Stricture Rate after Laparoscopic Roux-en-Y Gastric Bypass with a 21-mm Circular Stapler versus a 25-mm Linear Stapler

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Background: Obesity is estimated to affect more than one and a half billion adults. Laparoscopic Roux-en-Y gastric bypass (LRYGB) has become one of the preferred weight loss procedures. However, complications can occur. Strictures at the gastrojejunal anastomosis lead to clinical symptoms such as vomiting, dysphagia, and patient discomfort. The stricture rate has been correlated with the size and type of stapler used.

Methods: A retrospective review of the clinical records of patients who underwent LRYGB was performed between 2003 and 2010. A comparison was made between a 21-mm circular stapler technique and a 25-mm linear stapler technique.

Results: The stricture rate for the 21-mm circular stapler group was 7.12% and comparable to the national average. Using the 25-mm linear stapler, this complication rate significantly decreased to 1.09% ($p < 0.0004$; odds ratio 6.5; [95% confidence interval 1.96–33.83]).

Conclusions: Stricture after LRYGB is a serious complication. This study found that with a change in technique, this complication can be decreased considerably.

Introduction

OBESITY, DEFINED by a body mass index (BMI) $> 30 \text{ kg/m}^2$, is estimated to affect more than one and a half billion adults.¹ The surgical treatment of morbid obesity is the only effective long-term therapy to achieve and maintain a significant weight loss over time.² Laparoscopic Roux-en-Y gastric bypass (LRYGB) has become one of the most effective and preferred weight loss procedures, according to the American Society for Bariatric Surgery.³ Although relatively safe, the procedure does have marked complications. Strictures at the gastrojejunal (GJ) anastomosis lead to clinical symptoms such as vomiting, dysphagia, and patient discomfort.

The stricture rate appears to be correlated with the size of the circular stapler.⁴ GJ anastomosis stricture incidence is variable, occurring between 0.8% and 33% of patients, according to several studies.^{5–7} The aim of this study is to discuss the clinical implications and management of GJ anastomosis strictures after LRYGB. The GJ stricture rate is determined in the study population, and it is shown how a change in size and type of stapler can yield dramatic changes in patient outcomes.

This study also analyzes the onset of symptoms, associated risk factors, and the number of dilatations required to relieve symptoms. In a community hospital setting, comparable GJ

stricture rates to that of the national average with a 21-mm circular stapled anastomosis (CSA) were achieved. In addition, it is shown that transitioning to a 25-mm linear stapled anastomosis (LSA) leads to superior outcomes.

Methods

Clinical records of all the LRYGB procedures at the authors' institution were reviewed from 2003 to 2013. The focus was on two different time periods for the analysis of GJ anastomotic strictures. From 2003 to 2008, the LRYGB GJ anastomosis was performed with a 21-mm CSA, performed by one surgeon using a standardized technique. From 2008 to 2013, the GJ anastomosis was performed using a 25-mm LSA, performed by a second surgeon also using a standardized technique. All the relevant clinical data, including demographics, timing of presentation, comorbidities, and the number of dilatations, were analyzed. The patients with symptoms of anastomotic strictures underwent upper endoscopy. No patients were excluded from this study. All patients met the criteria proposed by the National Institutes of Health (NIH) Consensus Panel in 1991 for weight reduction surgery, and the updated criteria by the American Society for Bariatric Surgery in its 2004 Consensus Conference Statement.³

The 21-mm CSA technique was performed by partially transecting the stomach with an Echelon Flex Endopatch

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FIG. 1. Stricture of the gastrojejunostomy and passage of the endoscope into the jejunum.

Linear stapler (Ethicon US, LLC., Somerville, NJ), 2–3 cm below the gastroesophageal junction, after opening the gastrohepatic ligament. An Endopath Endoscopic Intraluminal 21-mm Circular Stapler (Ethicon US, LLC.) was then used to create the GJ anastomosis. This was achieved by creating a lateral gastrotomy and inserting the anvil into the gastric pouch. A silk suture was secured to the post of the anvil and was used to bring the anvil through a small gastrotomy along the upper staple line. Using the linear stapler, the lateral gastrotomy was then closed and the gastric pouch was completed. The next step consisted of identifying a point on the small bowel 30–40 cm distal to the ligament of Treitz. The small bowel was divided using a linear stapler, as was the mesentery. The staple line on the Roux limb was then opened, and the circular stapler was advanced through it. In this way, the CSA was performed. The staple line was reinforced with 2-0 polyglactin sutures. The open end of the Roux limb was then closed using a linear stapler. The jejunojejunal anastomosis was then created 150 cm distal to the GJ anastomosis using a linear stapled technique.

The 25-mm LSA technique was performed in a different fashion, starting with the jejunojejunal anastomosis. At a point 50 cm distal to the ligament of Treitz, the small bowel and its mesentery was divided using a linear stapler. The jejunojejunal anastomosis was then created 150 cm distal to the end of the Roux limb using a linear stapled technique. After this was completed, a window was opened in the gastrohepatic ligament and a linear stapler was used to divide the gastric pouch and the distal remnant. The pouch was anastomosed to the Roux limb using a posterior running stitch with absorbable suture. Next, an enterotomy and gastrotomy was created and a 25-mm linear stapler was used to create the stapled anastomosis. Finally, the remaining defect was closed with a running stitch using absorbable suture and oversewn with a Lembert layer.

An anastomotic stricture was suspected if the patient had frequent nausea, emesis, and/or dysphagia with liquids or meals. Upper endoscopies were performed liberally in patients with suspected strictures in an outpatient setting with intravenous sedation by one of two surgeons. Endoscopy was performed using a GIF-160 (10-mm) gastroscope (Olympus America, Inc., Melville, NY). A stricture was defined by the inability to pass a 10-mm gastroscope through the GJ anastomosis. For this study, the stricture size was determined by the endoscopist's dictated note. Dilation was performed if the stricture was <10 mm using a 7–18-mm CRE balloon (Cook CRE, Winston-Salem, NC) for 1 minute

under sedation without fluoroscopy (Figs. 1 and 2). Records were analyzed retrospectively, and statistical analysis was used when appropriate.

Specific management guidelines for anastomotic strictures have not been developed and are largely dependent on the endoscopist's clinical assessment. Nevertheless, Medbery *et al.* have published a significant experience in the field and developed a comprehensive management algorithm that deserves mention. Focus is placed on whether the stricture is traversable, and making the decision to use an endoscopic wire, fluoroscopy, or both.⁵

Results

The total number of patients with an anastomotic stricture was 29 patients out of 639 (365 patients from 2003 to 2008, and 274 from 2008 to 2013, cumulative 4.54%). These 29 patients required a total of 60 procedures, some with serial dilations. Out of the 21-mm CSA group, 26 patients developed strictures, while only three patients developed strictures in the 25-mm LSA group. There were 23 female patients and 6 male patients. The average age was 49.7 years (range 29–73 years), and the average BMI was 51.7 kg/m² (range 40–67 kg/m²). The most common comorbidities among those patients who suffered GJ strictures were hypertension (62.1%), osteoarthritis (58.6%), and a history of marginal ulcers (51.7%).

FIG. 2. The gastrojejunostomy after dilation.

FIG. 3. Associated comorbidities of 21-mm circular stapled anastomosis.

When comparing the patients who developed strictures according to the stapler used, the results clearly show an increased risk of stricture after using a 21-mm CSA.

The average age for the 21-mm CSA group was 49.4 years (range 29–65 years). The average preoperative BMI was 52.0 kg/m² (range 40–67 kg/m²). Hypertension was noted in 16 patients (61.5%), osteoarthritis in 16 patients (61.5%), a history of marginal ulcers in 14 patients (53.9%), gastro-esophageal reflux disease in 11 patients (42.3%), depression in nine patients (34.6%), hypercholesterolemia in eight patients (30.8%), and diabetes in six patients (23.0%; see Fig. 3). The average number of dilatations was 1.88 (range 1–9). In this group of patients, it was found that the onset of symptoms presented on average 11.85 months after LRYGB (range 1–59 months). However, in 17 of the 26 patients in this group, the onset of symptoms occurred within the first 5 months. Finally, the stricture rate was found to be 7.12% (26/365 patients).

The average age for the 25-mm LSA group was 52.7 years (range 33–73 years). The average preoperative BMI was 48.7 kg/m² (range 40–58 kg/m²). Hypertension was noted in two patients (66.7%), osteoarthritis in one patient (33.3%), a history of marginal ulcers in one patient (33.3%), and diabetes in one patient (33.0%; see Fig. 4). The average number of dilatations was 3.67 (range 2–6). In this group of patients, it was found that the onset of symptoms presented on average 4.3 months after LRYGB

FIG. 4. Associated comorbidities of 25-mm linear stapled anastomosis.

FIG. 5. Stricture rate. CSA, circular stapled anastomosis; LSA, linear stapled anastomosis.

(range 1–8 months). Finally, the stricture rate was found to be 1.09% (3/274 patients).

Summarizing, the stricture rate of the 21-mm CSA group was 7.12%, while the stricture rate of the 25-mm LSA group was 1.09%, which was a statistically significant finding ($p < 0.0004$). Hence, the odds ratio of finding a stricture after a 21-mm CSA is used compared to a 25-mm LSA is 6.5 [95% CI 1.96–33.83] (see Fig. 5).

When comparing the population according to sex, the following results were obtained. Six out of 29 patients who developed strictures were male. The average age for the male patients was 51.7 years (range 42–65 years). The average preoperative BMI was 52.5 kg/m² (range 45–62 kg/m²). Hypertension was noted in four patients (66.6%), diabetes in four patients (66.6%), osteoarthritis in three patients (50%), and a history of marginal ulcers in three patients (50%). Hypercholesterolemia was noted in two patients (33.3%). The average number of dilatations per male patient was 1.7 (range 1–3). In the male patients, it was found that the onset of symptoms was between 1 and 59 months, although most occurred within the first 5 months (66%).

Twenty-three out of 29 patients who developed strictures were female. In the female population, the average age was 49.2 years (range 29–73 years). The average preoperative BMI was 51.5 kg/m² (range 45–62 kg/m²). Hypertension was noted in 14 patients (60.9%), osteoarthritis in 14 patients (60.9%), a history of marginal ulcers in 12 patients (52.2%), gastro-esophageal reflux in 11 patients (47.8%), depression in seven patients (30.4%), hypercholesterolemia in six patients (26.1%), and diabetes in three patients (13%). The average number of dilatations was 2.17 (range 1–9). In the female patients, it was found that the onset of symptoms presented on average 10.09 months after LRYGB (range 1–40 months).

Discussion

GJ stricture is a complication variable depending on the study (1–23%).^{6–8} The present study population presented with a cumulative stricture rate of 4.54%. The diagnosis of these lesions is based on clinical suspicion for any patient who presents after LRYGB with epigastric pain and feeding intolerance.⁹ The diagnosis is confirmed with an upper gastrointestinal series or via an upper endoscopy. The treatment options include the performance of endoscopic pneumatic dilation over one or more sessions.

Technical factors seem to predispose patients to the development of GJ anastomotic strictures. Gonzalez *et al.*¹⁰ published a comparative study of the circular mechanical anastomosis versus manual anastomosis, noting a significant increase in stricture rate in the group with a CSA (31% vs. 3%). Other authors have confirmed these results. Nguyen *et al.*¹¹ reported a 11.4% stenosis with circular mechanical anastomosis, compared with 4.9% published by Higa *et al.*¹² with manual anastomosis. In another study, Nguyen showed a higher incidence of stenosis when performed with a circular stapler 21 mm in diameter (26.8% of cases) than when performed with a diameter of 25 mm (7.6%). Nguyen showed no appreciable difference in weight loss between groups.⁴ In terms of performing the GJ anastomosis with a linear stapler, the published stenosis rates are between 4% and 7%.^{13,14}

The technique in the current study with 21-mm CSA met the highest standards published, and the stricture rate was comparable to the national average using that same technique. When a 25-mm LSA technique was used, the stricture rate decreased significantly. In the present series, there was a stricture rate of 1.09% in the patients who had surgery with a 25-mm LSA, compared to 7.12% stricture rate with a 21-mm CSA.

Regardless of the study group, there was a high incidence of hypertension, diabetes, and hypertriglyceridemia. This is not a surprising finding due to the fact that metabolic syndrome is quite common in the obese patient population. In fact, in the United States, the prevalence of this syndrome in the 40–59 year age group is 40% and 34% in men and women, respectively.¹⁵ Osteoarthritis secondary to morbid obesity is also a well-described and expected finding.

However, it is interesting that considering the study population as a whole, 15 of the 29 patients who developed GJ strictures in fact had a history of marginal ulcers (51.7%). Further in-depth analysis is needed to confirm the statistical significance of this finding. However, this is outside the scope of this study.

The positive outcomes that come from changing from a CSA to a LSA technique are not limited to stricture rate. Penna *et al.* have shown via a meta-analysis that there are also statistically significant benefits for secondary outcomes, such as a lower wound infection rate, fewer incidences of postoperative bleeding, and shorter operative times.⁸

Although the present findings are clinically and statistically significant, the study does have limitations. Two different standardized techniques were used, and a separate surgeon performed each technique. It is difficult to quantify surgical expertise and whether that could be translated into better surgical practice. Although the first surgeon had more experience with 365 patients, the second surgeon had better results with what would appear to be less experience (274 patients). In addition, other confounding factors, such as fellowship experience and years in practice, could influence surgical outcomes.

Other risk factors to consider are smoking, nonsteroidal anti-inflammatory use, anemia, and *Helicobacter pylori* infection. It is a well-known fact that the first two are leading contributors to marginal ulcer and stricture formation in patients after Roux-en-Y gastric bypass.⁵ Complete data were not available on these variables, so they were not taken into

consideration for the purpose of this study. This is, however, a long-standing bariatric surgery program with excellent patient follow-up that has placed great emphasis on patient education and counseling for smoking cessation. This has been shown to improve outcomes in the bariatric population.¹⁶

Conclusion

LRYGB can be safely performed at a community hospital. The stricture rates with a change in technique from a 21-mm CSA to a 25-mm LSA have decreased dramatically (7.12% vs. 1.09%). Using the 25-mm LSA technique, stricture rates have been achieved that are slightly less than the reported average. With a change in technical practice, excellent results have been shown in postoperative complication rates, and practice has since been changed so as to attain the highest standards possible. A prior history of marginal ulcer has also been identified as a potential risk factor for developing GJ strictures. Secondary outcomes, such as lower wound infection rates, fewer incidences of postoperative bleeding, and shorter operative times, have proven to be added benefits from this change in technique.

Author Disclosure Statement

No competing financial interests exist.

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