Surg Endosc (2008) 22:1746–1750
DOI 10.1007/s00464-008-9788-0

REVIEWS

Outcome of endoscopic balloon dilation of strictures after laparoscopic gastric bypass

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Received: 27 August 2007 / Accepted: 19 January 2008 / Published online: 18 March 2008

Abstract
Objective Stricture formation at the gastrojejunal anastomosis is a relatively common complication after laparoscopic Roux-en-Y gastric bypass (LRYGB). The objective of this study was to report the incidence of stomal strictures after LRYGB in our institution and report our experience with their management by endoscopic balloon dilatation.
Methods This is a retrospective study of 1012 patients who underwent LRYGB from January 2001 to May 2004. Patients with nausea and vomiting after the surgery, suspected of having gastrojejunal (GJ) anastomotic stricture, had upper endoscopy. Stomas less than 10 mm in diameter, or those not allowing passage of the scope were considered significant strictures and were treated with balloon dilations. Dilations were performed with a through-the-scope (TTS) balloon, with sizes ranging from 6 to 18 mm. The following data were collected from these patients: age, sex, body mass index (BMI), comorbidities, size of balloon catheter, time from surgery until symptoms onset, number of endoscopies needed to relief symptoms, and complications of the procedure.
Results Sixty-one patients (46 females and 15 males) were found to have anastomotic strictures, corresponding to an incidence of 6%. In total, 134 upper endoscopies were performed, with 128 dilatations. The average age was 41.7 years (range: 19–68 years); mean preoperative BMI was 45 kg/m^2 (range: 42–61 kg/m^2). Mean time from surgery to symptoms onset was 2 months (range: 1–6 months). The number of dilations per patient was as follows: a single dilation in 28% of patients, two dilations in 33%, three dilations in 26%, four dilations in 11.5%, and five dilations in 1.5% of patients. All the patients responded to dilation without need for formal surgical revision. However, after balloon dilatation three patients (4.9%), all females, had bowel perforation by radiological criteria (free air on X-ray), which corresponded to 2.2% of all dilatations. The maximum balloon size used in this group was 13.5 mm. All three patients had exploratory laparoscopy without finding of perforation site. They were treated with bowel rest, intravenous antibiotics for 7 days, and drain placement. No factors were identified to predict a risk of perforation.
Conclusion This is the largest study to evaluate the outcome of endoscopic dilatations of GJ strictures after RYGB. Endoscopic balloon dilation is a safe and effective treatment for anastomotic strictures. However, it carries a small risk of perforation. Further case studies are needed to determine risk factors for perforation and if the patients can be managed conservatively in this setting.

Keywords Bariatric · Surgical–Technical · G-I endoscopy · Endoscopy

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Morbid obesity is defined by a body mass index (BMI) greater than 40 kg/m^2, as outlined by the National Institutes

of Health (NIH) consensus conference in 1995 [1]. Morbid obesity has been associated with increased mortality when compared to nonobese individuals [2]. It is associated with serious comorbidities, including hypertension, diabetes mellitus, dyslipidemia, obstructive sleep apnea, and osteoarthritis. Medical treatment for obesity has had disappointing results, particularly in morbidly obese individuals. Currently the Roux-en-Y gastric bypass (RYGB) is recognized as the standard surgical procedure to treat morbid obesity [2, 3]. The number of bariatric surgeries performed every year is growing because of the increased number of morbidly obese individuals that fail medical treatment. LRYGB has a shorter recovery time than the conventional open approach, yet is thought to have the same long-term results [4–7].A relatively common complication of LRYGB is the gastrojejunal (GJ) stricture, which has been reported in 3–27% of patients. Strictures can lead to refractory vomiting and nutritional deficiencies. The exact mechanism responsible for stricture formation is unknown. Detailed reports of endoscopic management of GJ strictures are limited. EGD with through-the-scope (TTS) balloon dilation has been advocated as an effective therapy for this complication. Few studies have been published regarding the efficacy and safety of endoscopic balloon dilation for the management of GJ anastomotic stenosis. We report our center's experience in the management of GJ strictures after LRYGB, determining its incidence, safety, and complications of balloon dilatation. To our knowledge this is the largest series reported in the literature.

Materials and methods

Institutional review board approval was obtained for a retrospective review. One thousand and twelve patients underwent a LRYGB from January 2001 to May 2004 at our institution. Sixty-one patients were found to have GJ strictures by initial UGI series or EGD. Some patients had repeat dilations if the stricture was very tight on initial endoscopy or if symptoms recurred; patients would return after an interval of 2–4 weeks for repeat dilation. Demographic and clinical information was collected from each of these patients.

The LRYGB operations were performed by two laparoscopic surgeons using a modified technique initially described by Wittgrove and colleagues [6]. In summary, a 15–30 ml gastric pouch was created with a 3.5-mm stapler. The small bowel was transected 45 cm below the ligament of Treitz (biliopancreatic limb) and the alimentary Roux-en-Y limb is brought up to create the gastrojejunostomy with a 45-mm linear cutter and a 2.5-mm stapler, reinforced with hand sewn sutures. The gastrojejunal (GJ) anastomosis was tested intraoperatively for leakage by using air insufflation and methylene blue test. The anastomosis was created to be tight enough to allow proper weight loss with a maximum diameter of 12 mm. The length of the alimentary limb depended on the patient's BMI. For the patients with a BMI between 35 and 50 kg/m^2, a 100-cm alimentary limb was performed; for individuals with a BMI between 51 and 60 kg/m^2, a 150-cm limb was created; and for the those with a BMI greater than 60 kg/m^2, a 200-cm limb was necessary. The jejunojejunal anastomosis was performed with a 45-mm linear cuter and 2.5-mm linear stapler. Discharge was planned for the first 48 h postoperatively, if there were no complications observed.

All patients suspected of having anastomotic strictures underwent UGI series or EGD after informed consent was obtained. Under intravenous sedation with Propofol, an adult upper-endoscope (Pentax) was used to inspect the size and integrity of the gastric pouch. The gastrojejunal anastomosis was visualized routinely and the opening size was estimated and recorded in each case by the endoscopist. A clinically significant stricture was recorded if the scope could not pass through the anastomosis or if the diameter was less than 10 mm.

Once the stricture was diagnosed, it was treated during the same procedure by passing a TTS balloon dilator with or without guidewire. The balloon catheters were selected from either Cook CRE (Winston-Salem, NC) or Boston Scientific (Watertown, MA). During the same procedure the strictures were dilated with progressively larger size balloons, from 6 to 18 mm, if necessary. The balloon was inflated for 30 s each time, followed by inflation for 1 min with the final balloon size. If the strictures were not successfully dilated in the first attempt or if symptoms recurred, the patient would come back in 2–4 weeks for another EGD with possible dilation.

After adequate dilation, the scope is advanced to explore the distal anatomy and exclude anastomotic ulcers. All patients received acid suppression with proton pump inhibitor after the procedure for 2 months or longer (4–6 months if uclers were present) if ulcers were present.

Results

Of the 1012 LRYGB patients, 61 patients (46 females, 15 males) were found to have GJ strictures. The mean age of patients was 44 years (range 20–69 years, see Table 1). The incidence of strictures was 6%. Other findings were observed as follows: 13% had anastomotic ulcers, 6.5% had pouchitis, 4.9% had esophagitis and 3.3% had bezoar (Table 2). The most common comorbidities in our patients

Table 1 Demographic and clinical data of studied patients

Age (years)	19–68
Mean age (years)	41.7
Male (*n*)	15
Female (*n*)	46
Mean BMI (kg/m^2)	45
Supermorbidly obese (BMI > 50) (%)	42
Mean number of comorbidities per patient	4
Hypertension (%)	47
Arthritis (%)	57
Diabetes (%)	21
Obstructive sleep apnea (OSA) (%)	59

Table 2 Other endoscopic findings in patients requiring dilation

	Number	Percentage (%)
Anastomotic ulcer	8	13
Pouchitis	4	6.5
Esophagitis	3	4.9
Bezoar	2	3.3

were: obstructive sleep apnea (59%), osteoarthritis (57%), hypertension (47%), and diabetes (21%).

In total, 128 dilatations with TTS balloons were performed. Seventeen patients (28%) had symptoms relieve with single dilation, and did not require further intervention. Forty-three patients (72%) required repeat dilations, with one patient requiring five dilations (Table 3). The mean time from the surgery to the onset of symptoms was 2 months (range 1–6 months). The size of TTS balloons used ranged from 6 to 18 mm for all dilations, depending on the diameter of the GJ stricture, which ranged from 2 to 10 mm. Two patients developed severe abdominal pain after balloon dilation. Both were hospitalized for observation and discharged in 24 h after normal UGI study and symptom relief.

Three out of 61 patients had classic symptoms and radiological findings of bowel perforation after dilation, with 2.2% incidence of perforation in our series. All these dilations were done with a maximum balloon size of 13.5 mm (Table 4). All the patients were young females and supermorbidly obese. Two perforations occured after first endoscopic dilation and a third after three previous dilations. All three patients underwent laparoscopic surgical exploration, without localizing the site of perforation by water test. It was felt that patients had sealed microperforations. All cases were managed with supportive treatment postoperatively (bowel rest, antibiotics intravenously for 5–7 days, and drains placement). None of the patients required surgical revision of the gastrojejunal anastomosis.

Table 3 Number of dilations per patient

Number of dilations	Number of patients	Percentage (%)
One	17	28
Two	20	33
Three	16	26
Four	7	11.5
Five	1	1.5

Discussion

LRYGB has shown a number of advantages over an open RYGB including shorter procedure time and less complications [6]. GJ strictures have been described with both the open and laparoscopic procedures, and there has been a concern that this problem may be more commonly after laparoscopic technique. Symptomatic GJ anastomotic stricture is a relatively common finding following gastric bypass and needs to be aggressively investigated and appropriately treated [7]. A handsewn technique (such as the one used in our series) using linear staplers instead of circular staplers, has been reported to have a lower rate of GJ strictures [8]. The cause of the stricture is not well understood, but ischemia caused by the stapler, tension on the anastomosis, edema, or a foreign-body reaction are recognized factors [9]. Patients with GJ strictures present with nausea, vomiting, and/or abdominal pain.

Several techniques have been used to treat GJ strictures. Currently endoscopic balloon dilations are used as a standard technique. The early endoscopic approach used pneumatic balloon catheters, replaced by the through-the-scope ones.

Some patients may require multiple dilations. It has been our practice to schedule subsequent EGD when, after the initial dilation, the anastomosis was very narrow or the endoscopist was concerned about perforation risk. If the initial stricture was dilated up to 10 mm, then it was recommended to perform another procedure after 2–3 weeks, with subsequent escalating dilations until the scope is able to advance or a minimum of a 12-mm stoma is achieved. In our series we followed a minimum of 2-week interval between dilations, including the patient with perforation. The maximal dilation size still needs to be determined. In our series one patient had 18-mm balloon dilation without complications. Unremarkable dilations with 15–16 mm balloon size were performed in several symptomatic patients, so the balloon size alone does not seem to be a risk factor for perforation. Other similar features shared by these patients were the fact that they were supermorbidly obese, and diabetes mellitus and hypertension were observed in two of them.

Table 4 Characteristics of the patients with perforation after dilation

	Age	Sex	BMI (kg/m^2)	Medical problems	Maximum size of balloon used (mm)	Number of subsequent dilations performed
Patient 1	42	F	53	DM, OSA	10.0	1
Patient 2	36	F	61	HTN	13.5	2
Patient 3	36	F	61	DM, HTN	13.5	2

Table 5 Incidence of GJ anastomotic stricture in selected series of LRYGB

Author	Number of patients	Incidence of strictures (%)	Mean BMI (kg/m^2)	Need for surgical revision
Schauer P 2000 [5]	275	4.7	48.3	No
Higa 2000 [9]	1040	4.9	50	Yes
Wittgrove 2000 [4]	500	1.6	45	Not available
Nguyen 2000 [10]	79	11.4	47.6	Not available
Dresel 2002 [11]	100	3	47.4	No
De Maria 2002 [12]	281	6.6	48.1	No
Papasavas 2002 [13]	116	3.4	49.3	No
Papasavas 2003 [14]	246	8.9	50.9	Yes
Abdel-Galil 2002 [15]	90	20	45	Not available
Gould 2002 [16]	223	5.4	50	Yes
Oliak 2002 [17]	300	2	51	Not available
Matheus 2000 [18]	48	27	52.3	No
Rossi 2005 [19]	223	17	46	No
Ahmad 2003 [20]	450	3.1	47	No
Go 2004 [21]	562	6.8	50	No
Barba 2003* [22]	218	11	49.6	Yes
Schwartz 2004 [23]	1000	3.2	45	Yes
McCarty 2005 [24]	2000	2.1	49	Not available

* Some procedures were performed as open gastric bypass

In light of the fact that none of these patients required surgical revision of the GJ anastomosis, despite exploration, it remains to be seen whether the optimal treatment of perforation should be either conservative medical management or operative intervention.

Previous authors have described their outcome with strictures after LRYGB (Table 5), emphasizing the surgical technique; only a few reports have published specific outcomes regarding management of strictures [19–22]. The incidence of strictures ranged tremendously, from 3% to 27%, likely related to different surgical techniques and experience.

The role of steroid injection into the anastomosis has to be explored. From our personal experience the use of steroid injection added no benefit. Most of the patients in these series responded well to balloon dilation.

Conclusion

In summary, we believe endoscopic balloon dilation is a highly effective treatment for GJ strictures after LRYGB and should be considered as a primary intervention prior to proceeding with a surgical revision. We describe one of the largest series evaluating endoscopic management of these strictures. The incidence of strictures in our series was relatively low, which was similar to most previously published reports, but multiple dilations were still necessary. We had 2.2% incidence of perforation and the only common factors among these patients were diabetes, hypertension, and the fact that they were all supermorbidly obese. The size of the balloon used and the number of dilations do not seem to play a significant role in the risk of perforation.

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