ORIGINAL ARTICLE

Revision Gastrojejunostomy Versus Suturing With and Without Omental Patch for Perforated Marginal Ulcer Treatment After Roux-en-Y Gastric Bypass

Christopher B. Crawford[1,2] · Leslie M. Schuh[2] · Margaret M. Inman[1,2]

Abstract

Background Ulceration at the gastrojejunostomy is a late bariatric surgery complication in 0.6–16% of Roux-en-Y gastric bypass (RYGB) patients. As there is no general consensus on management of acute ulcer perforations, we compare two methods of surgical repair: the most commonly performed procedure, suturing of ulcer with or without omental patch versus revision gastrojejunostomy (RG).

Methods A retrospective chart review of cases at a single large, Midwestern US high-volume bariatric center from November 2, 2006 through March 11, 2021 identified 144 RYGB patients undergoing surgical repair for a perforated ulcer: 72 treated by SGP and 72 by RG. Outcomes, including length of stay, leaks, readmissions, and reoperations, were compared. Categorical variables were compared by Chi-square tests and continuous variables by ANOVA.

Results Patients were primarily female (77.1%) and Caucasian (97.2%), 49.7 ± 12.5 years old, and 90.6 ± 26.6 kg. Most had laparoscopic RYGBs (98.6%). There were no demographic differences between groups. Of the RG patients, 11.4% experienced ulcer recurrence versus 41.7% of SGP patients ($p < .001$), and 2.8% of RG versus 11.1% of SGP patients required a reversal ($p < .05$). No significant differences between groups occurred in time to perforation (3.2 vs. 2.5 years for RG and SGP groups, respectively), length of stay (5.0 vs. 6.8 days), leaks (1.4% vs. 2.8%), readmissions (4.2% vs. 4.2%), or reoperations (2.8% vs 5.6%).

Conclusions Patients developing perforated marginal ulcers after RYGB can be safely and effectively treated by revision gastrojejunostomy with a lower likelihood of ulcer recurrence. Short-term morbidity was comparable to suturing with or without an omental patch.

Keywords Marginal Ulcer · Bariatric Surgery · Gastric Bypass

Introduction

Roux-en-Y gastric bypass (RYGB) has consistently remained one of the most common bariatric operations. It has been studied extensively and is generally well understood, but it does have shortcomings. Marginal ulceration at the gastrojejunostomy can be a challenging problem to address. The risk factors are numerous: ischemia, hypertension, smoking, non-steroidal anti-inflammatory (NSAID) medications, and a large gastric pouch [1–3]. Marginal ulcers (MUs) are reported to occur in 0.6 to 16% of Roux-en-Y gastric bypass (RYGB) patients, primarily on the jejunal side [4], and 0.6 to 0.8% of patients develop perforated MUs [5–7]. Although potentially difficult to treat, most MUs can be treated medically [8]. An ulcer can form in the early stages after a RYGB, with a 30-day post-operative incidence of MU in 44,379 patients of 0.35% [9], or it can develop years or decades later. Routine surveillance at 1 and 17 months post-operatively showed 6% early MU formation and 0.6% late MU formation [10].

The sequelae of MUs can be extensive, including fistula formation, bleeding, stricture, or perforation. The latter typically constitutes a surgical emergency, as a patient can rapidly develop peritonitis, sepsis, and death.

✉ Christopher B. Crawford
chriscrawford235@gmail.com

1 Meridian Surgical Group, 13430 N. Meridian St, Suite 275, Carmel, IN 46032, USA

2 Ascension St. Vincent Bariatrics, Carmel, IN 46032, USA

For a patient with a perforation, pain can be severe. These are nearly all imaged with a CT scan of the abdomen and pelvis. Laparoscopic repair of perforated ulcer disease has been demonstrated to be an effective way to manage perforated ulcers [5, 11–13].

There is not a general consensus on the optimal surgical treatment for perforated MUs. Several small case series [5, 12, 13] and a statewide administrative database [6] have examined surgical management strategies including open and laparoscopic closure with Graham omental patch or anastomotic revision. An anastomotic revision of a gastrojejunostomy (RG) would entail a partial gastrectomy, resection of the proximal alimentary Roux limb involved with the ulcer, and re-anastomosis of the gastric pouch and jejunum. Theoretical benefits of RG include reduction in the pouch size and anastomosis of two non-ulcerated viscera, to allow for proper healing. Disadvantages include increased operative time [12] and case complexity.

Surgeons at our facility have performed both procedures, based on clinical decisions. Their clinical judgment was that anastomotic revision may lead to fewer recurrent or persistent ulcers than primary closure techniques. A small quality improvement project confirmed this.

The primary objective of this retrospective chart review is to compare suture closure of a MU with or without omental (Graham) patch (SGP) and revision gastrojejunostomy for repair of perforated MUs in RYGB patients. Variables to be examined will include length of stay, rates of leaks, reoperation, 30-day readmission, re-ulceration, re-perforation, and reversal of RYGB.

Materials and Methods

Study Design

A retrospective chart review was conducted to examine outcomes of all cases of perforated MUs treated surgically at a single large, Midwestern US high-volume bariatric center. Analyses compared two procedures: suturing of the ulcer with or without omental (Graham) patch (SGP) and revision gastrojejunostomy (RG). The decision to perform either procedure was made at the surgeon's judgment. Patients were not randomized. Demographic and primary bariatric surgery characteristics and risk factors for MU were collected. Time from RYGB to marginal ulceration as well as overall follow-up rates and length of follow-up after the ulcer repair were computed. Outcomes included surgery time and length of stay, short-term complications including leak, 30-day re-operation, and 30-day readmission, and longer term complications (which could occur at any time post-surgery) including re-ulceration, re-perforation, and reversal, as well as time to re-ulceration or reversal,

and number of ulcers. Ulcer recurrence or non-healing ulcer disease was determined through follow-up endoscopies or in response to symptomatology.

Patients

A total of 144 Roux-en-Y gastric bypass (RYGB) patients underwent surgical repair for a perforated MU from November 3, 2006 through March 11, 2021. The program had performed a total of 17,087 RYGBs from its inception until March 2021, for a perforated MU rate of 0.84% among patients with documented follow up. SGP was performed on 72 patients (58 with and 14 without Graham patch) and RG on 72 patients. Patients had undergone RYGB from September 15, 2003 through June 29, 2020, a mean of 2.9 ± 2.5 years before the perforated ulcer.

Statistical Analyses

Continuous variables were reported as means and standard deviations, and categorical variables were reported as numbers and percentages. Differences between RG and SGP patients were examined via one-way ANOVA for continuous variables and Pearson's Chi-square for categorical variables. All tests used a two-sided significance level of $p < 0.05$. Statistical analyses were performed using PASW Statistics Version 25.0®.

Ethics

The project was approved by the Ascension St. Vincent IRB (Study no.RIN20220017) and was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Patient informed consent was waived by the institutional review board.

Results

As shown in Table 1, patients receiving SGP versus RG did not differ on any demographic characteristic. Patients were primarily female (77.1%) and Caucasian (97.2%). The majority had undergone laparoscopic RYGB (98.6%). They were a mean of 49.7 ± 12.5 years old, 90.6 ± 26.6 kg, and had a body mass index of 32.3 ± 8.1 kg/m^2 at the time of the perforated ulcer operation. Significantly more patients in the RG group were on proton pump inhibitor (PPI) therapy at the time of the ulcer. Patients presented from either our own emergency department or in transfer from other facilities that did not have the capacity to treat these patients. The diagnosis was typically made with a CT scan of the abdomen and pelvis.

Table 1 Demographic and surgery characteristics for patients receiving suturing with or without Graham patch (SGP) or revision gastrojejunostomy (RG) for perforated marginal ulcer repair

Variable, % (n)	SGP	RG	p value
Female	77.8 (56)	76.4 (55)	.84
Ethnicity			.25
Caucasian	100.0 (72)	94.4 (68)	
African American	0 (0)	2.8 (2)	
Other	0 (0)	2.8 (2)	
Prior procedure			1.0
Open RYGB	1.4 (1)	1.4 (1)	
Laparoscopic RYGB	98.6 (71)	98.6 (71)	
Comorbid risk factors			
Smoking history before RYGB	41.7 (30)	37.5 (27)	.61
Current smoking (at ulceration)	33.3 (24)	30.6 (22)	.72
Current alcohol use (any at ulceration)†	24.6 (16)	28.8 (19)	.59
GERD	55.6 (40)	55.6 (40)	1.0
NSAID Use	5.6 (4)	9.7 (7)	.35
Proton pump inhibitor use before ulceration	50.7 (36)	71.8 (51)	.01*
Surgical approach for ulcer repair			.31
Open	15.3 (11)	9.7 (7)	
Laparoscopic	84.7 (61)	90.3 (65)	
Variable, mean (s.d.)	**SGP**	**RG**	**p value**
Age (yr)	50.0 (12.5)	49.4 (12.5)	.78
Weight (kg)	91.6 (28.6)	90.0 (24.7)	.82
BMI (kg/m2)	32.2 (8.7)	32.4 (8.2)	.99
Time from RYGB to perforation, yr	2.6 (1.8)	3.2 (3.0)	.13
Operative time, min	57.7 (23.2)	93.8 (31.2)	< .001***
Length of stay after ulcer surgery, days	6.8 (8.6)	5.0 (3.9)	.12
Follow-up after perforated ulcer, yr	2.9 (3.1)	2.5 (2.8)	.30

†One revision patient reported heavy alcohol use

Comorbid risk factors included gastroesophageal reflux disease in 55.6% of patients and a history of cigarette smoking before RYGB in 39.6% of patients. At the time of ulceration, 31.9% had returned to cigarette smoking after achieving nonsmoking concentrations of urine cotinine before RYGB, and 26.7% of patients reported some alcohol consumption. The majority (22/35) reported less than weekly consumption. In addition, 7.6% reported regular nonsteroidal anti-inflammatory drug use at the time of ulceration.

Perforation occurred a mean of 2.9 ± 2.5 years after RYGB (see Fig. 1). No perforated cancer was found; however, one patient in the SGP group was undergoing chemotherapy for ovarian cancer at the time of ulceration. The majority (87.5%) of SGP and RG operations were performed laparoscopically. Operative times differed significantly, with SGP taking a mean of 57.7 min versus 93.8 min for RG, $p < 0.001$. The length of stay after ulcer repair, 5.9 ± 6.7 days, did not differ significantly by procedure type. Mean follow-up after ulcer surgery, 2.7 ± 2.9 years, also did not differ by surgery type. Esophagogastrojejunoscopy (EGJ) was performed on 56.3% of patients during the follow-up period (45 of SGP and 36 of RG group).

Participants had a mean of 1.2 ± 1.7 EGJs in the SGP group and 0.8 ± 1.1 in the RG group ($p = $ ns). The time to the first EGJ did not differ by group (87.0 ± 98.5 days for SGP and 86.1 ± 74.5 days for RG).

Short-term complications did not differ by ulcer procedure type (see Table 2). Leaks occurred in 2.1% of patients (2 SGP and 1 RG), 4.2% required re-operation during the hospital stay (to repair leaks/drain abscesses, $n = 4$; repair bleeding, $n = 2$; or perform a RYGB reversal, $n = 1$), and 4.2% (3 SGP and 3 RG) were readmitted within 30 days of surgery. Re-admissions occurred for abdominal pain due to fluid collection and possible abscess ($n = 3$); nausea/vomiting, inability to eat, and/or dehydration ($n = 3$); or ileus ($n = 1$). In contrast, longer term complications including re-ulceration (treated medically in 8 SGP and 1 RG patient, or surgically after the initial perforation in 22 SGP and 7 RG patients) and RYGB reversal were significantly less likely after RG compared to SGP (8 SGP versus 2 RG). In all cases, reversals were performed due to chronic ulcer disease. A total of 4 deaths occurred at any time following ulcer surgery, with 2 from each procedure type. For the SGP group, both deaths occurred during the hospitalization following

Fig. 1 Time (years) from Roux-en-Y surgery to perforated marginal ulcer for patients receiving suturing with or without Graham patch (SGP) or revision gastrojejunostomy (RG)
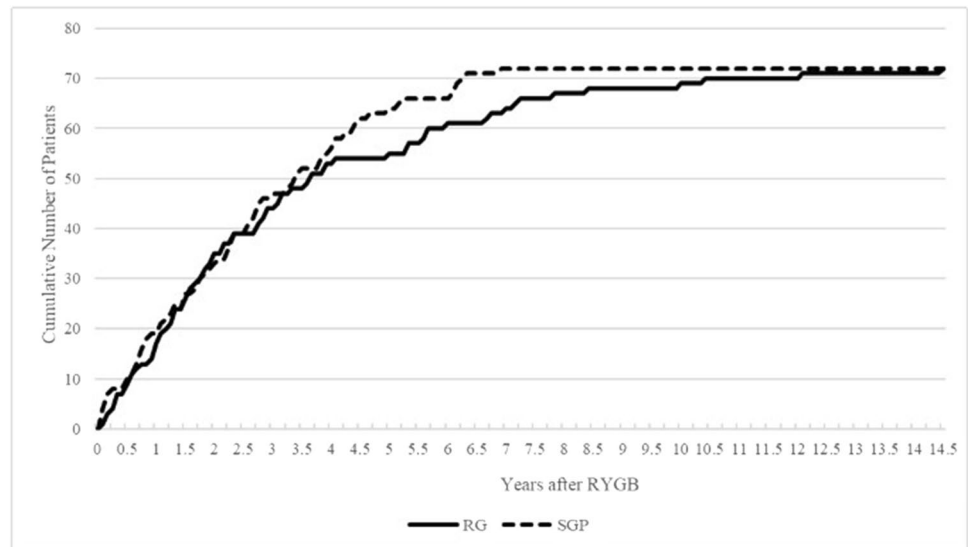

Table 2 Surgery complications for patients receiving suturing with or without Graham patch (SGP) or revision gastrojejunostomy (RG) for perforated marginal ulcer repair

Variable, % (n)	SGP	RG	p value
Leak	2.8 (2)	1.4 (1)	.56
Re-admission (30 days)	4.2 (3)	4.2 (3)	1.0
Re-operation (during initial hospital stay)	5.6 (4)	2.8 (2)	.40
RYGB reversal (at any time)	11.1 (8)	2.8 (2)	<.05*
Re-Ulceration (at any time)	41.7 (30)	11.4 (8)	<.001***
Deaths (at any time) [a]	2.8 (2)	2.8 (2)	1.0
Variable, mean (s.d.)	SGP	RG	p value
Total number of ulcers per patient	1.5 (0.6)	1.2 (0.5)	.001**
Time to second ulcer (mon)	35.5 (34.5)	24.9 (28.2)	.43
Time from perforated ulcer to RYGB Reversal (mon)	22.0 (32.0)	18.5 (12.0)	.89

[a]In the SGP group, 2 deaths occurred during the hospitalization after the repair. In the RG group, one death occurred 5 months after the perforation (cause unknown) and one death occurred 2.5 years after the perforation due to chronic liver disease/cirrhosis

the ulcer repair. For the RG group, the first death occurred 5 months post-operatively (cause unknown) and the second death occurred 2.5 years after surgery due to chronic liver disease.

Discussion

In this study, patients underwent emergent operations for perforated MU at a mean 2.9 years after their index procedure. The late gastric ulcers in the present series have been associated with high production of stomach acid, possibly related to a large gastric pouch. The size of the pouch may have been due to the size made during surgery or dilation over time [14]. These late anastomotic ulcers tend to be aggressive, more likely to result in acute perforation and severe bleeding [14]. We did also find that 31.9% of patients had been smoking at the time of the ulcer perforation, which is a well-known risk factor for MU formation.

These findings support previous studies that have shown a suture repair with or without Graham patch can be safely applied to treat an acute perforation of an MU. However, the underlying issue that led to the ulcer may still persist, particularly if it was an ischemic ulcer or due to a large gastric pouch or an occult gastro-gastric fistula. A revision gastrojejunostomy can be used to address all of those possibilities. Performing an RG was shown to significantly decrease the incidence of ulcer recurrence. SGP patients had a recurrent ulcer rate of 41.7%, compared to 11.4% of RG patients. This higher recurrence

rate requires additional treatment with either medical or surgical management, which comes with added cost or complications of ongoing treatment and risk of additional ulcer complications if left untreated.

This approach of an RG for acute perforation is certainly not appropriate in all situations, as an RG requires a more extensive dissection, resection of tissue, and a new anastomosis, which will likely increase operative time and blood loss, which may not be appropriate for an unstable patient.

However, our study found that an RG can be done in a mean of 93.8 min, less than previously reported times in the past [12]. As laparoscopic technology has advanced, and with increased experience among bariatric surgeons, an RG can be done in less time now than an SGP may have been done in the past. Certainly, for an unstable septic patient, the fastest procedure that can obtain adequate source control is the ideal choice, but for a stable patient with a perforated ulcer, an RG can deal with the acute perforation as well as avoid a chronic issue with a non-healing ulcer.

The present analysis has limitations. It was a retrospective, observational study of MU repair. Dietary history and compliance with medications were not assessed and could have influenced the results. Data included surgeries performed by eight surgeons, who made their own decisions about the proper operation for their patients. Except for one surgery, all were performed by surgeons with bariatric fellowship training and/or at least 5 years of bariatric practice. There was not a protocol to determine which patients would undergo SGP vs RG, nor was there random assignment to procedure. Operative notes were all reviewed to see if the decision rationale was explained. The authors' preference is to do an RG if feasible. Although precise measurement of perforation size was not available in all charts, surgeons appeared to choose SGP for patients with smaller perforations (mean ± s.d. of 42 ulcers was 0.35 ± 0.82 cm for SGP versus 1.34 ± 0.86 cm for 30 ulcers in RG. Of charts with descriptors, 9/11 of SGP ulcers were described as small, while 18/25 of RG ulcers were described as large to very large). Operative notes suggest that SGP was performed in patients with greater health challenges, including malnutrition, cancer, anticoagulant use, dialysis, pulmonary embolism, and sepsis (34 patients), while RG was performed more frequently in patients with chronic ulcer disease (20 patients). Reflective of this, patients on proton pump inhibitor (PPI) therapy at the time of the ulcer were more likely to receive RG as definitive treatment. Follow-up endoscopy was performed as clinically warranted, rather than on all patients. Finally, an additional surgical consideration not examined in this series would be performing a vagotomy to treat a refractory ulcer. This can be done laparoscopically or thoracoscopically, with improvement in ulcer healing rates having been previously reported [15].

Conclusion

While acutely perforated MUs have traditionally been repaired via suturing the perforation and applying an omental patch, the present study found that patients can be safely and effectively treated by RG with a significantly lower rate of ulcer recurrence, which could result in the subsequent need for an RG or even Roux-en-Y reversal.

Declarations

Competing Interests The authors declare no competing interests.

References

1. Azagury DE, Abu Dayyeh BK, Greenwalt IT, Thompson CC (2011) Marginal ulceration after Roux-en-Y gastric bypass surgery: characteristics, risk factors, treatment, and outcomes. Endoscopy 43:950–954.

2. Bhayani NH, Oyetunji TA, Chang DC, Cornwell EE, Ortega G, Fullum TM (2012) Predictors of marginal ulcers after laparoscopic Roux-en-Y gastric bypass. J Surg Res 177:224–227.

3. Coblijn UK, Lagarde SM, de Castro SM, Kuiken SD, van Wagensveld BA (2015) Symptomatic marginal ulcer disease after Roux-en-Y gastric bypass: Incidence, risk factors and management. Obes Surg 25:805–811.

4. Shikora SA, Claros L, Kim JJ, Tamoff ME (2008) Late complications: Ulcers, stenosis, and fistula. In Pitombo C editor. Obesity Surgery: Principles and Practice. New York, McGraw –Hill; pp. 313–318.

5. Kalaiselvan R, Exarchos G, Hamza N, Ammori BJ (2012) Incidence of perforated gastrojejunal anastomotic ulcers after laparoscopic gastric bypass for morbid obesity and role of laparoscopy in their management. Surg Obes Relat Dis 8:423-428.

6. Altieri MS, Pryor A, Yang J, Yin D, Docimo S, Bates A, Talamini M, Spaniolas K (2018) The natural history of perforated marginal ulcers after gastric bypass surgery. Surg Endosc 32:1215-1222.

7. Pyke O, Yang J, Cohn T, Yin D, Docimo S, Talamini MA, Bates AT, Pryor A, Spaniolas K (2019) Marginal ulcers continue to be a major source of morbidity over time following gastric bypass. Surg Endosc 33:3451-3456.

8. Csendes A, Torres J, Burgos AM (2011) Late marginal ulcers after gastric bypass for morbid obesity. Clinical and endoscopic findings and response to treatment. Obes Surg 21:1319-1322.

9. Clapp B, Hahn J, Dodoo C, Guerra A, de la Rosa E, Tyroch A (2019) Evaluation of the rate of marginal ulcer formation after bariatric surgery using the MBSAQIP database. Surg Endosc 33:1890-1897.

10. Csendes A, Burgos AM, Altuve J, Bonacic S (2009) Incidence of marginal ulcer 1 month and 1 to 2 years after gastric bypass:

a prospective consecutive endoscopic evaluation of 442 patients with morbid obesity. Obes Surg 19:135–138.

11. Moon RC, Teixeira AF, Goldbach M, Jawad MA (2014) Management and treatment outcomes of marginal ulcers after Roux-en-Y gastric bypass at a single high volume bariatric center. Surg Obes Relat Dis 10:229–234.

12. Wendling MR, Linn JG, Keplinger KM, Mikami DJ, Perry KA, Melvin WS, Needleman BJ (2013) Omental patch repair effectively treats perforated marginal ulcer following Roux-en-Y gastric bypass. Surg Endosc 27:384-389.

13. Wheeler AA, de la Torre RA, Fearing NM (2011) Laparoscopic repair of perforated marginal ulcer following Roux-en-Y gastric bypass: A case series. J Laparoendosc Adv Surg Tech A 21:57-80.

14. Racu C, Mehran A (2010) Marginal ulcers after Roux-en-Y gastric bypass: Pain for the patient …Pain for the surgeon. Bariatric Times 7:23-25.

15. Hunter J, Stahl RD, Kakade M, Breitman I, Grams J, Clements RH (2012) Effectiveness of thoracoscopic truncal vagotomy in the treatment of marginal ulcers after laparoscopic Roux-en-Y gastric bypass. Am Surg 78:663-668.