the pelvic canal for colonic or rectal resection and handsewn anastomosis through a single abdominal approach, or they had masses that could not be resected utilizing a rectal pull-through technique. Other techniques that have been described for treating disease within the pelvic canal include the full-thickness rectal pull through, the dorsal approach to the rectum, and an approach via a pubic osteotomy. The surgeons in this study preferred to perform the resection and anastomosis with the EEA stapler rather than use the previously described techniques, because the surgical time and morbidity to the animal could potentially be decreased.

Some animals were assessed initially with digital and colonoscopic examinations performed under general anesthesia in order to identify the level of pathology and to obtain biopsy samples. The remaining animals were admitted 1 day preoperatively for mechanical bowel preparation with three administrations of GoLYTELY[b] and warm-water enemas. Colonoscopies were performed in those animals, and surgeons determined that the masses could not be removed with the rectal pull-through technique; the animals were then taken directly to surgery. A first-generation cephalosporin was administered with induction of anesthesia, and general endotracheal anesthesia was maintained. Cefazolin was chosen because of its broad spectrum of activity against aerobes and especially anaerobes, as well as its prolonged duration of activity and minimal cost.[4] Each animal was positioned in dorsal recumbency with the anus positioned at the edge of the operating table to facilitate insertion of the stapler into the rectum. The surgical procedure for the transrectal colonic resection and anastomosis began with routine abdominal preparation and an abdominal midline incision to the level of the pubis. Extending the incision caudally to the level of the pubic symphysis was extremely important to facilitate visualization. The abdomen was explored for evidence of metastatic disease. Each animal had diseased portions of the distal colon or proximal rectum. The exact amount of tissue removed was not measured. The affected area of the colon or rectum was identified by palpation, and the vascular pedicles were ligated and transected with either a Ligate Divide Stapler (LDS)[6] or by ligation with absorbable sutures. Both ureters were identified and gently protected, and the remaining abdominal contents and bladder were retracted with the use of malleable retractors. The colonic contents were milked proximal to the area to be resected and digitally maintained. A linear cutting stapling device, Gastrointestinal Anastomosis Stapler,[c] or a linear noncutting Thoracoabdominal Stapler[d] was used at the peritoneal reflection for transection of the caudal aspect of the colon or proximal rectum to be resected [Figure 1]. Noncrushing forceps were placed orad to the proximal site of transection, and Carmalt forceps were placed distal to the site. The proximal resection site was transected, and a special purse-string instrument (i.e., Furniss clamp) or Autosuture Purse-String Device[e] was placed on the proximal colon [Figure 2].[4] Placing the purse-string instrument evenly across the colon to allow even placement of the anvil and shaft was important to allow a successful anastomosis [Figure 3]. The remaining portion of the diseased tissue was removed from the abdomen.

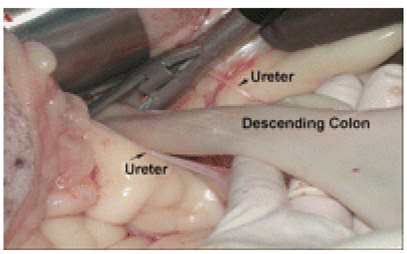

Figure 1— The linear noncutting Thoracoabdominal Stapler[d] is placed at the distal extent of the tissue to be resected. Note the identification of the ureters and the malleable retractor that is retracting the urinary bladder caudally.

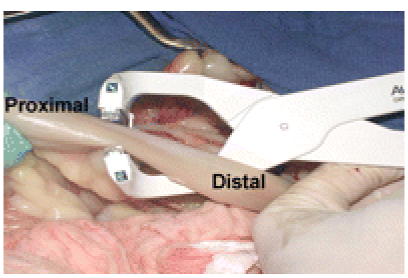

Figure 2— The colonic contents are milked proximally, and the Autosuture Purse-String Device[e] is placed and discharged perpendicular across the colon.

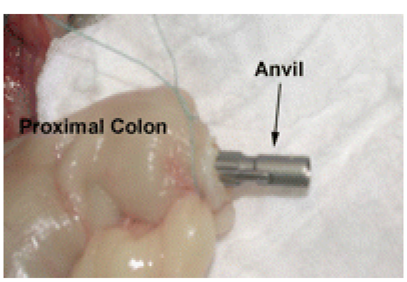

Figure 3— The anvil of the end-to-end anastomosis (EEA) stapler is placed in the proximal segment, and the purse string is tied. Note the end of the anvil protruding from the lumen.

The correct diameter of the EEA stapler selected was passed on a visual judgment at the time of surgery. The largest diameter that would maximize the colonic diameter without causing serosal tearing was chosen. The anvil for the EEA stapling device was placed in the proximal bowel, and the purse string was tied. The shaft of the circular stapler was lubricated well with water-soluble, sterile lubricant and was inserted transanally and manipulated to the level of the distal staple line [Figure 4]. The stapler was opened, allowing the plastic spike to penetrate the distal bowel at or near the midportion of the staple line. The spike was removed, and the orientation of the proximal and distal segments was checked. Once the shaft was inserted into the anvil, the wing nut on the stapler was closed until the reference markers on the device were aligned. This alignment indicated proper tension at the site, and the instrument was then discharged. The instrument was removed from the rectum, and two tissue rings were removed from the anvil [Figure 5].[4]

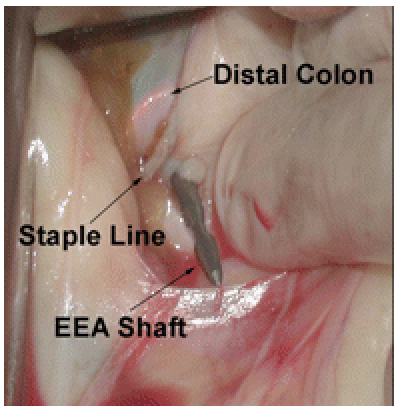

Figure 4— The shaft of the EEA stapler is inserted through the anus, and the spike is advanced next to the staple line through the rectal/distal colonic tissue.

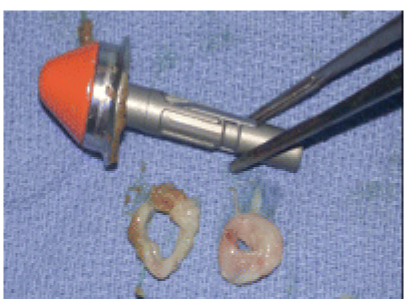

Figure 5— The discharged anvil of the EEA stapler is removed, and the two donut tissue rings are from the proximal and distal tissue margins.

These tissue rings should comprise all layers of the colon and be completely circular pieces of tissue. These pieces of tissue should be submitted for proximal and distal margins. An omental patch was then placed around the site for additional protection. Animals were offered water 12 hours after recovery from anesthesia, and if water was tolerated, solid food was offered on the first day postoperatively. Animals were rechecked 7 and 14 days postoperatively. At these times, rectal palpation was performed to evaluate the anastomosis site.

Results

All animals were evaluated for evidence of metastasis preoperatively by means of complete blood count, serum biochemical analysis, three-view thoracic radiographs, and abdominal ultrasound. Of the animals in the study, eight were dogs and two were cats. The breeds of dogs represented were boxer, pit bull terrier, cocker spaniel, golden retriever, Alaskan malamute, Dalmatian, Labrador retriever mix, and Shetland sheepdog. Both cats were domestic shorthairs. Four of the dogs were female, and four were male; one cat was female, and the other was male. All animals were spayed or neutered. The ages of the animals at the time of the surgical procedure ranged from 2 to 12 years (median age 10 years) for the dogs and 11 and 15 years for the two cats. Preoperative diagnoses for five of the 10 animals (four dogs and one cat) were obtained by either a fine-needle aspirate or biopsy via colonoscopy. The preoperative diagnoses were benign polyp (n=3), epithelial cell tumor of unknown origin, and adenocarcinoma. For the five animals without preoperative diagnoses, rectal palpation revealed that the masses either had a broad base of attachment or extended too far cranial to be removed with margins through the rectal pullthrough technique. Postoperative histopathology results for all 10 animals were available, but tissue margins were evaluated in only seven cases because of improper labeling of the margins. These diagnoses were adenocarcinoma (n=3), polypoid adenoma (n=4), mast cell tumor, transmural hemorrhage/ hematoma, and histiocytic ulcerative colitis. In one case, surgical biopsy changed the diagnosis from benign polyp to adenocarcinoma [see Table].

All but one of the animals survived the immediate post-operative period. An 11-year-old, spayed female Shetland sheepdog died from cardiopulmonary arrest 6 hours after completion of the surgical procedure. The dog had no preoperative physical abnormalities, and no issues or abnormalities were noted in the anesthetic report to indicate the cause of the arrest. A necropsy was not performed on this animal, but a diagnosis of adenocarcinoma was made.

Complications after discharge occurred in four cases, resulting in a total complication rate of five (50%) of 10. The complications seen after discharge from the hospital were colonic stricture at the anastomosis site in two cases and transient colitis in two cases. Animals were examined 1 and 2 weeks postoperatively with a digital rectal examination to check for stricture. In the two cases with transient colitis, signs lasted up to 4 weeks and were treated medically with a bland diet and metronidazole (10 mg/kg per os [PO] *q* 12 hours). The colitis resolved in both of these cases.

One of the animals that developed a stricture after surgery was the 7-year-old golden retriever. The stricture was identified by digital rectal examination 1 week postoperatively. A combination of digital dilatation and 20-mm balloon dilatation was used at that visit, and 1 week later the stricture had resolved. The other animal that developed a stricture was the 15-year-old cat. The stricture in this cat was identified at the 2-week recheck examination. The cat had repeated manual digital dilatation at weekly intervals 2, 3, and 4 weeks postoperatively. The clinician thought that the stricture was adequately dilated digitally and opted not to use balloon dilatation. On the 4th week, a triamcinolone transmucosal injection was performed. The cat developed septic peritonitis and died 5 days later. Determining if the digital dilatation or the steroid injection was responsible for the septic peritonitis was not possible, because the cat was taken to another facility and no necropsy was performed. The overall mortality rate for this procedure was two (20%) out of 10.

Discussion

Transrectal use of the EEA stapler has an application in veterinary medicine. Advantages to the use of stapling instruments are many, as long as the potential complications can be kept to a minimum. The EEAstapler creates a true inverting anastomosis by the use of B-shaped staples that are staggered in a double row. An inverting anastomosis has been shown to either maintain or decrease the lumen diameter, but without any reported complications arising from a stricture by using the EEA stapler.[5,6] An inverting anastomosis has not been shown to carry any advantages over an appositional pattern.[7-9] The staples provide hemostasis without collapsing the microcirculation, by allowing blood flow between the openings and around the individual staples.[10]

Other major advantages to using surgical staplers are the consistent mechanical accuracy of tissue approximation, a decrease in the surgical time, precision and neatness of the procedure, and a decrease in the risk of contamination from intestinal contents.[1,11] When compared to sutured anastomoses, stapled anastomoses of the colon have a higher bursting pressure during the early lag phase of healing and a higher tensile strength after 7 days. The double row of staples increases the mechanical strength, while the spatial alignment assures equal tension to the anastomosis site. Stapled anastomoses withstand higher pressures before disruption than sutured anastomoses.[12] When using the EEA stapler, the two donut rings of tissue are invaluable, because one can visually determine whether the staples have engaged the entire tissue thickness of each bowel wall. Tissue samples should be submitted for histopathology to determine clean margins in cases of neoplasia.[10] Although preoperative diagnosis was only made in 50% of the cases, it is still highly recommended. The preoperative diagnosis may change treatment from more of a surgical to a medical approach, like in the case of lymphoma. Surgical times were not available for all the procedures, so comparing surgical times between hand-sewn and stapled anastomoses could not be done in this study.

Other methods for removing masses from the rectum and descending colon include colonoscopic removal via a cautery snare, which allows removal of masses from the layer of the submucosa. The size of the base of the mass and the ability of the endoscopist are limiting factors to this procedure. Large sessile masses invading the muscular layer of the colon and rectum cannot be removed by snare excision without risk of perforation. Other techniques used for addressing distal colon and rectal masses include the rectal pull-through technique, pubic osteotomy, and a dorsal approach to the pelvic canal. In the rectal pull-through technique, potential complications include severe hemorrhage, incisional dehiscence, stricture, and incontinence. This technique is limited to abnormal tissue in the middle and caudal rectum by the tension created on rectal vessels.[13] With the ventral approach, a pubic symphysiotomy or a pubic osteotomy can be performed. This approach allows exposure to the proximal and midrectum and allows access to the ventral and dorsal portions of the tissue for a resection and anastomosis. The detachment of the pubic segment may increase the susceptibility of the bone to infection and sequestrum formation.[13] The dorsal approach to the rectum allows exposure of the rectum through transection of the rectococcygeus muscles and possibly the levator ani muscles. Damage to the pelvic plexus nerves can potentially occur, which can result in fecal incontinence.[13] Distal colonic and rectal resection with transrectal stapled anastomosis can be used for masses that are too large or located too proximal in the pelvic canal to be managed with these traditional techniques; also, possible complications from the previously described techniques can be avoided.

Distal colonic and rectal resection and transanal stapling with the EEA stapler is a procedure that has been used for many years in human medicine. Studies have shown that imperfections at the anastomosis site leading to leakage and stricture are the major complications. In one study,[14] these complications occurred in three (23%) of 13 cases, and the morbidity rates observed were similar to those of this current study. Asimilar application of the EEAstapler has been described with good success in the surgical treatment of megacolon in feline cases. The study describes using the stapler through a transcecal approach, which has the advantage of a single surgical field application and the possibility of a decreased risk of contamination.[5] In the authors' study, no incidence of infection thought to be related to the surgical procedure was seen in the immediate postoperative period.

Stricture formation is a complication from this procedure that was seen in two of this study's 10 cases. No evidence of leakage was seen on physical examination in either of the cases prior to the stricture formation. In colonic resection and anastomosis, colonic stricture forms as either a membranous tissue or stricture of the anastomosis site with scar tissue. Stricture formation has been proposed to be caused from different factors such as lack of blood supply, tension, surgical technique, and postoperative management. A study on beagles found that clinically relevant ischemia does not directly influence stricture formation in either hand-sewn or stapled distal colonic anastomoses, even though transrectal stapling demonstrated that circular stapling reduced blood flow less than hand-sewn anastomoses.[16] In another study of 12 dogs, two colonic anastomoses were performed with the EEAstapler. Intestinal contents were not allowed to pass through one of the anastomosis sites, but they were allowed to pass through the other. On the 28th postoperative day, the anastomoses made with the EEA stapler that were not in contact with feces developed significantly more strictures than those where feces were present.[16] Therefore, feces in the colon are important in preventing stricture formation by preventing the healing anastomosis site from forming scar tissue across the lumen.

Tension at the anastomosis site can be minimized through good surgical technique and tissue handling. Blood supply to the colon and rectum must be preserved by keeping the caudal mesenteric and middle and caudal rectal arteries intact. If the cranial rectal artery is ligated in dogs, most of the intrapelvic rectum should be resected in order to prevent tissue necrosis at the anastomosis site.[17] The descending mesocolon can be transected to decrease tension and allow maneuverability to the descending colon. Gentle manipulation and blunt digital dissection can be performed on the mesorectum to allow isolation and decrease tension on the rectum.

No similar studies comparing stapled anastomosis techniques in the colon in clinical veterinary medicine are currently available in the literature. Good results have been reported with a single surgical field approach for colonic resection in 15 cats with megacolon;[5] the report did not evaluate a dual-field surgical technique or describe removal of a portion of the rectum. In the human literature, a few reports have described studies performed on dogs to evaluate colonic stapling for the intended use in human colorectal surgery. An experimental study of 53 dogs to determine how blood flow in colonic anastomosis affected stricture formation demonstrated no clinical anastomotic leaks and no intra-abdominal abscesses with either hand-sewn or stapled anastomoses.[15] A similar study was performed on 11 normal dogs showing no clinical evidence of leaks when the EEA stapling device was used for colonic resection and transrectal anastomosis.[18] These were all checked with Gastrografin enemas 7 and 10 days postoperatively.[18] Another experimental study compared sutured and stapled anastomoses in greyhounds; anastomotic dehiscence occurred in eight of the 20 sutured and in one of the 19 stapled anastomoses.[12] A study on 60 human patients with either hand-sewn or stapled anastomosis for rectal carcinoma showed similar complications in each group.[19] Dehiscence related to the surgical technique was not seen in any of the animals of the authors' study, except when it was a complication of stricture formation.

Postoperative hospitalization time can also be considered an advantage to this technique. All the animals in this study were discharged within 48 hours of their surgeries. This would help to decrease hospital and owner costs. In a veterinary study using the pubic osteotomy for visualization of intrapelvic neoplasia, the animals were hospitalized 96 to 120 hours with exercise restriction for 6 weeks.[20] Animals in the authors' study had exercise restriction until suture/staple removal 10 to 14 days postoperatively; therefore, their postoperative recovery times were shorter, allowing for a quicker return to normal activity.

In the authors' study, stricture and hematochezia were the most common postoperative complications. The hematochezia resolved with medical treatment, while the stricture treatment consisted of balloon and digital dilatation as well as intraluminal steroid administration. The 20% stricture rate does seem high in this study, and recommendations to decrease this incidence would be to select the most appropriate EEA stapler diameter to maximize the lumen. Another suggestion would be to perform colonoscopy days to a week prior to the surgical procedure. Colonoscopy requires bowel preparation, which keeps the lumen devoid of feces for a period of time postoperatively. In the animals with stricture formation, colonoscopic removal of the masses was attempted. The masses were too large or they encompassed too much tissue to be removed through the colonoscopy or a rectal pull-through technique, so the animals were taken directly into surgery where the resections and anastomoses were performed. Having feces present in the colon postoperatively may have been beneficial.

A 20% postoperative stricture rate seems to be slightly higher than rates reported previously for hand-sewn and stapled anastomoses.[15,21,22] This study carries a low power because of the small number of cases. The complication rate could easily be moved in a positive or negative direction with just a few more cases. Both the human and veterinary literature contain many reports on complication rates involving sutured versus stapled anastomoses, and results vary. In the human literature, a study on dogs compared sutured anastomoses, stapled anastomoses, and biofragmentable rings, and the highest stricture rate was found in the sutured group.[21] The most comprehensive studies have been performed on human patients, with meta-analyses on patients with colorectal surgery and comparisons between sutured and stapled anastomoses that have similar survival rates and outcomes; results showed an increased rate of stricture with the stapled anastomoses.[22,23] Interestingly, when comparing results between humans and dogs, the findings are opposite. Based upon these results, the authors recommend leaving the judgment of using a hand-sewn or stapled anastomosis up to the clinician and his or her comfort level with the devices.

Conclusion

This technique has clinical application to the veterinary surgeon for management of disease within the pelvic canal. The stapled anastomosis has good success when properly applied, and the incidence of stricture formation, leakage, and other potential complications can be kept to a minimum with attention to good surgical technique. The stapled anastomosis is also invaluable for evaluating tissue margins and minimizing hospitalization and surgical times. The application of this surgical technique is a useful alternative to other techniques described for treating caudal colonic and proximal rectal disease.

Footnotes

[a] End-to-End Anastomosis Stapler; United States Surgical Corporation, Norwalk, CT 06856

[b] GoLYTELY; Braintree Laboratories, Inc., Braintree, MA 02185

[c] Gastrointestinal Anastomosis Stapler; United States Surgical Corporation, Norwalk, CT 06856

[d] Thoracoabdominal Stapler; United States Surgical Corporation, Norwalk, CT 06856

[e] Autosuture Purse-String Device; United States Surgical Corporation, Norwalk, CT 06856

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