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Original article

Proton pump inhibitor prophylaxis after Roux-en-Y gastric bypass: A national survey of surgeon practices

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Abstract

Background: Proton pump inhibitors (PPIs) are frequently used after Roux-en-Y gastric bypass (RYGB) to prevent marginal ulceration. The optimal duration of PPI treatment after surgery to minimize ulcer development is unclear.

Objectives: Assess bariatric surgeon practice variability regarding postoperative PPI prophylaxis.

Setting: Survey of medical directors of Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program–accredited centers.

Methods: Members of the American Society for Metabolic and Bariatric Surgery research committee developed and administered a web-based anonymous survey in November 2021 to bariatric surgeons of Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program–accredited programs detailing questions related to surgeons' use of PPI after RYGB including patient selection, medication, dosage, and treatment duration.

Results: The survey was completed by 112 surgeons (response rate: 52.6%). PPIs were prescribed by 85.4% of surgeons for all patients during their hospitalization, 3.9% for selective patients, and 10.7% not at all. After discharge, 90.3% prescribed PPIs. Pantoprazole was most often used during hospitalization (38.5%), while omeprazole was most prescribed (61.7%) after discharge. The duration of postoperative PPI administration varied; it was 3 months in 43.6%, 1 month in 20.2%, and 6 months in 18.6% of patients. Finally, surgeons' practice setting and case volume were not associated with the duration of prophylactic PPI administration after RYGB.

Conclusions: PPI administration practices vary widely among surgeons after RYGB, which may be related to the limited comparative evidence and guidelines on best duration of PPI administration. Large prospective clinical trials with objective outcome measures are needed to define optimal practices for PPI prophylaxis after RYGB to maximize clinical benefit. (Surg Obes Relat Dis 2022;■:1–6.) © 2022 Published by Elsevier Inc. on behalf of American Society for Metabolic and Bariatric Surgery.

Keywords: Proton pump inhibitor prophylaxis; PPI; Gastric bypass; RYGB; Marginal ulcer; Survey

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Roux-en-Y gastric bypass (RYGB) is one of the most commonly performed operations comprising 17.8% of all bariatric operations in the United States in 2019 [1]. It is a well-tolerated surgery with low morbidity and mortality and favorable weight loss outcomes [2]. RYGB is often preferred in specific bariatric populations, such as patients with preoperative gastroesophageal reflux (GERD) or type 2 diabetes mellitus [3]. However, the formation of marginal ulcers (MUs) is a common complication after RYGB with a reported incidence from 0.6% to 16% [4–7]. MU presentation varies from asymptomatic to perforation or massive bleeding with considerable morbidity that could potentially lead to death [7–9].

Marginal or anastomotic ulcers occur at or near the gastrojejunal anastomosis and are thought to be caused primarily by acid injuring the jejunum. Other recognized risk factors include increased anastomotic tension resulting in poor tissue perfusion, the presence of foreign bodies, the size of the gastric pouch, concomitant gastrogastric fistulas, ulcerogenic medication use (e.g., nonsteroidal anti-inflammatory drugs or steroids), smoking, and *Helicobater pylori* infection [6,7,10,11]. In this context, prophylactic proton pump inhibitor (PPI) administration, defined as in-hospital and postdischarge PPI prescription in the absence of MU, following RYGB, is thought to suppress acid secretion and prevent MU formation. In fact, recent studies have shown a lower MU incidence in patients taking PPI prophylactically versus no PPI use [12,13].

While prophylactic PPIs are often prescribed after RYGB by surgeons, the practice patterns of PPI prophylaxis are unknown, and there is no consensus on the type of medication, dosage, frequency, and duration of administration. Significant variability in the duration of PPI prophylaxis, which ranges from 1 month to lifelong administration has been described in the literature [14]. Although the American Society for Metabolic and Bariatric Surgery (ASMBS) guidelines [15] suggest considering prophylactic PPI after RYGB, there is a gap in the literature on optimal practices for PPI prophylaxis to maximize the clinical benefit to patients. Therefore, this study aimed to explore bariatric surgeon practices regarding use of prophylactic PPI administration in patients after RYGB and document any existing practice variability.

Methods

The ASMBS Research Committee [16] developed a survey to investigate the different prophylactic PPI administration practices among bariatric surgeons to prevent MU following RYGB. An institutional review board exemption was obtained from Indiana University before distributing the survey to the participants. This survey was part of a larger initiative of the ASMBS Research Committee aiming to establish a research collaborative among Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP)–accredited centers. The interest of MBSAQIP–accredited center medical directors was initially solicited via email contact. Medical directors who responded and expressed interest in the topic of PPI prophylaxis after RYGB were the target population for this survey. The anonymous web-based survey (Qualtrics, Provo, UT, USA) was circulated via email to this group in November 2021. If the medical directors did not respond to the first invitation for participation in the survey, a second reminder was sent. All responses were deidentified, and only cumulative results or anonymous individual responses were presented. The survey was conducted in English and was closed for analysis on December 22, 2021.

The survey consisted of 13 questions, including demographic (e.g., type of clinical practice and the volume of bariatric operations) and clinical questions regarding PPI administration after bariatric surgery (Appendix 1). Specifically, the questions focused on patient selection, medication, dosage, and treatment duration. Multiple-choice and multiple-answer questions were included in the questionnaire. To ensure that respondents could enter other answers that were not listed as options, we provided a separate reply to every question titled "Other." If the participants chose this answer, they were able to provide additional detail regarding their practices.

Basic descriptive statistics were used for the interpretation of the survey results, and qualitative data from the open-text box questions were analyzed accordingly. Finally, subgroup analyses were conducted to evaluate for associations between postbariatric PPI use and surgeons' practice setting and bariatric case volumes. Binary variables were presented as absolute or relative frequencies and compared using chi-square test (or Fisher's exact test when applicable). For all tests, $P < .05$ was considered significant. All statistical analyses were performed with STATA 16.0 software (STATA Corporation, College Station, TX, USA).

Results

Two hundred thirteen medical directors of MBSAQIP-accredited centers were invited via email to participate in the current survey and 112 surgeons (52.6%) from 32 states participated. Most respondents were hospital-employed (49.5%), followed by academic (30.1%) and private practice (20.4%). The volume of bariatric operations in each center was high; specifically, 53.9% of the sites performed more than 200 bariatric surgery cases per year, 29.4% 100 to 200, 15.7% 50 to 99, and only 1% less than 50 cases.

When asked about the use of PPI prophylaxis during hospitalization following bariatric surgery, most surgeons (85.4%) responded that they routinely administered PPIs to all their patients, while 10.7% did not. The most common reasons for not using PPIs prophylactically were that their administration was not considered necessary or that histamine 2 receptor (H2) blockers were used instead. Moreover,

Table 1
Type, dose, and frequency of PPI use during and after hospitalization

Questions	During Hospitalization	Postdischarge
What kind of PPI prophylaxis do you use?		
Esomeprazole	4 (4.4%)	4 (4.26%)
IV Pantoprazole	14 (15.4%)	0 (0%)
Lansoprazole	2 (2.2%)	4 (4.3%)
Omeprazole	27 (29.7%)	58 (61.7%)
Pantoprazole	35 (38.5%)	19 (20.2%)
Famotidine (H2 blocker)	9 (9.9%)	6 (6.4%)
Other	0 (0%)	3 (3.2%)
What daily dosage? (Omeprazole)		
20 mg	12 (44.4%)	12 (42.9%)
40 mg	15 (55.6%)	16 (57.1%)
In what frequency? (Omeprazole)		
Q 12	3 (10.3%)	2 (7.1%)
Q 24	26 (89.7%)	26 (92.9%)
What daily dosage? (Pantoprazole)		
20 mg	2 (5.6%)	12 (35.3%)
40 mg	32 (88.9%)	22 (64.7%)
80 mg	2 (5.6%)	0 (0%)
In what frequency? (Pantoprazole)		
Q 12	2 (5.6%)	1 (2.9%)
Q 24	34 (94.4%)	33 (97.1%)

H2 = histamine 2; PPI = Proton Pump Inhibitor.
Data are expressed as n (%).

3.9% of responders used PPI prophylaxis during hospitalization on a selective basis. Of the participants who administered PPI prophylaxis during hospitalization, 38.5% used pantoprazole, 29.7% omeprazole, 15.4% intravenous pantoprazole, 9.9% famotidine (H2 blocker), and 2.2% lansoprazole. The most common daily dosage for respondents who selected omeprazole was 40 mg (55.6%), with 89.7% of respondents preferring daily administration over twice a day (10.3%) (Table 1). For pantoprazole, the most common daily dosage during hospitalization was 40 mg, chosen by 88.9%.

Upon discharge, PPI prophylaxis was prescribed for all patients by 79.6% of surgeons, selective PPI by 11.7%, and 8.7% did not prescribe PPI. The type of medication prescribed shifted from pantoprazole to omeprazole (61.7%). Nonetheless, pantoprazole was the second most preferred postdischarge PPI medication (20.2%). The rest of the medication types represented smaller percentages (Table 1). Additionally, the daily omeprazole dose did not decrease after discharge, with 57.1% of the surgeons choosing 40 mg and 42.9% using 20 mg. However, the daily 40 mg pantoprazole dose was selected by a smaller percentage of surgeons (64.7%) compared to during hospitalization.

When asking participants about the postdischarge duration of prophylactic PPI administration, the most common period was 3 months (43.6%), followed by 1 (20.2%) and 6 months (18.6%) (Table 2). A subgroup analysis was conducted to evaluate how preoperative GERD affected the duration of PPI administration after discharge following bariatric surgery (Table 2). As reported by the respondents, the duration of postdischarge PPI administration following RYGB was statistically different in the presence of preoperative GERD ($P < .001$), and a slight shift toward more prolonged use was noted (Fig. 1).

Next, the participants' responses were analyzed based on their practice setting and their program's bariatric case volumes. There was no association between hospital-employed, academic, or private practice settings and PPI in-hospital or postdischarge prophylaxis, or type or duration of PPI. Centers with $\geq$200 annual cases were defined as high-volume, while sites with $<$200 cases were considered low-volume. The use of PPI prophylaxis during hospitalization did not differ significantly between the high- or low-volume centers. However, the percentage of surgeons who prescribed prophylactic PPIs postdischarge to all patients was higher in the high-volume centers (87.3% versus 70.2%; $P = .034$; Table 3). Additionally, the type of medication during and after discharge did not differ among the programs (Table 3). Although surgeons at high-volume centers tended to give PPI prophylaxis in RYGB patients without preoperative GERD for a longer duration than lower-volume centers, no statistical significance was revealed. Specifically, 6 months or longer PPI prophylaxis was selected by 27% of surgeons at high-volume centers versus 17% at low-volume sites (Table 3). In the presence of preoperative reflux, more surgeons in the high-volume group administered postdischarge PPIs for 6 months than in the low-volume group (26.9% versus 9.8%; $P = .037$).

Discussion

Our study examined the clinical practice variability of PPI prophylaxis for the prevention of MUs after RYGB of bariatric surgeons from a rather representative sample of MBSAQIP-accredited centers in the United States. We identified that while most bariatric surgeons (80%–85%) use PPI prophylaxis after RYGB during hospitalization and postdischarge, there is significant variability in the type of medication used for prophylaxis and the duration of use. The latter appears to be influenced by the presence of preoperative reflux as surgeons tended to prescribe PPI for longer period if patients had GERD preoperatively. However, no significant difference was detected in postdischarge PPI prophylaxis duration when analyzing the responses based on the case volume of the program. An exception to this was that more surgeons prescribed postdischarge PPIs for 6 months to patients with preoperative GERD in the high- versus low-volume centers. Additionally, the type of PPI prophylaxis during and after hospitalization did not vary significantly between the high and low-volume centers.

Similar to our findings, Steinemann et al. [14] published a survey of 189 international surgeons regarding MU management after RYGB. They reported that 88% of the respondents prescribed prophylactic therapy, with 91% of them

Table 2
Postdischarge duration of prophylactic PPI administration based on the presence of preoperative GERD

Duration of PPI use	GERD	No GERD	Total	*P* value
Never	0 (0%)	6 (6.4%)	6 (3.2%)	$P < .001$
1 mo	21 (22.3%)	17 (18.1%)	38 (20.2%)	
2 mo	3 (3.2%)	4 (4.3%)	7 (3.7%)	
3 mo	40 (42.6%)	42 (44.7%)	82 (43.6%)	
6 mo	18 (19.2%)	17 (18.1%)	35 (18.6%)	
Indefinitely	6 (6.4%)	4 (4.3%)	10 (5.3%)	
Other	6 (6.4%)	4 (4.3%)	10 (5.3%)	

GERD = gastroesophageal reflux disease; PPI = proton pump inhibitor; RYGB = Roux-en-Y gastric bypass; SG = sleeve gastrectomy.
Data are expressed as n (%).
P value is calculated using Fisher's exact test.

preferring PPIs over H2 blockers (5%) or other medication (4%). This tendency of bariatric surgeons to favor PPIs compared to H2 blockers aligns with current bariatric surgery guidelines suggesting the use of H2 blockers only for the treatment and not the prevention of MUs [15]. In a meta-analysis of randomized trials, PPIs were the most effective agent for ulcer prevention in nonsurgical patients compared to H2 blockers [17]. Similarly, Mo et al. [18] demonstrated the superiority of PPIs over H2 blockers in preventing gastrointestinal ulcers and bleeding. However, comparative data following RYGB support the superiority of PPIs versus H2 blockers in treating MUs without direct comparisons regarding their prophylactic administration [19].

In the same survey by Steinemann et al. [14], prophylactic medication was administered for 1 month, 3 months, 6 months, greater than 6 months, and lifelong by 25%, 37%, 28%, 4%, and 5% of surgeons, respectively. The median duration of administration was 3 months with an interquartile range of 1–6 months. Like our results, the most common duration of prophylactic PPI use postdischarge was 3 months, followed by 6 months. It is surprising that a decade later, surgeon PPI prophylaxis practices have hardly changed, and significant variability still exists. This may be related to the absence of explicit guidelines for PPI prophylaxis after surgery. The newest ASMBS guidelines suggested extending PPI prophylaxis to 12 months for high-risk patients [15]. However, no specific recommendations were provided on the type of medication, dosage, frequency of administration, or criteria to determine high-risk patients, which is likely the consequence of limited existing evidence. Indeed, a recent, single-center retrospective study demonstrated that PPI administration for 3 months versus 1 month was superior in preventing symptomatic MU, with an occurrence rate of 6.5% versus 12.4%, respectively [20]. Furthermore, a meta-analysis by Ying et al. [13], including 2917 participants, showed that patients receiving PPIs prophylactically had 50% lower incidence of MU compared to no PPI use. These findings in addition to previous studies showing that patients with MU produce more gastric acid and have a lower pH in their gastric pouch and for longer periods [8,21], clearly support the regular

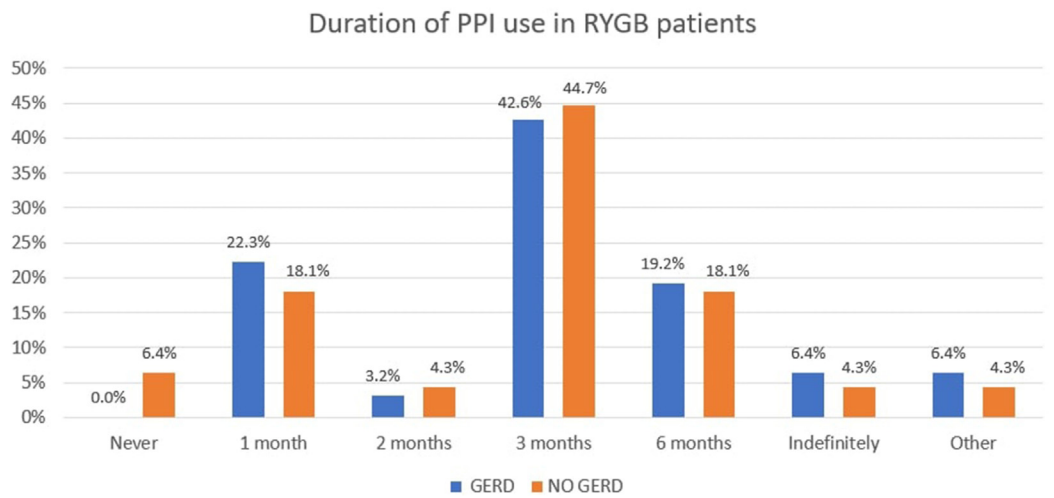

Fig. 1. Surgeon-reported postdischarge duration of prophylactic PPI administration in RYGP patients with or without preoperative reflux. PPI = proton pump inhibitor; RYGB = Roux-en-Y gastric bypass.

Table 3
Subgroup analysis of surgeons' responses based on bariatric volume of the program

Questions	Surgeons' responses based on annual bariatric volume of site			
	<200	≥200	Total	*P* value
Do you use postdischarge PPI prophylaxis?				
Yes, on all patients	33 (70.2%)	48 (87.3%)	81/102 (79.4%)	.034*
On select patients	8 (17%)	4 (7.3%)	12/102 (11.8%)	.128
No	6 (12.8%)	3 (5.5%)	9/102 (8.8%)	.194
Do you use PPI prophylaxis during hospitalization?				
Yes, on all patients	40 (85.1%)	47 (85.5%)	87/102 (85.3%)	.961
On select patients	1 (2.1%)	3 (5.5%)	4/102 (3.9%)	.388
No	6 (12.8%)	5 (9.1%)	11/102 (10.8%)	.551
What kind of PPI prophylaxis do you use during hospitalization?				
Esomeprazole	3 (7.3%)	1 (2%)	4/90 (4.4%)	.226
IV Pantoprazole	4 (9.8%)	10 (20.4%)	14/90 (15.6%)	.165
Lansoprazole	2 (4.9%)	0 (0%)	2/90 (2.2%)	.118
Omeprazole	13 (31.7%)	14 (28.6%)	27/90 (30%)	.746
Pantoprazole	15 (36.6%)	19 (38.8%)	34/90 (37.8%)	.831
Famotidine (H2 blocker)	4 (9.8%)	5 (10.2%)	9/90 (10%)	.944
What kind of PPI prophylaxis do you use upon patient discharge?				
Esomeprazole	3 (7.3%)	1 (1.9%)	4/93 (4.3%)	.203
Lansoprazole	2 (4.9%)	2 (3.9%)	4/93 (4.3%)	.808
Omeprazole	23 (56.1%)	34 (65.4%)	57/93 (61.3%)	.361
Pantoprazole	9 (22%)	10 (19.2%)	19/93 (20.4%)	.747
Famotidine (H2 blocker)	3 (7.3%)	3 (5.8%)	6/93 (6.5%)	.763
Other	1 (2.4%)	2 (3.9%)	3/93 (3.2%)	.703
What is the duration of the PPI in a RYGB patient without preop GERD?				
1 mo	8 (19.5%)	8 (15.4%)	16/93 (17.2%)	.601
2 mo	2 (4.9%)	2 (3.9%)	4/93 (4.3%)	.808
3 mo	16 (39%)	26 (50%)	42/93 (45.2%)	.291
6 mo	6 (14.6%)	11 (21.2%)	17/93 (18.3%)	.419
Indefinitely	1 (2.4%)	3 (5.8%)	4/93 (4.3%)	.423
Do not use	5 (12.2%)	1 (1.9%)	6/93 (6.45%)	.084
Other	3 (7.3%)	1 (1.9%)	4/93 (4.3%)	.203
What is the duration of the PPI in a RYGB patient with preop GERD?				
1 mo	11 (26.8%)	9 (17.3%)	20/93 (21.5%)	.267
2 mo	1 (2.4%)	2 (3.9%)	3/93 (3.2%)	.703
3 mo	17 (41.5%)	23 (44.2%)	40/93 (43%)	.789
6 mo	4 (9.8%)	14 (26.9%)	18/93 (19.4%)	.037*
Indefinitely	3 (7.3%)	3 (5.8%)	6/93 (6.5%)	.763
Other	5 (12.2%)	1 (1.9%)	6 (6.5%)	.084

GERD = gastroesophageal reflux disease; H2 = histamine 2; PPI = proton pump inhibitor; RYGB = Roux-en-Y gastric bypass.
Data are expressed as n (%).
P value is calculated using Chi-square or Fisher's exact test when appropriate.
* The difference is significant at the 0.05 level.

prescription of prophylactic PPIs after RYGB [10,14]. Additional high-quality evidence would be useful to guide best practices to minimize the risk of MU after RYGB.

The results of the present survey should be interpreted in the context of some limitations. The survey included only medical directors of MBSAQIP-accredited centers in the United States. This decision was made to ensure a high and accurate response rate. Although disseminating the questionnaire to wider groups could increase the total responses, it would probably lead to a lower response rate, especially when sent to large groups (>1000 individuals) [22,23]. This could introduce nonresponse bias, which is a possible threat to the study's validity evidence [24]. Nevertheless, a disadvantage of this methodology was that the PPI prophylaxis practices of international surgeons and those at non-MBSAQIP centers or programs with lower bariatric volumes were not represented in the study. As with most surveys, recall bias is a potential limitation. However, surgeons are likely to remember the medications they prescribe for their patients daily accurately. Finally, the present study did not address the effectiveness of prophylactic PPI use in preventing MU after RYGB; therefore, no conclusions should be made regarding the best type of PPI, dosage, or duration of administration.

In conclusion, our study demonstrated high variability in prophylactic PPI administration regarding medication type, dosage, frequency, and duration. This heterogeneity among experienced bariatric surgeons may be caused by the limited available comparative data, lack of standardization of prophylactic PPI administration, and absence of consensus on

best preventive practices to decrease the incidence of MUs. These findings point to a need for large prospective clinical trials with objective outcome measures to define optimal practices for PPI prophylaxis after bariatric surgery to maximize the clinical benefit for the bariatric patient.

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Authors' contributions

The authors confirm contribution to the paper as follows: Study conception and design: Stefanidis D, Athanasiadis D., Giannopoulos S, Clapp B., Lyo V., Ghanem O., Puzziferri N. Data collection: Giannopoulos S, Athanasiadis D. Analysis and interpretation of results: Giannopoulos S, Stefanidis D. Draft preparation: Giannopoulos S; Stefanidis D. Critical content revision: Stefanidis D., Clapp B., Lyo V., Ghanem O., Puzziferri N.

Supplementary data

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.1016/j.soard.2022.10.002.

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