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TECHNICAL INNOVATION

Low Anastomotic Stricture Rate After Roux-en-Y Gastric Bypass Using a 21-mm Circular Stapling Device

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Abstract
Background Laparoscopic Roux-en-Y gastric bypass (LRYGB) has been established as a safe and effective procedure for morbid obesity management. Amongst some of the postoperative complications are gastrojejunal (GJ) anastomotic strictures, with an incidence of 3 to 27 % in some series. This study evaluates the incidence of GJ strictures using a 21-mm circular stapling device and its response to treatment with endoscopic balloon dilation.
Methods A retrospective chart review was conducted of patients who underwent LRYGB between January 2007 and September 2010. We used our previously published technique of retrocolic, retrogastric Roux-en-Y bypass, using a 21-mm circular stapler to construct the gastrojejunostomy. Postoperatively, patients with persistent food intolerance underwent an endoscopy. Those found to have a GJ stricture (defined as inability to pass the endoscope beyond he anastomotic site) underwent pneumatic dilation with a 12-mm balloon.
Results A total of 338 patients underwent LRYGB. Median follow-up was 57.6 weeks (8–137). Twenty-two patients underwent an endoscopy due to food intolerance. Sixteen patients (4.7 %, 16/338) were identified with GJ stricture and received at least one endoscopic dilation. The other six patients had a normal endoscopic evaluation. GJ strictures presented at an average of 35 days (13 to 90 days) postoperatively. Four patients underwent two endoscopic interventions, and one underwent three endoscopic interventions.
Conclusions We hereby demonstrate that the construction of GJ anastomosis with a 21-mm circular stapler is associated with a low stricture rate using our standardized technique. Strictures are amenable to balloon dilatation with subsequent long-term resolution of symptoms.

Keywords Obesity · Gastric bypass · Complications · Stricture · Bariatric surgery · Balloon dilation

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Introduction

Since 2000, the number of people with BMI greater than 35 kg/m^2 has increased at an alarming rate. Officially recognized as a major public health issue, morbid obesity has surpassed its prevalence in prior decades. In 2004, 4.7 % of the population 20 years of age and older were morbidly obese, with BMI greater than 40 kg/m^2 [1, 2].

Bariatric surgery has been the most effective treatment of morbid obesity, as demonstrated by the amount of weight loss and resolution of comorbidities [3]. Laparoscopic Roux-en-Y gastric bypass (LRYGB) has offered significant long-term weight loss [4–6]. Among the postoperative complications of LRYGB are gastrojejunal (GJ) strictures, which present with an incidence of 3–27 % in some series [5, 7]. The aim of this study is to evaluate the incidence of GJ strictures using the

21-mm circular stapling device and its response to treatment with endoscopic balloon dilation.

Materials and Methods

The cohort for this IRB-approved retrospective study consisted of 338 patients who had undergone LRYGB at Scripps Memorial Hospital, La Jolla, CA from January 2007 to September 2010, and whose data were prospectively collected. All operations were performed by the same surgeon using the same standard technique. All patients were evaluated by a multidisciplinary team prior to having LRYGB as their primary bariatric operation. No revisional surgeries were included. Feeding intolerance was defined as vomiting, dysphagia, and abdominal pain during meals not amenable to diet modification.

Wittgrove Surgical Technique for Gastrojejunostomy in LRYGB [8]

The gastric pouch is fashioned around an orogastric tube with a 15-cm^3 balloon passed by the anesthesiologist. An upper endoscopy is performed using a standard 28 Fr adult video endoscope. A snare is passed through the endoscope and pressed against the mucosa of the pouch posterior to the gastric staple line. Electrocautery is used to open onto the snare allowing it to be seen within the abdominal cavity with the laparoscope. An 18 G catheter is then placed percutaneously into the abdominal cavity, and a looped #1 polydioxanone (PDS) suture is passed through the catheter. This suture is grasped with the snare and pulled out of the patient's mouth. The anvil of a "Stealth" 21-mm stapling device (ENDOPATH® ILS Endoscopic Curved Intraluminal Stapler, Ethicon Endosurgery, Inc.) is attached to the looped PDS, and the anvil is pulled down into the small gastric pouch. Endoscopic evaluation has shown no evidence of damage to the esophagus with this technique.

A small counterincision is then carried out on the antimesenteric border of the small intestine, several inches from the stapled end of the Roux limb. The circular stapler is introduced through the abdominal wall on the patient's left side and introduced into the bowel lumen through the antimesenteric opening. The stapler is advanced to the stapled end of the Roux limb, connected to the anvil, and the GJ anastomosis is created in an end-to-end fashion. The knob on the stapling device is turned clockwise until it cannot turn any more, ensuring that the staples fired are of the appropriate height for the thickness of the tissue involved. This variable height (between 1.0 and 2.5 mm) stapling feature is unique to this device and allows each stapler to be catered to the patient's tissues. The opening for the introduction of the "Stealth" stapler is closed with a linear 45-mm stapling device (ENDOPATH® ETS Linear Cutter, Ethicon Endosurgery, Inc.). Three sutures are placed anteriorly to imbricate any potential ischemic tissue between the gastric staple line and the stable line of the GJ anastomosis. The proximal Roux limb is cross-clamped with an atraumatic bowel clamp, and a final endoscopy is performed to rule out leak.

Technique for Dilatation

A 12-mm balloon dilator (CRE Fixed Wire Esophageal Balloon Dilation Catheter, Boston Scientific) is introduced through a standard 10-mm adult video endoscope and placed through the gastrojejunostomy. Even very tight GJ strictures are dilated to 12 mm for 1.5–2 min at the first endoscopic evaluation. The small bowel distal to the anastomosis is always visualized to insure there is no ulceration present. Since the anastomosis is created in an end-to-end fashion, guide wire and fluoroscopy are not needed (Fig. 1).

Results

The cohort consisted of 112 men and 226 women. All 338 patients had BMI ≥40 or ≥35 with comorbidities. Sixteen (4.7 %) patients developed symptomatic GJ anastomotic strictures, consisting of 11 females and five males (Table 1). Strictures ranged between 3 and 5 mm (mean of 3.75 mm).

Of the 16 patients, symptoms resolved after one dilation in 12 (75 %), two dilations in 3 (18.75 %), and three dilations in 1 (6.25 %) patients. No complications were seen. Subsequent reintervention was needed on average 21 days after the first endoscopic balloon dilation in patients requiring a second dilation for alleviation of stenosis. These patients had an initial stenosis ranging from 23 to 30 days postoperation. In the patient requiring three endoscopies with balloon dilation, interventions were at 28, 49, and 138 days.

No patients in our series required more than three dilations or operative revision of the anastomosis for their strictures. The median time interval to the diagnosis of stricture formation was 33 days (range of 13 to 90 days). All patients had complete resolution of symptoms after one, two, or three dilations.

Discussion

Stricture at the GJ anastomosis is one of the most common complications after LRYGB. The presentation is readily recognizable with symptoms of dysphagia (first with solids and progressing to intolerance even with liquids), emesis, and at times pain in the epigastric to retrosternal area.

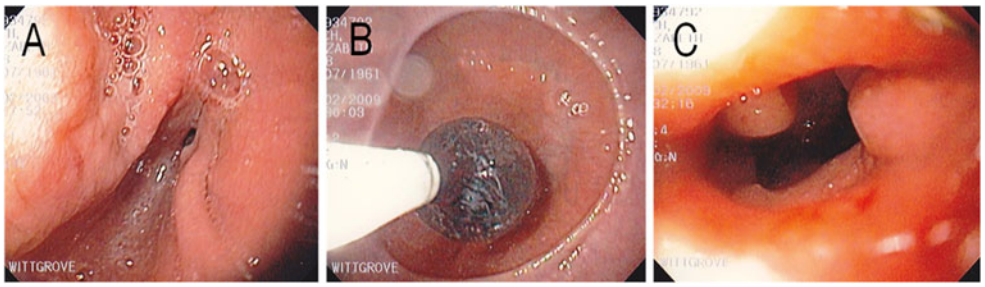

Fig. 1 Endoscopic images of balloon dilation. **a** Gastrojejunal anastomotic stricture about 3 mm in diameter. **b** Balloon dilation procedure. **c** Relieved stricture just after dilation

Nausea is not usually associated with stricture of the GJ anastomosis. Recognition and intervention are imperative since it is very important to maintain hydration and protein intake. Historically, rates of GJ strictures have varied considerably in the literature with some studies citing stricture rates of greater than 20 % [9, 10]. This discrepancy may be due to factors such as different surgical techniques for creating the GJ anastomosis (end-to-end, end-to-side, and side-to-side), size of the gastric pouch, tension, path of the Roux limb, medications, smoking, or how the strictures are defined and diagnosed. Clear instructions to patients regarding diet advancement that they can easily understand and adhere to is also an important factor specially in early recognition of symptoms of stricture development.

Creation of the GJ anastomosis can be accomplished via a hand-sewn technique or utilization of a linear or circular stapler (either 21 or 25 mm in diameter). In some series, rates of GJ stricture have been lowest among hand-sewn anastomoses or those constructed with a linear stapler [11, 12]. Da Costa et al. observed a stricture rate of 7.8 % in a study of 1,330 patients who underwent LRYGB [13] with an antecolic, antegastric Roux limb, and a hand-sewn GJ anastomosis. This rate is consistent with other studies in the published literature [14] and has been reproducible even in open RYGB [15]. This similarity in stricture rate regardless of an open or laparoscopic approach indicates that development of this common complication is more dependent on the method of creating the GJ anastomosis rather than the surgical approach (open vs laparoscopic).

When comparison is made with linear staplers, a relatively equivalent rate is encountered. Ukleja et al. retrospectively reviewed 1,012 LRYGB patients for development of GJ anastomotic strictures and observed a stricture rate of 6 % utilizing a 2.5-mm linear stapler [16]. Once again, this complication rate is within expected values in the published data. With the circular staplers, however, several studies have published higher rates of GJ strictures, with the highest rates specifically with the 21-mm circular stapler. Nguyen et

Table 1 Demographics and patient information

Patients	Sex	Age	Time from operation, days	Stricture diameter, mm	Endoscopy	Complication	Duration of follow-up, weeks	Time to second dilatation, days	Time to third dilatation, days
1	M	55	23	3	2	None	102	43	
2	F	53	23	4	2	None	71	5	
3	M	46	24	3	1	None	8		
4	F	26	28	3	1	None	39		
5	F	36	35	3	1	None	47		
6	F	19	36	3	2	None	137		
7	F	48	43	3	1	None	55		
8	F	65	37	4	1	None	79		
9	F	50	20	4	1	None	25		
10	F	45	51	3	1	None	107		
11	F	32	13	5	1	None	46		
12	F	48	90	5	1	None	45		
13	M	55	28	4	3	None	60	21	89
14	M	44	16	5	1	None	122		
15	F	39	30	3	2	None	52	14	
16	M	53	28	5	1	None	175		

al. [9], for example, observed a 15.7 % stricture rate with the 21-mm circular stapler and were only able to achieve a lower rate of strictures at 8.8 % with the 25-mm circular stapler [9, 10, 17–19]. More recent studies since the Nguyen study [9] published in 2003 still present a higher stricture rate when compared to our study. Gould et al. [17] looked at 145 patients from 2002 to 2005 and observed a 15.9 % stricture rate with the 21-mm circular stapler. In the Gould study, just like in the Nguyen study, a lower stricture rate (6.2 %) was only achieved when the 25-mm circular stapler was used.

Our experience from January 2007 until September 2010 on 338 patients undergoing a LRYGB utilizing the Wittgrove technique produced a stricture rate of 4.7 % (16 patients) and an average stricture size of approximately 3.75 mm utilizing the 21-mm circular stapler for our GJ anastomoses. This rate has been consistent throughout our program's history with a 3.8 % stricture rate with our first 1,000 cases (data presented but not published) and now the same rate looking at a cohort within our last 338 cases out of a total of over 5,500 cases since 1993. This rate represents one of the lowest in the published literature among other studies that also utilize the circular stapler [6, 19]. Mathew et al. [6] observed an anastomotic stricture rate of 11.1 % among 385 LRYGB patients utilizing the 25-mm circular stapler, a higher incident of GJ strictures in the laparoscopic cohort when compared to the open cohort utilizing a hand-sewn technique [6]. Dolce et al. [18] reviewed 159 LRYGB using a transabdominal 21-mm circular stapling technique with an antecolic, antegastric Roux limb and observed a 9.4 % stricture rate, once again consistent with the published literature, but higher than what we encountered in our study. This low stricture rate may be due to the tension-reducing effect of the retrogastric, retrocolic approach, and anterior stitches at the GJ anastomosis [6, 10, 18, 19].

There is considerable variability in stricture rates between different techniques utilizing different size staplers. Within one stapler category, however, there is still significant variability in GJ stricture rates. Alasfar et al. utilized a 21-mm circular stapler to create GJ anastomosis in patients undergoing LRYGB encountered a symptomatic stricture rate of 23 %, whereas Suter et al. also used a 21-mm circular stapler to perform GJ anastomosis with two different laparoscopic techniques and encountered a stricture rate of 3.7 % [10, 19]. This variation in rates may be partly explained by the difference in how some clinicians defined a stricture and how patients with clinical symptoms are worked up.

In some studies, only patients with severe dysphagia, requiring intravenous hydration, were offered an endoscopic evaluation [19] Patients with moderate or less severe dysphagia were treated conservatively on a soft diet for a few weeks. Other studies conduct endoscopic workup in patients that were deemed appropriate when symptoms persist despite negative imaging studies [6]. In our study, however, a diagnostic endoscopy was performed on all patients with symptoms of emesis or dysphagia with liquids. Those found to have a stricture underwent a balloon dilation. The variation in determining when a patient is appropriate for endoscopic evaluation is also accompanied with a variation of the overall date of presentation of strictures. In our study, patients present with strictures at 33 days postoperatively, compared to other studies that used a 21-mm circular stapling device [10, 18]. Alasfar et al. [10] had a 23 % stricture rate with an average date of presentation at 52 days postoperatively. In addition, we also observed early onset of strictures when compared to studies that had equivalent overall rates of strictures, i.e., 3.4 % at an average of 46.8 days [20].

Even when compared to other studies that had a similar date of presentation of strictures, the rate of strictures with our study was still lower [6]. Mathew et al. not only had a stricture rate of 11.1 % among LRYGB patients with an average presentation at 66.2 days but also had an average of 2.2 dilations required to resolve patient symptoms. Therefore, not only is our technique consistent at producing a lower rate of stricture, those which do develop, resolve with few interventions, compared to the published literature [6] Consistent, high-quality follow-up care ensures that the few patients that do develop anastomotic site strictures are expeditiously and effectively diagnosed and treated when the complication does occur.

Despite limitations of our study due to its retrospective nature, our series clearly indicates that with the technique described above for construction of the GJ anastomosis, using the 21-mm circular stapler, a stricture rate of less than 5 % can be expected. This rate of stricture is among the lowest seen with the 21-mm circular stapler and is comparable to the lowest rates reported in the recent literature [6, 21–23]. With dilation at 12 mm proving to be an effective and safe treatment for strictures, most patients have resolution of symptoms after only one therapeutic endoscopy.

Conclusion

Using our technique, construction of the gastrojejunal anastomosis with a 21-mm circular stapler is associated with a low stricture rate, which is amenable to endoscopic balloon dilation.

Conflict of Interest The authors have no conflict of interests to declare.

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