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Marginal ulcer after mini gastric by-pass and sleeve gastrectomy with transit bipartition

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Abstract

The aim of this study to present the incidence of marginal ulcer among patients who underwent laparoscopic mini gastric by-pass (MGBP) or laparoscopic sleeve gastrectomy with transit bipartition (SG-TB), and to determine demographic, clinical and surgical risk factors associated with marginal ulcer development. This case-control study was designed as a retrospective analysis of an SG-TB and MGBP surgical series. The marginal ulcer group consisted of 8 patients who developed marginal ulcers during their follow-up. The control group was formed with a randomly selected sample of 18 people matching according to age, sex and operation type among the remaining 626 patients. The median age of all patients included in the study was 51 (27-62) years. 75.0% of the marginal ulcer group and 66.7% of the control group were males (p = 1.000). Marginal ulcer developed in 1.26% of all patients who underwent bariatric-metabolic surgery, in 6.45% of patients who underwent MGBP, and in 0.99% of patients who underwent SG-TB. It was observed that the ulcers of all cases recovered completely. No perforation was observed in any patient, no surgical intervention was required, and no marginal ulcer-related mortality was observed. There was no significant difference between the marginal ulcer group and the control group in terms of surgical, clinical and demographic features. Considering our practices and results, it was thought that post-operative PPI treatment for at least 6 months had a preventive effect on marginal ulcer development, and PPI treatment used after marginal ulcer development had an important role in healing.

Keywords: obesity, marginal ulcer, mini gastric by-pass, sleeve gastrectomy with transit bipartition, bariatric-metabolic surgery

1. Introduction

Obesity is a growing public health problem which is comparable to a pandemic since it affects more than 1 billion people worldwide (1). Bariatric-metabolic surgery (BMS) has unique efficacy in the treatment of obesity and related complications, and its indications continue to expand (2). This increased frequency of administration inevitably increases the frequency of complications. In particular, late complications are not uncommon and can occur several years after surgery (2, 3). Sleeve gastrectomy (SG) has been specifically associated with incisura angularis stenosis and gastroesophageal reflux disease, gastric bypass (GBP) is specifically associated with marginal ulceration, gastrojejunal anastomotic stenosis, internal hernia, gastro-gastric fistula, while cholelithiasis, abdominal pain and undesirable weight gain may occur after either surgery (2, 4).

The incidence of marginal ulcer after BMS has been reported in a very wide range, from 0.35% to 25% (4, 5). Studies claim that various factors contribute to the pathophysiology of marginal ulcer, including high acidity due to large pouch size or gastro-gastric fistula, loss of protective effects provided by pancreatobiliary secretions in the jejunum (due to gastrojejunal anastomosis), helicobacter pylori, local ischemia, foreign bodies (e.g., suture material), suture technique, smoking, corticosteroid and non-steroidal anti-inflammatory drug (NSAID) use (2, 6, 7). However, the roles of these factors in the pathophysiology of marginal ulcers have not been clarified. Both laparoscopic SG and mini GBP (MGBP) are newer bariatric procedures compared to the classical Roux-en-Y GBP (RY-GBP). In particular, SG has become a mainstay procedure to treat morbid obesity. MGBP is also rapidly gaining global acceptance as an effective BMS procedure (8-11). First described by Santoro et al., the SG with transit bipartition (SG-TB) procedure is an adaptation that involves manipulation of the digestive tract to modulate neuroendocrine response of the distal small intestine in order to minimize malabsorption (12). Studies evaluating marginal ulcers have mainly focused on RY-GBP (7, 13) and the incidence or risk factors of marginal ulcers after MGBP (3, 14) or SG-TB (15, 16) have been researched relatively rarely.

In this study, we aimed to present the incidence of marginal ulceration in patients who underwent laparoscopic MGBP or laparoscopic SG-TB and to determine the risk factors for marginal ulcer development by comparing the clinicodemographic and surgical features of patients with and without marginal ulceration.

2. Material and Methods

This single-centered case-control study was designed as the retrospective analysis of a surgical series investigating laparoscopic SG-TB and laparoscopic MGBP for which data

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had been collected prospectively. The surgical procedures administered in our Bariatric Surgery Center of Exellence (COE), Department of General Surgery, Büyük Anadolu Hospital, Istanbul, Turkey was approved by the local Ethics Committe (No: YDU/2022/102-1515). The study was conducted in compliance with the 1964 Helsinki declaration and its later amendments.

2.1. Participants and data collection

The data of 634 patients with body mass index (BMI) ≥ 35 kg/m^2 who underwent BMS in our department between 2015 and 2021 were evaluated retrospectively. Laparoscopic SG-TB was performed to 603 obese patients with type 2 diabetes mellitus (T2DM) and a BMI of ≥35 kg/m^2, and laparoscopic MGBP was performed to 31 patients without T2DM and with a BMI of ≥40 kg/m^2. As a result of endoscopic controls, it was observed that marginal ulcer developed in 8 patients who comprised the marginal ulcer group. The "control group" was formed with a randomly selected sample of 18 subjects from the remaining 626 patients by matching according to age, sex and operation type. Patients younger than 18 years old and older than 65 years, patients who underwent revision surgery, patients who died, those whose data could not be reached, those with known peptic ulcer, Barrett's esophagus or liver cirrhosis, recipients of preoperative proton pump inhibitors (PPI), and those with major psychiatric disease were excluded from the study. Data of the cases, such as age, sex, BMI, type of operation, presence of diabetes, alcohol consumption and smoking, preoperative campylobacter-like organism (CLO) test results, drugs used, preoperative hemoglobin A1c (HbA1c) values, total cholesterol and triglyceride values were obtained from the digital records in the hospital database.

2.2. Surgery, follow-up and treatment

A routine surgical protocol was performed to all patients for BMS and routine follow-up was applied after surgery. Patients were called for controls 1 week, 1 month, 3 months, 6 months, 1 year after surgery and once a year thereafter. Oral PPI (pantoprazole 40 mg) was administered to all patients once a day for 6 months after the operation (14, 17). Upper gastrointestinal system endoscopy was performed before the operation and at 6-month intervals after the operation. In addition to the routine control examinations, upper gastrointestinal endoscopy was also performed in patients with relevant complaints. PPI treatment was resumed (if discontinued by patient) or continued in all patients with marginal ulceration, and nutritional regimens were adjusted according to the advice received from a dietitian. Patients with bleeding were hospitalized and necessary medical treatment and blood replacement procedures were applied, and the treatments of those using anticoagulants were altered if deemed necessary after hematology referral.

2.3. Statistical analysis

All analyses were performed in IBM SPSS v25.0 (IBM Corp., Armonk, NY, USA) with a significance threshold set at $p < 0.05$. The suitability of quantitative variables to normal distribution was evaluated with histogram and Q-Q plots. Quantitative variables were summarized as median (smallest value - largest value), while qualitative variables were summarized as frequency (percentage). Quantitative variable comparisons were performed with the Mann-Whitney *U* test. Qualitative variable distributions were compared with the Fisher's exact test.

3. Results

The median age of all patients included in the study was 51 (27-62) years. In terms of age, the marginal ulcer group [51 (32-61)] and the control group [51.5 (27-62)] were similar ($p = 0.802$). Males comprised 75.0% of the marginal ulcer group and 66.7% of the control group ($p = 1.000$).

Six of the patients who developed marginal ulcer also had T2DM. In patients with T2DM, marginal ulcer was observed on endoscopic examination performed at the first-year control examination. In patients without T2DM, marginal ulcer was observed 3 years after the operation in one patient and 4 years after the operation in the remaining patient. Two patients with T2DM applied with the complaint of bleeding and both of these patients were using anticoagulants. In the endoscopies of patients with bleeding, the bleeding ulcer was observed on the ileal side of the gastroileal anastomosis. The primary complaint of the remaining 4 patients with T2DM was epigastric pain. Both non-T2DM patients with marginal ulcers were active smokers and one had excessive alcohol consumption. The primary complaint of the patient with alcohol consumption was bleeding, while the other reported epigastric pain.

Overall, it was determined that marginal ulcer developed in 1.26% of all patients who underwent BMS. This percentage was 6.45% among MGBP recipients, and 0.99% among SG-TB recipients. The intergroup differences of all investigated variables are summarized in Table 1, and the demographic and clinical characteristics of all patients with marginal ulcers are summarized in Table 2. It was observed that all marginal ulcers were completely healed in the control upper gastrointestinal system endoscopies performed 3 months later. No perforation was observed, no surgical intervention was required, and no marginal ulcer-related mortality was observed in any of these patients.

4. Discussion

Marginal ulcer is a well-established complication that can occur after BMS. Although many factors have been associated with its pathophysiology, the contributions of these factors remain unclarified (2, 7). In the present study, the incidence of marginal ulcer was found to be 1.26% in all patients who underwent BMS. While this rate was 6.45% in MGBP patients, it was 0.99% in SG-TB patients. Asymptomatic marginal ulcer was not observed in any of our patients undergoing control endoscopy. There was no significant difference between the marginal ulcer group and the control group in terms of the parameters evaluated in the study.

Table 1. Patient characteristics and intergroup analysis results

	Marginal ulcer group (n=8)	Control group (n=18)	p
Age	51 (32 - 61)	51.5 (27 - 62)	0.802
Sex			
Male	6 (75.0%)	12 (66.7%)	1.000
Female	2 (25.0%)	6 (33.3%)	
Body mass index (kg/m^2)	35.95 (35.0 - 46.0)	35.15 (30.1 - 60.9)	0.278
Operation			
Mini gastric bypass	2 (25.0%)	4 (22.2%)	1.000
Sleeve gastrectomy with transit bipartition	6 (75.0%)	14 (77.8%)	
Diabetes mellitus	6 (75.0%)	14 (77.8%)	1.000
Alcohol consumption	2 (25.0%)	3 (16.7%)	0.628
Smoking	4 (50.0%)	6 (33.3%)	0.664
Preoperative CLO Test			
Negative	7 (87.5%)	15 (83.3%)	1.000
Pozitive	1 (12.5%)	3 (16.7%)	
Drug use			
Non-steroidal anti-inflammatory drug	5 (62.5%)	6 (33.3%)	0.218
Oral antidiabetic	6 (75.0%)	11 (61.1%)	0.667
Insulin	5 (62.5%)	7 (38.9%)	0.401
Anticoagulant	5 (62.5%)	9 (50.0%)	0.683
Antihypertensive	6 (75.0%)	6 (33.3%)	0.090
HbA1c (%)	9.4 (5.4 - 13.2)	10.05 (4.4 - 12.8)	0.846
Total cholesterol (mg/dL)	168 (57.8 - 281)	117.3 (47 - 281)	0.127
Triglyceride (mg/dL)	162.5 (118 - 666)	181.5 (45 - 606)	0.890

Quantitative variables are given as median (smallest value - largest value) and qualitative variables are given as frequency (percentage).
Abbreviations; CLO: Campylobacter-like organism, HbA1c: Hemoglobin A1c

Table 2. Characteristics of patients with marginal ulceration

No	Age	Sex	BMI	Operation	DM	Alcohol	Smoking	Preoperative CLO Test	NSAID	Oral antidiabetic	Insulin	Anticoagulant	Antihypertensive	HbA1c(%)	Total cholesterol(mg/dL)	Triglyceride(mg/dL)
1	38	Male	46.0	MGBP	-	+	+	-	-	-	-	-	-	5.4	144	124
2	32	Female	41.0	MGBP	-	-	+	-	-	-	-	-	-	5.6	78	132
3	51	Male	35.0	SG-TB	+	-	+	-	+	+	+	+	+	10.3	169	189
4	56	Male	35.4	SG-TB	+	-	-	-	+	+	+	+	+	8.1	57.8	366
5	52	Male	35.0	SG-TB	+	+	-	-	+	+	+	+	+	8.5	241	666
6	45	Male	36.0	SG-TB	+	-	+	+	-	+	-	-	+	13.2	281	222
7	61	Female	35.9	SG-TB	+	-	-	-	+	+	+	+	+	10.7	210	118
8	51	Male	37.4	SG-TB	+	-	-	-	+	+	+	+	+	13.0	167	136

Abbreviations: BMI: Body mass index, CLO: Campylobacter-like organism, DM: Diabetes mellitus, HbA1c: Hemoglobin A1c, MGBP: Mini gastric bypass, NSAID: Non-steroidal anti-inflammatory drugs, SG-TB: Sleeve gastrectomy with transit bipartition

Morbid obesity is associated with increased mortality and morbidity. Surgical treatment provides sustainable weight loss, reduction in comorbidity and improvement in quality of life (7). Despite these benefits of BMS, both surgeons and patients may face the risks of some important complications, such as the development of marginal ulcers in or just distal to the gastroenteral anastomosis (7). In previous studies, the incidence of marginal ulcer has been reported between 0.35% and 25% (4, 5). In this study, it was observed that marginal ulcer developed in 1.26% of all patients, 6.45% of patients who underwent MGBP, and 0.99% of patients who underwent SG-TB. In a retrospective study, marginal ulcer development rates in SG and MGBP patients followed for at least 5 years were found to be 0% and 1.4%, respectively (11). Ece et al. (n = 26) and Topart et al. (n = 71) did not observe any marginal ulcers in any of the patients who had SG-TB during their 1-year and 2-year follow-up periods, respectively. In these studies, it was also reported that marginal ulcers did not occur in patients who had undergone RY-GBP (n = 83, n = 71, respectively) (16, 18). In a systematic review of 12.807 patients who underwent

MGBP, the incidence of marginal ulcer was reported as 2.7% (10). Clapp et al. reported a marginal ulcer incidence of 0.35% in 44.379 GBP patients (4). In another study, the incidence of marginal ulcer reported by the surgeon after a total of 27,672 MGBP operations performed by 86 surgeons was investigated and this incidence was determined as 2.24% (14). It can be said that the frequency of marginal ulcer detected in our study is compatible with other studies. The reasons for the large differences in the incidence of marginal ulcer development after BMS may include different distributions of risk factors, patient characteristics, preoperative preparation, prophylaxis, surgical technique(s) and surgeon experience (14).

In this study, it was observed that the majority (6/8) of marginal ulcers developed within the first year. It was also noteworthy that all of them were identified in patients with T2DM who had undergone SG-TB. This result is consistent with the results of other studies reporting that marginal ulcers develop after 30 days of the intervention and within the first 2 years (4, 7, 19-21). If marginal ulcer is not diagnosed and treated early, it may cause serious complications such as massive bleeding and perforation and may require revision surgery. As a result of marginal ulcer after MGBP, perforation can be seen with a frequency of 8.2% and bleeding with a frequency of 9.5% (22, 23). A series of 7 cases with delayed anastomotic perforation caused by marginal ulcer after MGBP has been published (3). In a cohort study, 1-year outcomes of SG, MGBP and SG-TB operations were compared. While marginal ulcers were not observed in any patients in the SG group (0/104), marginal ulcer-induced perforation occurred in 1 patient (1/39) in the MGBP group and in 2 patients (2/34) in the SG-TB group (15). In the current study, none of the patients suffered from marginal ulcer perforation or had required revision surgery. Three of the 8 patients presented with the complaint of non-massive bleeding and completely recovered with conservative medical treatment.

Another important result of this study was that all patients with marginal ulcers were symptomatic. Baksi et al. argued that routine surveillance endoscopy performed 1 year after MGBP operation could detect asymptomatic marginal ulcers, and thus prevent ulcer-related complications (24). In this study, it was observed that none of the patients developed asymptomatic marginal ulcers. Therefore, it can be said that the necessity of routine control endoscopy in asymptomatic patients is not clear; however, since 6 of the 8 marginal ulcers were identified at the first year follow-up examination, the likelihood of asymptomatic marginal ulcer should not be overlooked in the earlier periods (23).

Risk factors that facilitate marginal ulcer occurrence after BMS have been the focus of attention for many researchers. Different risk factors for marginal ulcers have been identified in studies (6, 13, 21, 25). There was no significant difference between the patients with and without marginal ulcer in terms of the parameters we examined in this study, possibly due to the relatively low incidence of marginal ulcer in our patients. In a comprehensive study, increased BMI, need for percutaneous transluminal cardiac catheterization, history of deep vein thrombosis and pulmonary embolism were reported as significant risk factors for marginal ulcer after GBP (4). In the study of Mahawar et al., surgeons stated that the most important risk factors for the development of marginal ulcer after MGBP were smoking, NSAID use and alcohol consumption (14). In a population-based cohort study, risk factors for marginal ulcer development were investigated in 20,294 GBP patients, and it was stated that the presence of diabetes and a history of peptic ulcer were the most important risk factors, while hyperlipidemia, hypertension, chronic obstructive pulmonary disease, low-dose aspirin and NSAID use were not risk factors (26). In various studies, use of NSAIDs for more than 30 days, active smoking or smoking history, use of immunosuppressive drugs, preoperative gastroesophageal reflux disease, diabetes, dyslipidemia, coronary artery disease, chronic lung disease, time elapsed after surgery, inhaled steroid use, and gastric pouch location and its size were identified as risk factors for marginal ulcer development after RY-GBP (5, 6, 13, 21, 27, 28). The pathophysiological effects of these risk factors have not been clarified. Azagury et al. hypothesized that the increased incidence of marginal ulcers, particularly in patients with cardiovascular risk factors, may be related to impaired mucosal microcirculation around the gastro-jejunal anastomosis (21). Although it seems difficult to pinpoint definite risk factors, it can be said that the presence of diabetes, smoking and NSAID use in particular stand out as possible risks.

Acid exposure plays a role in the development of marginal ulcers and the effectiveness of PPI therapy in the treatment of marginal ulcers is clearly known (21). Coblijn et al. reported that 6 months of acid suppression therapy following surgery reduced marginal ulcer incidence from 7.3% to 1.2%, also Kang et al. showed that a 90-day PPI treatment was more effective than a 30-day treatment in preventing the occurrence of marginal ulcers (17, 29). In another study, it was argued that using PPI before the operation halved the probability of developing a marginal ulcer (13). In a survey study, 82.4% of 86 surgeons stated that they used PPIs prophylactically; however, it has been observed that there are differences in the drugs used, dosages and durations (14). Although there is no definite consensus regarding the duration of PPI use, many studies have suggested the use of PPIs in the first 6 months post-operatively (17, 24, 30). Some bariatric surgeons have argued that marginal ulcers after MGBP are more persistent, less responsive to PPI, and can lead to anastomotic perforation even years after surgery (31-33). We initiated PPI treatment in all patients undergoing BMS for at least 6 months postoperatively, and to patients who developed marginal ulcers until they were completely healed. We think that this approach has an important role in reducing marginal ulcer likelihood and the success of marginal ulcer management.

This study has some limitations. The fact that it was a single-centered study limited the generalizability of the results. Since the study was retrospective, data on some factors that may affect marginal ulcer development, such as gastric pouch width, sutures, staples or other foreign bodies, smoking and alcohol consumption could not be accessed, and therefore, their effects could not be investigated. Since marginal ulcer is a rare complication, the inevitably low number of cases may have affected the statistical results concerning the comparison of groups. The lack of follow-up of patients after inclusion in the study may have obscured the incidence of asymptomatic marginal ulcers that may occur later, and thus, the true incidence of marginal ulcers.

In conclusion, the overall incidence of marginal ulcer after BMS was found to be 1.26% (6.45% in patients who underwent MGBP, and 0.99% in patients who underwent SG-TB). There was no significant difference between the marginal ulcer group and the control group in terms of surgical, clinical and demographic characteristics. Considering our practices and results, it was thought that post-operative PPI treatment for at least 6 months had a protective effect in preventing marginal ulcer development, and PPI treatment in patients with marginal ulcer contributed to better management. It will be useful to carry out comprehensive and multicenter studies in order to determine the true incidence and risk factors of marginal ulcer and to establish a generally-accepted treatment and/or prevention algorithm.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Authors' contributions

Concept: M.A., Design: M.A., Data Collection or Processing: M.A., Analysis or Interpretation: M.A., Literature Search: M.A., Writing: M.A.

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