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Omental patch repair effectively treats perforated marginal ulcer following Roux-en-Y gastric bypass

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Abstract
Background Marginal ulcer formation remains a significant complication of Roux-en-Y gastric bypass (RYGB). Up to 1 % of all RYGB patients will develop free perforation of a marginal ulcer. Classically, this complication has required anastomotic revision; however, this approach is associated with significant morbidity. Several small series have suggested that omental patch repair may be effective. The aim of this study was to examine the management of perforated marginal ulcers following RYGB.
Methods All patients who underwent operative intervention for perforated ulcers between 2003 and 2011 were reviewed. Those with a history of RYGB with perforation of a marginal ulcer were included in the analysis. Data collected included operative approach, operative time, blood loss, length of hospital stay, complications, smoking history, and steroid or NSAID use.
Results From January 2003 to December 2011, a total of 1,760 patients underwent RYGB at our institution. Eighteen (0.85 %) developed perforation of a marginal ulcer. Three patients' original procedure was performed at another institution. Eight patients (44 %) had at least one risk factor for ulcer formation. Treatment included omental patch repair (laparoscopic, $n = 7$; open, $n = 9$) or anastomotic revision ($n = 2$). Compared to anastomotic revision, omental patch repair had shorter OR time (101 ± 57 vs. 138 ± 2 min), decreased estimated blood loss (70 ± 72 vs. 250 ± 71 mL), and shorter total length of stay (5.6 ± 1.4 vs. 11.0 ± 5.7 days).
Conclusions Perforated marginal ulcer represents a significant complication of RYGB. Patients should be educated to reduce risk factors for perforation, as prolonged proton pump inhibitor therapy may not prevent this complication in a patient with even just one risk factor. In our sample population we found laparoscopic or open omental patch repair to be a safe and effective treatment for this condition and it was associated with decreased operative time, blood loss, and length of stay.

Keywords Gastric bypass · Marginal ulcer · Perforation · Omental patch

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The prevalence of obesity continues to rise despite enormous efforts and resources dedicated to this problem [1, 2]. An increase in bariatric surgeries has followed this trend. The number of bariatric surgeries performed worldwide has been reported at over 340,000, with a majority being performed in North America. The Roux-en-Y gastric bypass (RYGB) accounts for ~40 % of these procedures. In a 5-year period from 2003 to 2008, worldwide incidence of RYGB has increased from 95,000 to 168,000 [3]. This procedure possesses its own unique set of complications, of which marginal ulceration remains quite common.

The incidence of marginal ulceration is commonly cited at 0.6–16 % [4–15] and is most frequently found at the gastrojejunal anastomosis [16]. Multiple risk factors have been identified, including diabetes, smoking, large gastric pouch size, gastrogastric fistulas [16, 17], nonabsorbable suture [13], use of NSAIDs [14, 17], and *H. pylori* [12, 18, 19]. However, the cause of marginal ulcers is still not well understood, and some of these factors continue to be debated. Most patients present with abdominal pain [12, 16], but the most severe presentation remains perforation.

Recent studies suggest 0.89–1.0 % of all RYGB patients will present with perforation of a marginal ulcer [20, 21]; however, the preferred management has not been determined. With an increase in bariatric surgery procedures, it would follow that this complication will be encountered more frequently. Therefore, it is important to identify the preferred management of the perforated marginal ulcer. We aim to demonstrate that omental patch repair is a safe and effective treatment of the perforated marginal ulcer.

Materials and methods

A retrospective review of all patients who underwent operative intervention for perforated ulcers between 2003 and 2011 was performed. All patients who where found to have perforations of a marginal ulcer at the gastrojejunal anastomosis after RYGB were included. Data collected included time to presentation, presenting symptom, demographic information, operative time, estimated blood loss (EBL), ICU length of stay, total length of stay, and preoperative proton pump inhibitor (PPI) use. Data regarding risk factors (smoking, NSAID use, systemic steroid use) for marginal ulceration were included. These risk factors were chosen because they are reversible, apply to our patient population or RYGB technique, and were available in our review of the data. Results are expressed as either mean (±standard deviation) or median (range), as appropriate. Statistical analysis was performed using an unpaired Student's *t* test. *P* values <0.05 were considered significant.

Laparoscopic Roux-en Y gastric bypass technique

For all procedures done at our institution, a 30-mL gastric pouch was created using sequential firings of a linear surgical stapler. RYGB reconstruction was performed using a 150-cm Roux limb in an antecolic/antigastric fashion. An end-to-side gastrojejunostomy was created with a 25-mm circular surgical stapler. Anastomotic integrity was evaluated endoscopically and with insufflation while submerged in saline. Closed suction drainage was placed adjacent to the anastomosis in all patients.

Perforated marginal ulcer repair technique

At the time of presentation, all patients were evaluated by either abdominal plain film or computed tomography, and the presence of pneumoperitoneum was discovered. Patients underwent one of two repairs: omental patch repair (open or laparoscopic) or exploratory laparotomy with revision of the gastrojejunostomy. Omental patch repair was performed in the standard fashion, as for duodenal ulcer disease, with a tongue of omentum being approximated over the perforation with silk suture. Both the laparoscopic and open omental repairs selectively included primary closure of the perforation with an absorbable suture and/or drain placement.

Results

Over a 9-year period from January 1, 2003 to December 31, 2011, a total of 1,760 patients underwent laparoscopic RYGB at our institution. Fifteen (0.85 %) developed perforation of a marginal ulcer at the gastrojejunal anastomosis. Three additional patients were treated for this condition whose original RYBG (all open) were performed at another institution. In total, 18 patients were treated for gastrojejunal perforation. A summary of the data is presented in Table 1. The median time to presentation was 24 (2–98) months. Females accounted for 72.2 % of those presenting. Abdominal pain was the presenting symptom for all but one patient. This patient presented 1 week before perforation for a necrotic soft tissue infection and was in critical condition when the perforation occurred. Eight patients (44 %) had at least one risk factor for marginal ulcer formation and two patients (11 %) had two risk factors. Of these eight patients, three (38 %) were taking

Table 1 Time to presentation and presence of risk factors in individual cases

Case No.	Time to presentation (months)	Risk factors			
		Smoking (y/n)	NSAIDs (y/n)	Systemic steroids (y/n)	PPI use (y/n)
1	2				✔
2	3				
3	5				
4	8	✔			
5	36		✔		✔
6	Unknown	✔			✔
7	54				✔
8	60		✔		
9	72	✔	✔		✔
10	2		✔	✔	
11	19				
12	30				✔
13	48			✔	
14	60				
15	15				
16	98		✔		
17	14				✔
18	24				✔
	Median = 24	$N = 3$	$N = 5$	$N = 2$	$N = 8$

Table 2 Summary of data by operation

	Omental patch repair ($n = 16$)	Anastomotic revision ($n = 2$)
Operative time (min)	101 ± 57	137 ± 2
EBL (mL)	70 ± 72	250 ± 71
LOS	5.60 ± 1.40	11.00 ± 5.66

EBL estimated blood loss, *LOS* length of stay

Table 3 Comparison of open versus laparoscopic omental patch repair

	Laparoscopic ($n = 7$)	Open ($n = 9$)	*P* value
Operative time	90 ± 56	110 ± 60	0.4983
EBL	18 ± 9	109 ± 74	0.0116
LOS	5.43 ± 1.13	5.75 ± 1.67	0.6747

EBL estimated blood loss, *LOS* length of stay

PPIs at the time of perforation. There were five patients (30 %) who were on PPI therapy with no identified risk factor present.

Surgical treatment included laparoscopic abdominal washout with Graham patch repair ($n = 7$), open washout with Graham patch repair ($n = 9$), or gastrojejunal anastomotic revision ($n = 2$). A summary of the results by technique is given in Table 2. Compared to anastomotic revision, patients who underwent abdominal washout with omental patch repair had decreased operative time, estimated blood loss, and total length of stay. A comparison of laparoscopic and open omental patch repair is given in Table 3. Patients who underwent laparoscopic washout and omental patch repair had a nonsignificant decrease in OR time ($p = 0.4983$) and total length of stay ($p = 0.6747$) compared to those of the open technique. Estimated blood loss was significantly less ($p = 0.0116$) in laparoscopic repair compared to open.

The overall operative morbidity was 16.7 %. Two patients in the laparoscopic group developed abdominal abscesses. One of the two patients in the anastomotic revision group developed a pulmonary embolism and abdominal abscess. The operative mortality rate was 5.6 %. This one death was the patient who was critically ill preceding the perforation; this patient received an open omental patch repair.

Discussion

Our aim was to demonstrate that omental patch repair is safe and effective in treating perforated marginal ulcers. We believe we have done so. In treating 16 patients in this fashion, we demonstrated acceptable perioperative parameters in operative time, blood loss, length of stay, and morbidity at 1 month follow-up (Table 3). We found the incidence of perforated marginal ulcers in our study to be 0.85 %, which is consistent with the published literature. Lublin et al. [20], Kalaiselvan et al. [22], Felix et al. [21], and Patel et al. [11] reported rates of 0.89, 0.82, 1.0, and 0.44 %, respectively, with sample sizes ranging from 902 to 3,430. Our median time to presentation was 24 months (2–98), but varied greatly. One patient presented more than 8 years after her original surgery, which is the latest presentation we found in our literature search. Of those presenting, 72.2 % was female. This is consistent with our bariatric surgery patients, which is ~70 % female.

Multiple studies have evaluated risk factors for marginal ulcer formation [12, 16], but ultimately the process is not completely understood. There is even less known in regard to risk for marginal ulcer perforation.

Smoking is a well-known risk factor for marginal ulceration [16] due to its impact on microvasculature and mucosal barriers. It is likely a risk factor for perforation as well. Three of our patients were smokers at the time of their presentation. It has also been implicated by the three studies that investigated perforated marginal ulcers while reporting smoking status. Kalaiselvan et al. [22] had a smoking incidence of 60 % in his group of perforated marginal ulcers. Wheeler et al. [23] found a 50 % incidence in his population. Felix et al. [21] found 51 % of perforations were in smokers, a statistically significant difference when compared to the smoking rate of a matched cohort of nonperforators. In fact, four patients perforated a second time. This led the recommendation that gastric bypass patients who continue to smoke be placed on lifelong PPI therapy.

Both systemic steroids and NSAIDs increase the risk for marginal ulcer formation as they decrease the levels of protective prostaglandins in the gastrointestinal tract. There is also evidence that this may increase the risk of perforation. Felix et al. [21] and Kalaiselvan et al. [22] each found the incidence of NSAID use to be ~30 % in those who presented with perforation of a marginal ulcer. Consistently, NSAID use was present in 22 % of our population and steroid use in 11 %. Sasse et al. [24] reported seven cases of gastric perforation after RYGB of which six patients were using or abusing NSAIDs. They have adopted a zero-tolerance policy toward NSAID use in gastric bypass patients.

Gastric acid has been associated with marginal ulcer formation. The mucosa of the jejunum is not physiologically adapted to deal with gastric acid. Larger gastric pouches have a higher likelihood of containing parietal cells and have been associated with higher rates of marginal ulceration [25]. Smaller pouches confined to the

cardia have shown much lower marginal ulcer rates [26]. In addition to acid production in the pouch, gastrogastric fistula allows the low pH environment of the remnant stomach to communicate with the anastomosis. Marginal ulceration is the rule rather than exception in this situation. Capella et al. [17] observed 105 individuals with gastrogastric fistula; only one did not have marginal ulceration. PPI therapy in conjunction with sucralfate is curative in many patients [8]. There are other factors involved, however, as eight (44 %) of our patients were on full-dose PPIs at the time of their perforation, five of which had no other identifiable risk factor for marginal ulceration.

The orientation of the alimentary limb, either ante- or retrocolic, has been suggested to play a role in marginal ulcer formation, theoretically due to increased tension and ischemia with an antecolic technique. Lublin et al. [20] examined 902 cases of laparoscopic gastric bypass performed by a single surgeon. The first 403 patients underwent retrocolic anastomosis, where no perforated marginal ulcers occurred. The remaining patients all had an antecolic bypass and seven perforations occurred in this group. This would suggest that the orientation of the alimentary limb plays an important role. However, these results have not been duplicated in other studies. Felix et al. [21] did not find a significant difference in a sample size nearly four times as large. Kalaiselvan et al. [22] and our study looked at only antecolic orientation but had a similar incidence to that of Lublin [20] (0.82 and 0.85 % compared to 0.89 %, respectively) All gastric bypasses at our institution are performed using an antecolic technique due to higher rates of internal hernia associated with retrocolic anastomoses [27], which we believe justifies our choice of technique.

Another technical debate is how to perform the gastrojejunostomy. Linear stapler, circular stapler, and hand-sewn anastomoses are all utilized to varying degrees. Some have advocated that a hand-sewn anastomosis results in less ischemia of the tissue and therefore may decrease marginal ulcer formation. This has not been clearly demonstrated, however. In a series of 882 consecutive patients with a 2-month follow-up, Bendewald et al. [28] found no difference in marginal ulcer formation rates.

The role *H. pylori* has in the development of marginal ulcers has been widely debated. Schirmer et al. [29] found a significantly lower incidence of marginal ulceration after RYGB after they began to perform preoperative screening. However, preoperative eradication was not confirmed. Rasmussen et al. [12] found that marginal ulceration was twice as common after RYGB in patients who were seropositive prior to their operation, even after adequate treatment. Conversely, both Papasavas et al. [18] and Yang et al. [30] found that *H. pylori* infection was not related to marginal ulcer formation. In studies that specifically looked at perforation of marginal ulcers after RYGB, both Felix et al. [21] and Kalaiselvan et al. [22] had no seropositive patients in those who where tested. In the Hartin et al. [31] study there were no perforations in those who were tested; all perforations were in the nontested group. The difference, however, did not reach statistical significance. It is also unknown how many patients in the untested group were seropositive, as this was a retrospective study. As this topic continues to be explored, it is our policy not to routinely screen for *H. pylori* prior to gastric bypass. However, patients will undergo preoperative EGD with biopsy and *H. pylori* testing if symptomatic.

At this time, the preferred operation for perforated marginal ulcers has not been defined. Some have advocated revision of the gastrojejunal anastomosis, and this technique has been used for management of refractory ulcer disease [32]. However, revisional bariatric surgery can be technically challenging in a controlled, elective setting. It becomes even more so under emergent conditions as exposure of the upper abdomen is difficult in the setting of free perforation. This also places the integrity of the small gastric pouch at risk, and major complication rates have been cited as high as 30 % [33]. For these reasons, omental patch repair has been explored as a potential therapy. For years it has been utilized in the treatment of perforated duodenal ulcers. Even though our sample size is too small for significant statistical analysis, we found omental Graham patch repair to be superior to anastomotic revision in terms of OR time, estimated blood loss, and length of stay. This is intuitively logical as it is a less complex operation. There have been other small series or case reports that have also found Graham patch repair to be safe and effective [20, 22, 23, 34–37].

Anastomotic revision may be better suited for elective cases of intractable ulcer disease or for perforations that are not amendable to omental patch because of location or extent. In regard to intractable ulcer disease, both minimally invasive techniques and partial revisions have been described with some success [11, 33].

In regard to whether the abdominal washout and omental patch repair should be performed open or laparoscopically, several factors need to be considered. Binenbaum et al. [34] suggests that a laparoscopic approach is safe within 24–48 h of the onset of symptoms. Also, the hemodynamic stability of the patient and their ability to tolerate abdominal insufflation must be considered. Finally, the technical abilities of the operating surgeon and their comfort with performing minimally invasive techniques in the bariatric patient are important. The benefit of minimally invasive omental patch repair for the treatment of perforated duodenal and peptic ulcer disease has been demonstrated [38–41]. It is logical to assume that these same benefits would be seen in the treatment of perforated marginal ulcer as long as the considerations listed above are acknowledged.

Conclusions

Perforated marginal ulcer represents a significant and not uncommon complication of RYGB. RYGB patients should be educated to reduce risk factors for perforation, as prolonged PPI therapy may not prevent this complication in the presence of even one risk factor. Further studies are needed to determine the optimal dose and duration of PPI therapy in at-risk bariatric populations.

Laparoscopic or open abdominal washout with omental patch repair is a safe and effective treatment for this condition that was associated with decreased operative time, blood loss, and hospital stay compared to anastomotic revision in our sample population. We believe laparoscopic surgery is preferable in the appropriate surgical candidate with a surgeon comfortable with the technique in a bariatric patient.

Disclosures Dr. Mark R. Wendling, Dr. John G. Linn, Dr. Kara M. Keplinger, Dr. Dean J. Mikami, Dr. Kyle A. Perry, Dr. W. Scott Melvin, and Dr. Bradley J. Needleman have no conflicts of interest or financial ties to disclose.

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