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2014 SSAT POSTER PRESENTATION

Endoscopy in the Early Postoperative Setting after Primary Gastrointestinal Anastomosis

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Abstract
Introduction Gastrointestinal anastomoses may require early evaluation and treatment via flexible endoscopic techniques when complications arise. There is reticence, however, to perform endoscopy given the applied mechanical forces. We aimed to identify the incidence of gastrointestinal anastomotic perforation or disruption resulting from endoscopy performed ≤6 weeks of anastomoses.
Methods Review of patients from 2002 to 2013 who underwent flexible endoscopy within 6 weeks of creation of gastrointestinal anastomosis. Exclusion criteria included intraoperative endoscopy, anastomotic perforation prior to endoscopy, and endoscopy remote from the anastomotic site. Data are presented as median (interquartile range; IQR) or percentages as appropriate.
Results Twenty-four patients met our criteria (age 69 years [IQR 54–77], 54 % men]). Endoscopy was performed at a median postoperative time of 18 days (IQR 8–30). Indications for endoscopy included bleeding (66 %), obstruction (13 %), pain (13 %), concern for pancreatic duct leak (4 %), and concern for ischemia (4 %). Six patients underwent therapeutic endoscopic procedures including coagulation (8 %), balloon dilation (8 %), tube decompression (8 %), and stent placement (4 %). There were no anastomotic perforations or disruptions as a result of endoscopy.
Conclusion Despite theoretical risks of adverse events of flexible endoscopy in the early postoperative period, no endoscopic perforations or disruptions occurred in recently created surgical anastomoses.

Keywords Gastrointestinal anastomosis · Endoscopy · Anastomotic dehiscence · Healing · Collagen

Introduction

Gastrointestinal (GI) anastomoses are a frequent surgical procedure in the United States.[1] Complications after GI anastomoses confer morbidity and mortality and with substantial social and economic burdens.[2–4] These complications, including anastomotic bleeding, obstruction, stricture, and dehiscence, can potentially be evaluated and corrected by endoscopic techniques.[2,4,5] Evaluation of anastomotic integrity by means of flexible endoscopy allows complete visualization of the anastomosis, providing information about patency, viability, and bleeding. In addition, endoscopic techniques can be used to treat anastomotic leak or narrowing.[6–9] Unfortunately, there are risks associated with endoscopy. The combination of air insufflation, local endoscope trauma, and torque lead to increased mechanical tension on the anastomosis. This tension is paramount as the newly created anastomosis is progressing through stages of wound healing and is, therefore, uniformly weaker than native tissue. Maximum tensile strength is not attained until at least 4 weeks after creation.[10] Surgeons are weary, therefore, of endoscopic evaluation of these fresh and fragile anastomoses.

Likely as a result of this hesitancy, there are few data to either support or refute endoscopy in the early postoperative

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period. Studies of intraoperative and early postoperative endoscopic evaluation of Roux-en-Y gastric bypass (RYGB) have shown promise, as early endoscopy was found to be safe and effective for diagnosing and treating anastomotic leaks.[11–14] Postoperative endoscopy of other anastomoses, however, has not been studied thoroughly. Given the potential benefits offered by flexible endoscopy, we aimed to evaluate outcomes of early postoperative endoscopy within 6 weeks of GI anastomosis at our institution where more than 20,000 endoscopies are performed annually.[15] We hypothesized that there would be minimal risk of anastomotic dehiscence following endoscopic procedures.

Materials and Methods

Following Institutional Review Board approval, patients who underwent endoscopic evaluation ≤6 weeks from creation of a GI anastomosis between 2002 and 2013 were identified for inclusion using the Mayo Clinic Life Sciences Services/Data Discovery Query Builder (MCLSS/DDQB). The MCLSS/DDQB is a web-based repository containing billing data for our institution since 1997 and clinical patient records since 1994. It is maintained collaboratively with IBM® by dedicated information technologists, regularly audited, and validated in the literature as accurate for ICD-9 searches.[16,17] The DDQB was queried for ICD-9 codes for intestinal anastomoses (44.5, 42.63, 42.65, 42.68, 42.53, 42.55, 42.58, and 45.90–45.94) with the addition of ICD-9 codes for endoscopic procedures (45.12, 45.13, and 45.22–45.29). Additionally, formal review of all identified patients' clinical charts was conducted to verify the presence of endoscopy within 6 week of a GI anastomosis. Patients were excluded if the endoscopic evaluation was intraoperative, if there was evidence of anastomotic perforation prior to endoscopy, or if the endoscopy was remote from the anastomotic site (i.e., esophagogastroduodenoscopy [EGD] after colonic anastomosis or colonoscopy after upper GI anastomosis).

Data were retrospectively collected using a standardized data collection form and included demographics, preoperative diagnosis, chronic steroids use, operative information, type of operation, type and location of anastomosis, date of endoscopy, type of endoscopy, endoscopic findings, endoscopic indication, and post-endoscopic complications. Indications for endoscopy included clinical concern for GI bleeding, intestinal obstruction, intestinal ischemia, abdominal pain, and pancreatic duct leak. Endoscopic findings of interest included suture or staple line anastomotic bleeding, anastomotic ulcers, anastomotic narrowing or stricture, anastomotic dehiscence, or a normal healing anastomosis. It was also noted if the anastomosis was visualized and traversed, visualized only, or not visualized. Anastomotic dehiscence or leak following endoscopy was the primary outcome. Patients' comorbidities were identified using Charlson comorbidity index.[18] Analysis of distribution was performed with continuous variables data presented as median and interquartile ranges (IQR) and categorical variables presented as percentages.

Results

There were 11,578 patients identified who underwent GI anastomosis in our institution during the study period, of whom 47 (0.4 %) underwent a postoperative endoscopic procedure. Of these, 23 were excluded as the procedure was remote from the anastomosis. Therefore, 24 (0.2 %) patients were included in this analysis. The median age was 64 years [IQR 58–72] and 54 % were male. Median time from index operation to endoscopy was 18 days [IQR 8–30]. Ten patients (42 %) had a repeat endoscopy, with a median time between endoscopies of 52 [IQR 30–94]. The median Charlson comorbidity score was 6.5 [IQR 2.25–10]. Six patients (25 %) were chronic steroid users preoperatively. Operative indications for the index procedure included cancer (38 %, $n=9$), bowel obstruction (29 %, $n=7$), perforation (8 %, $n=2$), bleeding diverticulosis (8 %, $n=2$), arteriovenous malformation (AVM, 8 %, $n=2$), mesenteric ischemia (4 %, $n=1$), inflammatory bowel disease (4 %, $n=1$), and reversal of Roux-en-Y gastric bypass (4 %, $n=1$). The index operation was performed laparoscopically in 8 % of patients, with the remaining index procedures performed in an open fashion. A total of 33 anastomoses were performed in the 24 patients (11 small intestinal, 8 colocolic, 5 ileocolic, 3 esophagogastric, 2 gastrojejunal, 2 jejunocolic, 1 gastrocolic, 1 bilioduodenal). Of these, 66 % were stapled and 33 % were hand sewn.

Indications for postoperative endoscopy included upper or lower GI bleeding (66 %), obstruction (13 %), persistent postoperative abdominal pain (13 %), concern for pancreatic duct leak (4 %), and concern for ischemia (4 %; Fig. 1). Sixteen patients (67 %) underwent lower endoscopy (38 % colonoscopy and 29 % sigmoidoscopy), 7 patients (33 %) underwent EGD, and 1 patient underwent endoscopic retrograde cholangiopancreatography (ERCP). The anastomosis was completely visualized and traversed in 71 % of the endoscopic procedures, while the remaining anastomoses were not visualized, but the endoscope was passed in close proximity to the site of anastomosis. Endoscopic findings included patent anastomosis with no abnormalities (29 %), ulceration at the anastomotic site with or without bleeding (17 %), bleeding suture/staple line (8 %), stricture/stenosis at the anastomosis site (4 %), ischemic changes with edema and hyperemia (4 %), AVM (4 %), and pancreatic duct leak (4 %; Fig. 2). Six patients underwent therapeutic endoscopic procedures including coagulation (8 %, $n=2$), tube decompression (8 %, $n=2$), balloon dilation (4 %, $n=1$), and stent placement (4 %, $n=1$). The index procedures and anastomoses,

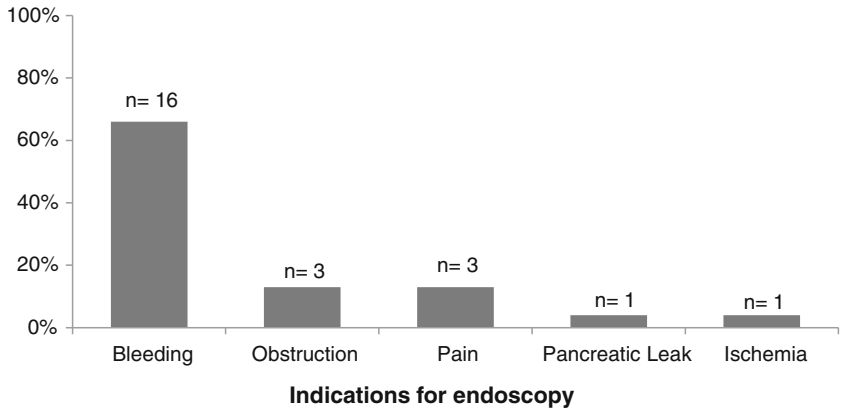

Fig. 1 The endoscopy findings in the immediate postoperative period (within 6 weeks) included patent anastomosis, bleeding suture/staple line, anastomosis site ulceration with or without bleeding, arteriovenous malformation (AVM), ischemic changes with edema and hyperemia, stenosis and stricture at the anastomosis site, and pancreatic duct leak. The endoscope was not able to visualize the rest of the anastomoses but was in close proximity

indications for endoscopy, endoscopic findings, and interventions for all 24 patients are shown in Table 1.

The earliest endoscopy was performed two days postoperatively and performed in two patients. The first was a sigmoidoscopy performed for suspected ischemia after ileocecal resection with stapled ileocolic anastomosis. Because the anastomosis was viable, an unnecessary return to the operating room was avoided. The second was a colonoscopy performed for persistent postoperative pain after a hand sewn ileocolonic anastomosis; the anastomosis was patent and a colonic decompression tube was inserted to relieve his symptoms. The endoscopic procedure most distant in timing from the anastomosis creation was an EGD performed 42 days after an end-to-end, hand-sewn duodenojejunostomy following resection of a duodenal AVM. The indication was postoperative upper GI bleeding and revealed an additional AVM proximal to the anastomotic site. There were no post-endoscopic complications identified including anastomotic dehiscence. The mortality rate within the 6-week postoperative period was 8 %; however, neither death was related to the endoscopic procedure.

Discussion

Despite the diagnostic and therapeutic benefits offered by early endoscopic evaluation of GI anastomoses, hesitancy exists due to the theoretical risk of damage to healing tissue. This has resulted in a paucity of literature weighing the risks and benefits of post-anastomotic endoscopy. The only existing study of early endoscopic evaluation of anastomoses not limited to RYGB is from 1981 by Waldmann et al.[19] Though the authors did not find any complications of endoscopy, the postoperative timing of endoscopy was not available and the most common indication for endoscopy was insertion of an intestinal tube, a clear departure from current practice. In this study, we report a series of 33 GI anastomoses in 24 patients which were evaluated by endoscopy within 6 weeks of creation. No endoscopic complications occurred. Furthermore, patients benefited from endoscopic diagnosis and treatment of anastomotic complications. Many avoided more invasive surgical procedures for definitive diagnosis or treatment. When endoscopic treatment of an anastomotic complication was not possible, endoscopy facilitated timely revision of the anastomosis.

Fig. 2 Postoperative day (POD) after which the endoscopy was performed ranging between 2 to 42, with a median time from index operation to endoscopy of 18 days [IQR 8–30]

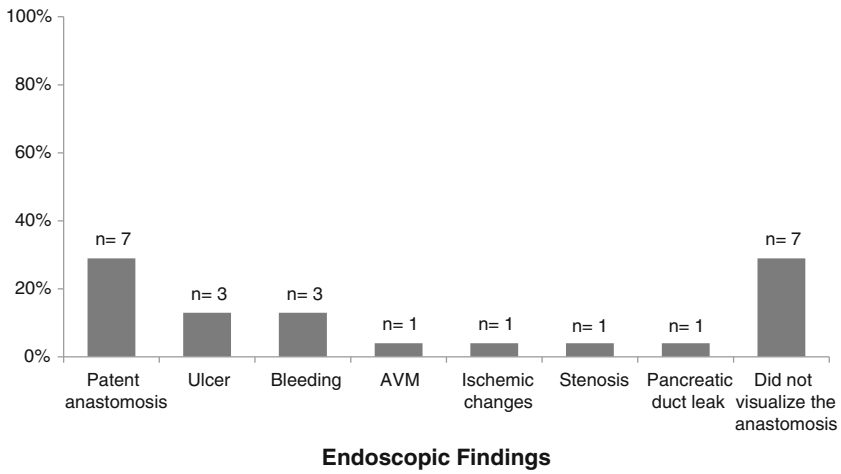

Table 1 List of patients outlining surgical and endoscopic data

Patient	Age/ sex	Diagnosis	Anastomosis type	POD	Endoscopy	Indication	Anastomotic findings	Therapy
1	87 M	SBO	Jejunojejunostomy (St)	17	Colonoscopy[a]	LGI bleeding	None	None
2	52 F	Reversal of RYGB due to postprandial hypoglycemia	Esophagogastrostomy (St) and jejunojejunostomy (St)	13	EGD	Vomiting	Patent anastomosis	NG/NJ tube placement
3	88 M	Perforated colon and duodenum	Gastrojejunostomy (St) and colocolic (St)	18	EGD	LGI bleeding	Ulcer	None
4	60 M	Esophageal Ca	Esophagocolostomy (St) and colojejunostomy (St)	42	EGD	Esophageal stenosis	Stenosis	Balloon dilatation
5	71 M	Esophageal Ca and small bowel ischemia	Esophagogastric (St) and jejunojejunostomy (St)	36	EGD	LGI bleeding	Ulcer	None
6	81 M	Diverticulosis and intraabdominal abscess	Jejunojejunostomy (St) and colocolic (St)	8	Colonoscopy	LGI bleeding	Bleeding	None
7	53 F	Sigmoid Ca	Colorectal (St)	36	Colonoscopy	Abdominal pain	Patent anastomosis	None
8	40 M	Ileocecal stricture	Ileocecal (St)	21	Colonoscopy	LGI bleeding	Patent anastomosis	None
9	67 F	Ileal AVM	Ileoileal (HS)	4	Sigmoidoscopy and EGD[a]	UGI bleeding	None	None
10	48 F	abdominal sarcoma	Ileocolic (St), jejunojejunostomy (HS) and gastrojejunostomy (HS)	7	Sigmoidoscopy[a]	LGI bleeding	None	None
11	81 M	Sigmoid volvulus	Colorectal (HS)	2	Colonoscopy	Persistent abdominal pain	Patent anastomosis	Decompressive rectal tube
12	65 M	Perforated appendicitis	Ileocolic (HS)	11	Colonoscopy and EGD	LGI bleeding	Patent Anastomosis and duodenal ulcer	None
13	70 F	SBO	Jejunocolostomy (HS)	30	Sigmoidoscopy[a]	Obstruction	None	None
14	56 M	Cecal perforation	Ileocolic (St)	2	Sigmoidoscopy[a]	Ischemia	None	None
15	73 M	Ileostomy closure	Ileoileal (St)	3	Colonoscopy and EGD	UGI bleeding	Bleeding	None
16	25 M	Crohn's disease	Ileorectosigmoid (HS)	19	Sigmoidoscopy	LGI bleeding	Patent anastomosis	None
17	63 F	Pancreatic Cancer	Duodenojejunostomy (St)	13	ERCP	Pancreatic duct leak	Pancreatic duct leak	Sphincterotomy and pancreatic stent placement
18	81 M	Diverticulosis and intraabdominal abscess	Ileoileal (St)	8	Colonoscopy	LGI bleeding	Patent anastomosis	None
19	77 F	Ileal perforation	Ileoileal (St)	12	Colonoscopy	LGI bleeding	Ischemia	Revision of anastomosis
20	74 F	SBO	Jejunoileal (HS)	21	Colonoscopy and EGD[a]	UGI bleeding	None	None
21	37 M	Ileocecal Stricture	Ileoileal (St) and Ileocolic (St)	38	Sigmoidoscopy[a]	persistent abdominal pain	None	None
22	75 F	Duodenal AVM	Duodenojejunostomy (HS)	42	EGD	UGI bleeding	Additional AVM	Coagulation
23	70 F	Esophageal Ca	Esophagogastrostomy (St)	40	EGD	UGI bleeding	Anastomotic ulcer, AVM	Coagulation
24	56 F	SBO	Ileoileal (St)	28	Colonoscopy	LGI bleeding	Anastomotic ulcer	None

POD postoperative day, *SBO* small bowel obstruction, *St* stapled, *LGI* lower gastrointestinal, *RYGB* Roux-en-Y gastric bypass, *EGD* esophagogastroduodenoscopy, *NG/NJ* nasogastric/nasojejunal, *HS* hand sew, *AVM* arteriovenous malformation, *UGI* upper gastrointestinal, *R/O* rule out

[a] The endoscope did not visualize the anastomosis but was in close proximity to the anastomosis site

The concern about endoscopy following GI anastomosis is based on tissue repair and the trajectory of increased tensile strength as time progresses. The healing process of the GI tract progresses through three phases: lag, proliferative, and remodeling. Each stage is associated with a different level of integrity which theoretically alters the forces that an anastomosis can incur before perforation or dehiscence occurs. The lag phase is marked by the efflux of inflammatory cells which are essential for the release of growth factors. During this phase, the collagenase activity will be maximal; therefore, the anastomosis will be most vulnerable to tension in the first two postoperative days. Early anastomotic strength is then dependent on the suture- or staple-holding capacity of existing collagen until large amounts of new collagen can be synthesized by both fibroblasts and smooth muscle cells during the proliferative phase lasting days 3–4 through 14.[11,17–19] Jonsson et al. found the strength of suture anastomoses to decrease during the first three postoperative days, falling to 15 % of the initial postoperative strength, before starting to increase at day 4.[20] Lastly, the remodeling phase occurs at around day 14 and lasts up to 4 weeks in the small intestine and up to 4 months in the colon. During this phase, maximal strength of the anastomosis will be gained through maturation of the newly formed collagen fibers into thick bundles and contractile units.[10,20] Despite the theoretical early weakness of anastomoses during the lag phase of healing, this study found that endoscopic evaluations on postoperative day two in two patients did not result in perforation, albeit this experience was limited to two patients. In addition, six patients received steroids preoperatively, which are known to increase the risk of anastomotic leak and dehiscence due to inhibition of the inflammatory process with the subsequent decrease in collagen synthesis and deposition as indicated in several studies,[21–23] yet none had any anastomotic disruption.

Though GI tract tissues gain tensile strength faster than cutaneous wounds, neither attain full preoperative strength.[10,24] Furthermore, studies show the transient decrease in anastomotic collagen secondary to collagenase activity in the lag phase is less pronounced in the ileum. Therefore, small bowel anastomoses approach the strength of unwounded tissue approximately 4 weeks following creation while colonic anastomoses will only obtain 75 % of normal strength by 4 months.[10,20,24–28] Though the majority of anastomoses included in this study involved the colon, no post-endoscopic perforations occurred implying that small bowel anastomoses may have an even greater ability to withstand potential injury from postoperative endoscopy.

In addition to demonstrating the safety of diagnosing GI anastomotic pathology by early endoscopy in a small, selected patient population, our data also demonstrates a relative safety of endoscopic therapies. Six patients in this study underwent interventions, including coagulation of bleeding, stent placement, and anastomotic dilation, all without compromising anastomotic integrity. This is consistent with bariatric literature, where it has been shown that endoscopic treatment of post-RYGB gastric bypass anastomotic leaks, hemorrhage, and stricture is safe and effective.[29] Though it is known that strength of a GI anastomosis is greater immediately after creation than in the following 2 to 3 days, intraoperative endoscopy of newly created anastomoses in RYGB procedures has not been shown to decrease anastomotic integrity.[30,31] Additionally, Yimcharoen et al. demonstrated that early gastrojejunal strictures are more amenable to endoscopic dilation than late strictures, with 46 patients undergoing endoscopic dilation within 90 days of RYGB.[32]

As perforation of native bowel is a known complication of upper and lower endoscopy, it is surprising that no cases of perforation occurred following endoscopic evaluation of healing bowel. The reasons for this are unclear. Certainly, this study had inadequate power to identify perforations which resulted from post-anastomotic endoscopy despite our institution being a very busy endoscopy center. Furthermore, given the 0.4 % rate of leak associated with intraoperative endoscopy of gastrojejunal anastomoses, a larger sample size is required to detect endoscopic-related disruption of GI anastomoses.[31] As a result of our institution's extensive experience, we strongly suspect that the endoscopists are more careful during the procedure and use limited air insufflation while minimizing torque given the perceived tenuousness of the anastomoses. Additionally, there is an anecdotal tradition among the surgeons to be present during the endoscopic procedure so soon after anastomosis creation. At our institution, advanced fellowship trained gastroenterologists perform the overwhelming majority of endoscopies. Certainly, the most experienced endoscopist, whether surgeon or gastroenterologist, should be the one to perform these complicated procedures. Ideally, the force exerted by endoscopic evaluation and procedures could be compared to the force necessary to result in perforation of a recent GI anastomosis. Though the force and torque exerted by colonoscopy has been studied, the force needed to disrupt a GI anastomosis as various time points following creation has not been.[23–25]

Limitations of this study include the small sample size and retrospective nature of data collection. As a result, comparison analysis to look for characteristics of patients with post-endoscopic perforations could not be performed. Despite the limited sample size, this is the largest series of early postoperative endoscopic evaluation of GI anastomoses not limited to RYGB in the literature since 1981.[19] Additionally, this study did not collect information on force and torque exerted by endoscopic procedures on the included GI anastomoses.

Conclusion

In summary, the results of this study demonstrate that early postoperative endoscopic evaluation of a variety of GI anastomoses is safe. These procedures allow for definitive diagnosis of anastomotic complications and even treatment of

certain complications. Though limited by a small sample size, these results should encourage increased, but cautious, use of early postoperative endoscopic evaluation of potential anastomotic complications, facilitating larger studies with further delineation of the risks and benefits.

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