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Linear vs. circular-stapled gastrojejunostomy in Roux-en-Y gastric bypass

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Abstract

Background Various surgical techniques exist to create the gastrojejunostomy during laparoscopic Roux-en-Y gastric bypass (LRYGB). Linear-stapled anastomosis (LSA) and circular-stapled anastomosis (CSA) are two commonly employed techniques. We hypothesized that CSA is associated with an increased rate of surgical site infection (SSI) and gastrojejunostomy stenosis when compared to LSA.

Methods This study is a retrospective review of patients who underwent LRYGB for morbid obesity at a single institution between 2012 and 2016. Three bariatric surgeons contributed patients to this series. Clinical information and perioperative outcomes were collected through 90 days after surgery.

Results 171 patients met the inclusion criteria. Two patients did not complete 90-day follow-up and were excluded from the analysis (88 patients CSA, 81 LSA; 99% 90-day follow-up). Patient demographics did not differ between groups. The LSA technique was associated with a significantly reduced rate of SSI (0 (0%) vs. 6 (6.8%), $p=0.02$) and stenosis (2 (2.5%) vs. 17 (19.3%), $p<0.01$). The CSA technique demonstrated a greater number of endoscopic dilations per stenotic event (1.5 ± 0.8 vs. 1.0 ± 0, $p=0.03$).

Conclusion In our experience, a gastrojejunostomy constructed with an LSA technique was associated with a significantly reduced rate of stenosis and SSI compared to the CSA technique. LSA is currently our anastomotic technique of choice in LRYGB.

Keywords Surgical site infection · Stenosis · Gastrojejunostomy · Laparoscopic Roux-en Y gastric bypass · Circular-stapled anastomosis · Linear-stapled anastomosis

The Roux-en-Y gastric bypass was first introduced in the 1960s and since then has emerged as one of the most commonly performed bariatric procedures for treating obesity. Of all primary bariatric surgical procedures performed in the United States each year, about 40% are laparoscopic Roux-en-Y gastric bypass (LRYGB) procedures [1]. It has been demonstrated that variability in surgical technique exists, particularly when it comes to the construction of the gastrojejunostomy [2]. Creation of the gastrojejunostomy represents one of the most challenging aspects of the procedure, and the potential for morbidity if this is done poorly is high. The two most commonly utilized techniques include the circular-stapled anastomosis (CSA) and linear-stapled anastomosis (LSA) [3]. Potential advantages to a CSA include a lower level of technical difficulty, decreased OR time, and a reproducible gastrojejunostomy caliber. An LSA anastomosis does not involve passage of a large stapler directly through the abdominal wall. This may translate into a lower rate of wound infections. We conducted a retrospective review of a clinical series of LRYGB constructed with both CSA and LSA to determine the difference in perioperative outcomes to 90 days.

Methods

After Institutional Review Board approval, a retrospective review of prospectively collected data was undertaken to compare outcomes for patients undergoing LRYGB at a single institution by one of 3 bariatric surgeons between

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2012 and 2016. All data were prospectively recorded and retrospectively reviewed. Gastrojejunostomy construction technique was based on surgeon preference. One surgeon performed only LSA and one performed only CSA. The third surgeon changed his preferred technique from CSA to LSA at the mid-point of the study interval and contributed an equal number of subjects to each study group. All other steps of the procedure were similar for each surgeon. Specifically, all Roux limbs were placed in the antecolic, antegastric position. All surgeons divided the jejunal mesentery in a similar manner and closed the jejunojejunostomy space mesenteric defect but not Peterson's space as a matter of routine.

Our surgical technique for gastric bypass involves the creation of a divided gastric pouch of approximately 20–30 mL. Hiatal hernias are always repaired when identified. A 50-cm biliopancreatic limb and a 100-cm (Body Mass Index [BMI] < 50 kg/m^2) to 150-cm (BMI > 50 kg/m^2) Roux limb are created. The Roux limb is in an antecolic and antegastric position. The gastrojejunostomy is constructed with either a linear-stapled or circular-stapled technique based on surgeon preference [4].

The CSA technique involves the transgastric placement of a 25-mm circular stapler anvil through a gastrotomy. A 20–30 mL isolated gastric pouch is created once the anvil is placed. The opening in the stomach through which the anvil is passed is closed with a stapler. The circular stapler is passed through a lateral port site that has been dilated with a large clamp. The circular stapler is placed in a well-lubricated plastic sleeve when passed to avoid contact of the stapler itself with the subcutaneous tissues. The Roux limb is opened at the staple line, and the circular stapler is inserted into the open end. The spike of the circular stapler is brought out of the antimesenteric portion of the jejunum, and the stapler and anvil are connected. The stapler is fired to create the CSA. The open end of the Roux limb along with the blind end of the jejunum proximal to the gastrojejunostomy are resected with a linear stapler and retrieved in a specimen retrieval bag. The gastrojejunostomy is oversewn with Vicryl sutures. Leak tests are performed intraoperatively in all patients with an endoscope.

The LSA technique involves creating a gastrotomy in the lateral corner of the gastric pouch staple line. An enterotomy is made in the antimesenteric portion of the Roux limb approximately 3-cm proximal to the staple line. A linear stapler is inserted into both the gastric pouch and the Roux limb for 25-mm and fired. A 32 French bougie is passed into the Roux limb transorally. The opening in the anastomosis is closed with absorbable sutures with the bougie in place. Leak testing is performed with endoscopy as for CSA.

Clinical information and perioperative outcomes were collected through 90 days after surgery. Because we were more interested in perioperative outcomes and morbidity than in weight loss, follow-up was to 90 days. Patients were excluded from the analysis if they did not have 90-day follow-up data available. Surgical site infection (SSI) was defined per the Centers for Disease Control (CDC) surgical site infection criteria [5]. SSIs included superficial incisional SSI, deep incisional SSI, and organ/space SSI. Gastrojejunostomy stenosis was defined as the presence of symptoms consistent with narrowing or obstruction such as nausea, vomiting, food intolerance, dysphagia, or regurgitation in a patient with a gastrojejunostomy diameter < 11 mm on upper endoscopy. This gastrojejunostomy diameter threshold was selected based on our previous work on the topic of stenosis and the diameter of the endoscope we use for dilation [6]. Weight loss at 90-days was represented as percent excess body mass index lost (%EBMIL) and calculated according to the formula:

$$\%\text{EBMIL} = (\text{preop BMI} - \text{postop (90-day) BMI}) / (\text{preop BMI} - 25) \times 100$$

Statistical analysis was conducted with SPSS, version 21 (IBM corp.). Categorical data were analyzed with Chi square tests and continuous data were analyzed with *t*-tests. A p-value of ≤ 0.05 was considered statistically significant.

Results

A total of 171 patients underwent LRYGB with either the CSA or LSA during the study interval. Two patients did not have 90-day follow-up and were excluded to bring the cohort to 169 (99% follow-up to 90 days). There were 88 patients in the CSA group (52.1%) and 81 in the LSA group (47.9%). The overall sample was 83% female (82% CSA vs. 84% LSA, $p = 0.71$). Mean age was 45 years and did not differ by study group (44 +/− 12 years CSA vs. 46 +/− 12 years LSA, $p = 0.51$). Preoperative BMI was similar in each group as well (47.8 +/− 8.6 kg/m^2 CSA vs. 50 +/− 7.5 kg/m^2 LSA, $p = 0.48$). Weight loss at 90-days post op was similar between study groups (32.1 +/− 10.1% CSA vs. 29.7 +/− 11.4%; $p = 0.15$).

The CSA technique was associated with a greater rate of SSI (CSA 6 (6.8%) vs. LSA 0 (0%), $p = 0.02$). There were no gastrojejunostomy leaks or deep organ space SSIs with either technique in this series. The CSA patients also suffered from a significantly higher rate of gastrojejunostomy stenosis (CSA 17 (19.3%) vs. LSA 2 (2.5%), $p < 0.01$). When

a stenosis did occur, more endoscopic dilation sessions were required with CSA to resolve the condition (1.5 +/− 0.8 sessions CSA vs. 1.0 +/− 0 LSA, $p = 0.03$). Reinterventions in the CSA group in the first 90 days included 25 therapeutic endoscopies, another 8 diagnostic (normal) endoscopies, a wound exploration, a percutaneous drainage of a subcutaneous abscess, and a negative diagnostic laparoscopy. Some of these interventions occurred in the same patients, and the overall portion of patients requiring reintervention in the first 90 days was therefore 25%. Reinterventions in the LSA group included 2 therapeutic endoscopies, 2 normal diagnostic endoscopies, an umbilical hernia repair, and a laparoscopic cholecystectomy. The 90-day reintervention rate in the LSA group was 7.4% ($p < 0.01$).

Readmissions in the first 30 days occurred at an overall rate of 6.5%. Readmissions occurred at a similar rate for each study group (9.1% CSA vs. 3.7% LSA; $p = 0.22$). Of the 8 readmissions in the CSA group, 2 were related to a wound infection and 3 were for symptoms ultimately determined to relate to a gastrojejunostomy stenosis including nausea and vomiting, dysphagia, and dehydration. Of the 3 readmissions in the LSA group, one was determined to relate to a gastrojejunostomy stenosis, and this patient was admitted with dehydration and inability to tolerate oral intake.

Discussion

A retrospective review of our experience suggests that the CSA technique for creating the gastrojejunostomy is associated with increased rates of SSI and gastrojejunostomy stenosis when compared to LSA. The three most common techniques for constructing the gastrojejunostomy in LRYGB are hand-sewn anastomosis (HSA), CSA, and LSA. A survey of members of the American Society of Metabolic and Bariatric Surgery published in 2008 revealed that at that time, CSA was performed by 43%, LSA by 41%, and HSA by 21% of those to respond [3]. A more recent analysis of practice patterns with regards to gastrojejunostomy construction technique has not been published to our knowledge. A number of different publications have demonstrated variation in outcomes based on gastrojejunostomy technique however. A meta-analysis and systematic review was conducted comparing CSA to LSA in LRYGB [7]. Eight studies involving 1,321 patients were included. A significantly decreased risk of gastrojejunostomy stenosis was observed after LSA vs. CSA (Relative Risk [RR] 0.34; 95% confidence interval [CI] 0.12–0.93; $p = 0.04$). Wound infection risk and operative time were significantly reduced with LSA. A Nationwide cohort study from the Scandinavian Obesity Registry on nearly 35,000 patients to undergo LRYGB from 2007 to 13 revealed the same findings [8]. CSA was associated with longer operative time, hospital stay, and postoperative complications compared with LSA.

Gastrojejunostomy stenosis following LRYGB has been reported to occur with differing frequencies depending on the technique, definition, and clinical series. A recently published meta-analysis designed to compare HSA to LSA and CSA included 12 trials comprising 13,626 patients (3309 HSA vs. 6791 CSA vs. 3526 LSA) [9]. There was no difference in operative time based on technique. HSA was associated with a significantly lower incidence rate of postoperative bleeding (OR 0.48; 95% CI 0.31–0.74; $p = 0.001$) and wound infection (OR 0.19; 95% CI 0.08–0.45; $p = 0.0002$) than CSA. There were no significant differences in all comparable outcomes between HSA and LSA in this analysis. Another meta-analysis, this one designed to compare only CSA and LSA included 9 trials comprising 9374 patients (2946 LSA vs. 6428 CSA) [10]. Primary outcome analysis revealed a statistically significant increase in the rate of gastrojejunostomy stenosis associated with CSA. A significantly reduced rate of wound infection, bleeding, and operative time was associated with LSA. There is a wide range in the reported rates of gastrojejunostomy stenosis when comparing series utilizing the same gastrojejunostomy technique. Other factors including the size of the circular stapler (21-mm vs. 25-mm) in CSA, the type of suture used to oversew or create the anastomosis, and even the presence of gastroesophageal reflux disease have been implicated as risk factors for higher rates of stenosis [11–13]. The postulated mechanisms underlying stricture formation are local tissue ischemia, tension on the anastomosis, subclinical leak, submucosal hematoma, acid or peptic ulceration, early experience with laparoscopic gastric bypass, and method of gastrojejunostomy construction [14].

Surgical site infections were once a common occurrence in gastric bypass surgery, especially in the era of open surgery. With an improved understanding of the mechanisms of SSI and better attention to preventative strategies, many programs have reported declining rates of SSI following LRYGB in recent years. It does appear as if SSI rates are higher following CSA when compared to LSA. Out of nearly 10,000 cases, a meta-analysis reported a significantly reduced incidence of wound infection associated with LSA compared to CSA (pooled odds ratio = 0.32, 95% confidence interval 0.23–0.44, $p < 0.0001$) [10]. Finks et al. analyzed data from the Michigan Bariatric Surgery Collaborative and found that in 9,904 patients, wound infection was far more common with CSA than with LSA (4.7% vs. 1.6%; $p < 0.0001$) [15]. Several investigators have reported strategies and tactics that can lead to decreased rates of SSI following CSA. In one single center review of nearly 500 LRYGB patients with a CSA over a 6-year period, surgical technique modifications including sterile coverage of the circular stapler, sterile specimen-bag retrieval of the

gastrojejunostomy enteric remnant, and port site Penrose drainage resulted in a significant reduction in SSI (odds ratio 2.98 [95% CI 1.33–6.69]) [16]. In another study of 350 patients to undergo LRYGB with CSA, SSI rates decreased from 15 to 3.8% with intraoperative interventions that included the addition of a stapler cover, wound irrigation, wound antibiotic application, and primary wound closure to their protocol [17]. SSIs following CSA are likely related to the passing of the circular stapler through the abdominal wall and directly into the GI tract without the use of a trocar. In the LSA technique, the abdominal trocars are not removed and a specimen is not retrieved from the abdomen (CSA technique often requires a small piece of jejunum proximal to the gastrojejunostomy to be resected to complete the anastomosis).

Our study had a number of limitations. Due to this being a single institution study, our sample size was relatively small. We collected data on patients up to 90 days postoperatively in order to include the time frame where most stenotic events occur. While the technical components of performing gastric bypass are similar among the 3 surgeons to contribute patients to this series (other than the gastrojejunostomy technique), there are likely small variations that could account for these differences in part. Despite these shortcomings, we feel we have demonstrated that the CSA technique is associated with a higher rate of stenosis, that these stenoses are more difficult to treat, and that SSIs are more common than is seen with the LSA technique. In part, as a result of these findings, all surgeons in our program have changed or now perform the LSA technique during LRYGB.

Compliance with ethical standards

Disclosures Dr. Gould is a consultant for Torax Medical/Ethicon. Alexander C. Barr, Kathleen L. Lak, Melissa C. Helm, Tammy L. Kindel, Rana M. Higgins and Jon C. Gouldhave no financial conflicts to declare.

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