



Perioperative Interventions to Prevent Gastroesophageal Reflux Disease and Marginal Ulcers After Bariatric Surgery — an International Experts' Survey

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Abstract

Objective This study aimed to survey international experts in metabolic and bariatric surgery (MBS) to improve and consolidate perioperative interventions to prevent gastroesophageal reflux disease (GERD) and marginal ulcers (MU) after MBS.

Background Very important long-term complications after MBS include GERD, Barrett's esophagus, and MU. Prevention might be fundamental to reduce the incidence, severe complications, and the increasing number of revisional bariatric surgeries.

Methods An international scientific team designed an online confidential questionnaire with 45 multiple-choice questions. The survey was sent to 110 invited experts and 96 of them (from 41 different countries) participated from 21 July 2022 to 4 September 2022.

Results Most experts ($\geq 90\%$) prescribe postoperative acid suppression agents after MBS. Life-long proton pump inhibitors prophylaxis in smokers with avoidance of non-steroidal anti-inflammatory drugs are recommended by most of the experts (66%, 73%) after any type of gastric bypass. Two-thirds of experts (69%) perform *Helicobacter pylori* eradication prior to MBS. Two-thirds of experts (68%) routinely perform EGD and biopsy before MBS. Follow-up esophagogastroduodenoscopy (EGD) and timing threshold for revisional and conversional MBS were variable among experts.

Conclusion This expert survey underlines important perioperative interventions that reached a two-thirds consensus among MBS international experts. Variability in follow-up EGD, approach to complication management, and thresholds for revisional and conversional MBS emphasize the need for further researches and consensus guidelines.

Keywords GERD · Esophagitis · Barrett's esophagus · Marginal ulcers · SG · RYGB · OAGB · Revisional bariatric surgery · Long-term complications

Key Points

1. Most ($\geq 90\%$) of the experts prescribe postoperative acid suppression agents after SG, RYGB, and OAGB.
2. Life-long PPI prophylaxis in smokers and life-long avoidance of NSAIDs are recommended by the experts after any type of gastric bypass.
3. Two-thirds of experts routinely perform EGD and biopsy prior to MBS.
4. Follow-up EGD is recommended mostly in symptomatic patients after SG, RYGB, and OAGB.
5. Revisional MBS in esophagitis C and D after SG and marginal ulcers after gastric bypass are considered 6 months after conservative treatment.
6. Revisional MBS in Barrett's esophagus after SG is considered 6 months after diagnosis.

Abbreviations

SG	Sleeve gastrectomy
RYGB	Roux en Y gastric bypass
OAGB	One anastomosis gastric bypass
GERD	Gastroesophageal reflux disease
BE	Barrett's esophagus
MU	Marginal ulcers
PPIs	Proton pump inhibitors
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
NASH	Nonalcoholic steatohepatitis
H-pylori	<i>Helicobacter pylori</i>

Extended author information available on the last page of the article

Introduction

Bariatric surgery results in the greatest gains in health-related quality of life [1] and leads to greater improvements in weight loss outcomes and all obesity-associated medical problems, compared with non-surgical interventions, regardless of the type of surgical procedures used. Furthermore, modern bariatric procedures have strong evidence of efficacy and safety [2]. The three most commonly performed bariatric and metabolic surgical procedures (MBS) worldwide include sleeve gastrectomy [3], Roux-en Y (RYGB) gastric bypass, and one anastomosis gastric bypass (OAGB) [4]. Long-term complications include predominantly gastroesophageal reflux disease (GERD) [5] and Barrett's esophagus (BE) [6] after SG and marginal ulcers (MU) after gastric bypass procedures [7, 8]. Primary, secondary, and tertiary prevention might be fundamental to reduce the incidence of these long-term complications and reduce severe complications, such as ulcer perforation [9], bleeding, and stricture. Prevention may also reduce the number of revisional bariatric surgeries for important complications, such as BE after SG [10].

It is well known that prophylactic proton pump inhibitors (PPIs) help to reduce the incidence of MU after gastric bypass and PPIs treatment significantly improves ulceration compared to no PPIs treatment [11]. The use of soluble PPIs (open capsules) has been demonstrated to speed healing in MU after gastric bypass and may be considered, since they get absorbed more easily than intact capsules [12].

Furthermore, the Clinical Practice Updates Committee of the American Gastroenterological Association advice that patients with GERD and acid-related complications (i.e., erosive esophagitis or peptic stricture) should take a PPI for short-term healing, maintenance of healing, and long-term symptoms control (Best Practice Advice 1) [13].

Non-steroidal anti-inflammatory drugs (NSAIDs), smoking, and the presence of *Helicobacter pylori* are important risk factors for marginal ulcers after OAGB [8] and RYGB [14], and surveillance for early detection secondary prevention with esophagogastroduodenoscopy (EGD) is recommended after SG and OAGB [15].

Nevertheless, no consensus guidelines regarding the prevention and management of GERD and MU exist in the current literature. In addition, consensus surveillance and timing of EGD after MBS and thresholds for revisional bariatric surgery for GERD and MU are still lacking.

The aim of this experts' survey of well-known bariatric surgeons and gastroenterologists from 41 countries is to give our bariatric community guidance and define the best clinical practice on the prevention and management of GERD and MU after MBS. The hope is that this experts'

survey reduces long-term complications of the three most commonly performed bariatric and metabolic surgical procedures in the future.

Methods

An international scientific team including leading bariatric and metabolic surgeons and gastroenterologists, who work in the field of MBS, designed an online confidential questionnaire to address controversies around "Perioperative Interventions to Prevent GERD and Marginal Ulcers after MBS." The link (<https://www.surveymonkey.com/r/GERD-MU>) of this multiple choice 45-questions survey was sent to 110 invited experts, of whom 96 accepted to participate, between 21 July 2022 and 4 September 2022.

All invited experts (20 gastroenterologists, 90 surgeons) are well-known with related publications or co-authorships of international guidelines or have/had a leading role in IFSO, ASMBS, or IFSO-Chapters Member Societies. A comment box was put at the end of each question to ensure that participants could write their personal opinions. Table 1 presents the 45 questions and their answer choices.

Data were extracted from @Survey monkey and analyzed using descriptive statistics as numbers (percentages) and graphs were used for representation where applicable.

Results

In total, 96 well-known experts from 41 different countries including all IFSO Chapters and ASMBS members participated in this survey (Fig. 1).

Postoperative Acid-Suppressive Agent Prophylaxis

Most of the experts prescribe postoperative acid suppression agents after SG, RYGB, and OAGB (95.8%, 89.4%, and 93.5% respectively). PPIs 40 mg/daily is the most commonly prescribed dosage after MBS, followed by 20 mg/daily and 40 mg every 12 h.

Pantoprazole, omeprazole, and esomeprazole are the most common PPIs prescribed after MBS, respectively.

Opinions differ on the duration of postoperative PPIs administration. About 31.5% of experts recommend PPIs for 3 months after SG, and 26% and 25% prescribe PPIs for 1 and 6 months, respectively. Some experts (11.9%) recommend continuing PPIs if a patient has GERD symptoms after SG.

The experts' opinions are the same for post-RYGB PPIs duration, and 37.2%, 29%, and 26.7% recommend PPIs for 3, 1, and 6 months after RYGB, respectively.

Table 1 Questions and answer choices

Question	Answer Choices
1. Do you prescribe postoperative acid-suppressive agent prophylaxis after sleeve gastrectomy (SG)?	Yes No
2. If yes, what do you prescribe?	Antacids H2-receptor antagonists PPI 20 mg daily PPI 40 mg daily PPI 40 mg/BID Other
3. If yes, for how long?	2 weeks 4 weeks 3 months 6 months 12 months As long as patient has GERD symptoms Lifelong
4. When you prescribe a proton pump inhibitor (PPI), which PPI is mainly used in your practice?	Omeprazole Esomeprazole Lansoprazole Rabeprazole Pantoprazole I do not prescribe PPI Other
5. Do you prescribe postoperative acid-suppressive agent prophylaxis after Roux en Y gastric bypass (RYGB)?	Yes No
6. If yes, what do you prescribe?	Antacids H2-receptor antagonists PPI 20 mg daily PPI 40 mg daily PPI 40 mg/BID Other
7. If yes, for how long?	2 weeks 4 weeks 3 months 6 months 12 months As long as patient has GERD symptoms Lifelong
8. When you prescribe a proton pump inhibitor (PPI), which PPI is mainly used in your practice?	Omeprazole Esomeprazole Lansoprazole Rabeprazole Pantoprazole I do not prescribe PPI Other

Table 1 (continued)

9. Do you prescribe postoperative acid-suppressive agent prophylaxis after one anastomosis gastric bypass (OAGB)?	Yes No
10. If yes, what do you prescribe?	Antacids H2-receptor antagonists PPI 20 mg daily PPI 40 mg daily PPI 40 mg/BID Other
11. If yes, for how long?	2 weeks 4 weeks 3 months 6 months 12 months As long as patient has GERD symptoms Lifelong
12. When you prescribe a proton pump inhibitor (PPI), which PPI is mainly used in your practice?	Omeprazole Esomeprazole Lansoprazole Rabeprazole Pantoprazole I do not prescribe PPI Other
13. Is the duration of PPI prophylaxis in your practice different in smokers?	Yes No
14. PPI prophylaxis should be continued lifelong in smokers after SG	Agree Disagree
15. PPI prophylaxis should be continued lifelong in smokers after any type of gastric bypass surgery	Agree Disagree
16. Is the duration of PPI prophylaxis in your practice different in Non-steroidal anti-inflammatory drugs (NSAID) users?	Yes No
17. Do you recommend life-long avoidance of NSAIDS after gastric bypass surgery?	Yes No
18. PPI prophylaxis can be decreased in hand sewn gastro-entero anastomosis after gastric bypass surgery	Agree Disagree
19. Does the presence of preoperative gastroesophageal reflux disease (GERD) influence your decision to use PPI after all bariatric procedures?	Yes No
20. If yes, what is the difference?	Lifelong PPI prophylaxis Not performing gastric bypass

Table 1 (continued)

	Not performing sleeve gastrectomy No difference
21. Do you consider a step-down approach when stopping postoperative PPI prophylaxis?	Yes No I do not perform PPI prophylaxis
22. Do you always perform helicobacter pylori (HP) eradication prior to surgery?	Yes No
23. HP eradication is important in bypass procedures (increased marginal ulcers) and not in SG	Agree Disagree
24. Which standard therapy do you use for HP eradication?	<p>Clarithromycin triple therapy (PPI, clarithromycin, and amoxicillin (metronidazole if the patient is allergic to amoxicillin))</p> <p>Bismuth quadruple therapy (PPI or histamine-2 receptor antagonist, bismuth, metronidazole, and tetracycline)</p> <p>Concomitant therapy (PPI, amoxicillin, clarithromycin, and a nitroimidazole (tinidazole or metronidazole))</p> <p>Sequential therapy (PPI plus amoxicillin for 5 days, followed by a PPI, clarithromycin, and a nitroimidazole for an additional 5 days)</p> <p>Hybrid therapy (7 days of a PPI and amoxicillin followed by another 7 days of PPI, amoxicillin, clarithromycin, and a nitroimidazole)</p> <p>Levofloxacin triple therapy (PPI and amoxicillin; modified sequential therapy consisting of 5 to 7 days of a PPI, levofloxacin, and a nitroimidazole)</p> <p>Fluoroquinolone sequential therapy</p> <p>Other</p>
25. Do you perform an HP eradication confirmation test?	Yes No
26. If yes, what is the confirmation tool?	<p>Urea breath test</p> <p>Endoscopic biopsy-based test</p> <p>Stool antigen test</p> <p>Serology</p> <p>I do not test</p>

Table 1 (continued)

27. In the case of resistant HP, how many times do you repeat eradication prior to surgery?	Never 1 time 2 times 3 times
28. Do you perform upper endoscopy with biopsy prior to surgery in all patients?	Yes No
29. What should be the correct gastric pouch volume in RYGB?	<10 mL 10–25 mL 25–50 mL >50 mL
30. Do you scan for GERD/Barrett after sleeve gastrectomy?	Yes No
31. Do you scan for marginal ulcers after gastric bypass surgery?	Yes No
32. Do you recommend upper endoscopy after medical treatment of marginal ulcers?	Yes No
33. If yes, when?	Answer Choices 1 week 1 month 6 weeks 2 months 3 months 6 months Other
34. Post surgery, when do you recommend performing upper endoscopy in SG patients who were asymptomatic prior to surgery?	after 6 months after 1 year after 2 years after 5 years Only in symptomatic patients
35. Post surgery, when do you recommend performing upper endoscopy in RYGB patients who were asymptomatic prior to surgery?	after 6 months after 1 year after 2 years after 5 years Only in symptomatic patients
36. Post surgery, when do you recommend performing upper endoscopy in OAGB patients who were asymptomatic prior to surgery?	after 6 months after 1 year after 2 years after 5 years Only in symptomatic patients
37. Post surgery, when do you recommend performing upper endoscopy in patients with GERD prior to surgery?	after 6 months after 1 year after 2 years after 5 years Only in symptomatic patients
38. Does the long-term use of PPI (>6 months) automatically indicate a control-endoscopy?	Yes No
39. Do you recommend increasing the intake of calcium, vitamin B12, or	Yes No

Table 1 (continued)

magnesium beyond the recommended dietary allowance in long-term use of PPI (>6 months)?	
40. Gastrin is predominantly produced in the prepyloric antrum (remnant stomach after gastric bypass surgery). An elevated gastrin level (reference > 90 ng/L) leads to increased acid production. Do you consider gastrin levels in the case of recurrent marginal ulcers?	Yes No
41. When do you perform laparoscopic conversion of SG to RYGB due to GERD?	in esophagitis A and B in esophagitis C and D and Barrett Esophagus Only in Barrett Esophagus in all symptomatic patients, irrespective of endoscopic pathology
42. After what time of conservative treatment do you perform conversion of SG to RYGB in GERD C/D?	1 month 3 months 6 months 12 months Never
43. After what time of conservative treatment do you perform conversion of SG to RYGB in Barrett's esophagus?	1 month 3 months 6 months 12 months Never
44. When do you perform revisional/conversional surgery in marginal ulcers after RYGB/OAGB?	After 1 month of conservative PPI treatment After 3 months of conservative PPI treatment After 6 months of conservative PPI treatment After 12 months of conservative PPI treatment
45. Should it be mandatory for Zollinger-Ellison syndrome to be excluded prior to revisional surgery in marginal ulcers after RYGB/OAGB?	Yes No

Contrary, the most recommended PPI use duration after OAGB is 6 months (35.6%), followed by 3 and 1 months in 27.5% and 21.8% of the respondents.

About 62.5% of the experts believe that the duration of PPIs prophylaxis should differ in smokers. Forty-nine

percent recommend lifelong PPI prophylaxis in smokers and SG; however, 65.6% recommend lifelong prophylaxis after any type of gastric bypass in smokers.

Although 51% of experts disagree with life-long PPIs prophylaxis in smokers after SG, 65.6% recommend

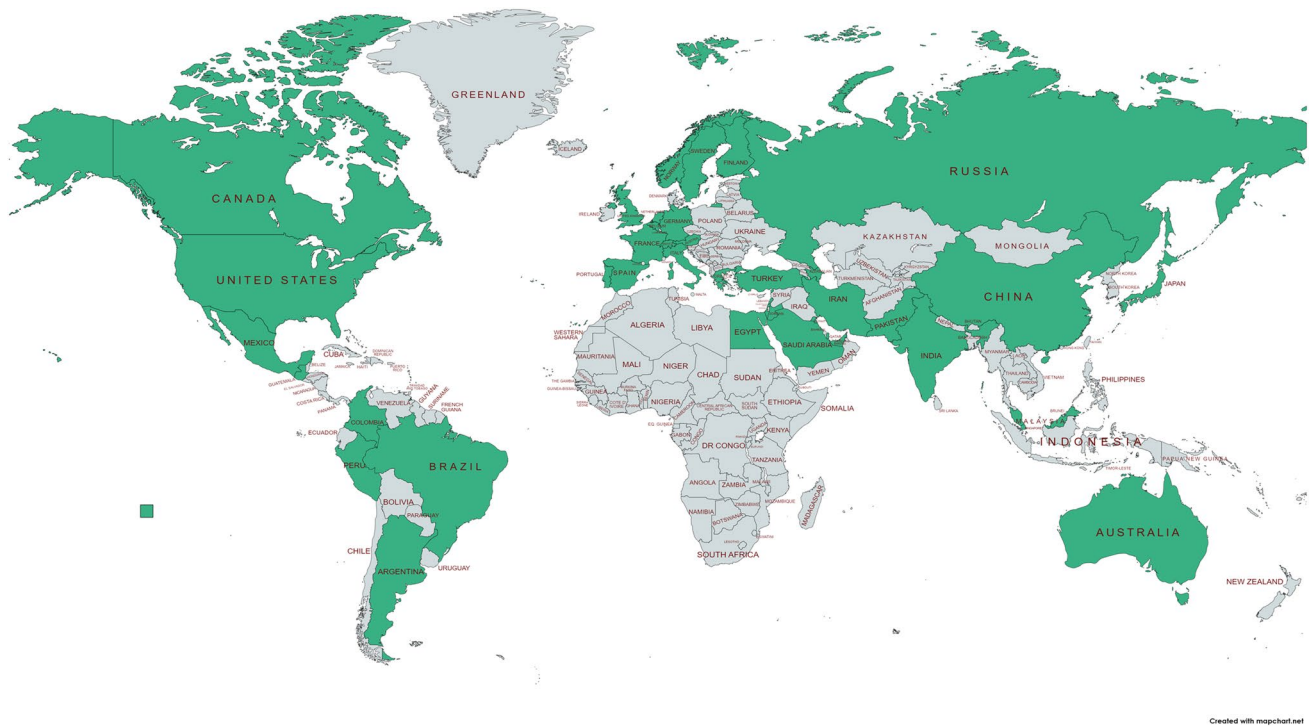


Fig. 1 The expert participants' countries are shown in green

life-long PPIs prophylaxis after any type of gastric bypass in smokers.

Most experts (67.7%) recommend a longer duration of PPIs prophylaxis in NSAID users with 72.9% recommending life-long avoidance of NSAIDs after gastric bypass surgery. Only half of the experts believe that the presence of preoperative GERD influences the decision to use PPIs after MBS with 53.1% of them agreeing that the presence of preoperative GERD affects the duration of PPIs use after MBS.

Approximately 48.7% of experts mentioned that they do not perform SG in patients with preoperative GERD, but 32% believed that preoperative GERD should not dictate the type of MBS or the need for longer postoperative PPIs prophylaxis.

As an elevated gastrin level (reference > 90 ng/L) can indicate an alternative etiology to refractory marginal ulcers, 62% of the experts suggested evaluating gastrin levels in this setting.

Proponents and opponents of the step-down approach for postoperative PPIs prophylaxis use were exactly equal.

Only 45.8% of experts recommend increasing the intake of calcium, vitamin B12, or magnesium beyond the recommended dietary allowance in patients using PPIs for greater than 6 months, and the rest of them (54.2%) do not recommend any increased dose of these supplements.

Helicobacter pylori Eradication

About 68.5% of the experts perform standard *Helicobacter pylori* (H-pylori) eradication prior to MBS, and 58.5% of experts believe it should be done before all MBS, not just RYGB. The most common H-pylori eradication therapy reported by experts (69.1%) is *Clarithromycin triple therapy* (PPIs, clarithromycin, and amoxicillin or metronidazole if the patient is allergic to amoxicillin).

About 65.6% of experts perform confirmatory H-pylori eradication testing using urea breath test, stool antigen test, or endoscopic biopsy, respectively.

In the case of resistant H-pylori, 40.8% of experts repeat H-pylori eradication prior to MBS, while 21.5% and 10.7% of experts repeat eradication two and three times respectively. Surprisingly 28.6% of experts do not repeat eradication at all.

Esophagogastroduodenoscopy (EGD)

Only 67.7% of experts routinely perform EGD and biopsy before MBS.

Approximately 69% of participants recommend EGD for the detection of GERD/BE after SG. Less than two-thirds of experts (59.3%) believe that there is no need to do follow-up EGD for MU after gastric bypass procedures. Most experts

(95%) recommend EGD after medical treatment of MU, and about 33% of them perform it after 6 weeks of medical treatment. Other experts recommend follow-up EGD after 3, 2, 1, and 6 months (29.6%, 23.0%, 8.7%, and 5.5% respectively).

In patients asymptomatic prior to SG, 36.5% of experts recommend follow-up EGD 1 year after, while 17.7% and 12.5% of them recommend it at 5 and 2 years after SG, and 28% only recommend it in symptomatic patients.

Only 21.8% of participating experts believe that follow-up EGD should be performed 1 year after RYGB in patients who were asymptomatic prior to surgery and most of the experts (65.6%) recommend it only in symptomatic patients after RYGB. In OAGB patients who were asymptomatic prior to surgery, 38.4% of experts believe that follow-up EGD should be done only in symptomatic patients postoperatively, with 30.7% and 14.2% of experts recommending EGD at 1 and 5 years after OAGB, respectively.

In patients with GERD prior to surgery, about 32% and 20% of experts recommend postoperative EGD at 1 year and 6 months after MBS, respectively. Approximately 33% of experts believe that postoperative EGD should be performed only in presence of GERD. In addition, 57.2% of participants believe that the long-term use of PPIs (> 6 months) necessitates further investigation with EGD.

Surgical Considerations

About 87.5% of the experts disagree that PPI prophylaxis can be decreased in hand-sewn gastro-intestinal anastomosis after gastric bypass surgery.

Approximately two-thirds of experts (63.5%) believe that the proper gastric pouch volume in RYGB should be 25–50 mL to decrease the chance of MU, while 30.2% of experts recommend a 10–25 mL gastric pouch volume.

About 47% of experts indicate conversion of SG to RYGB due to GERD, in all symptomatic patients, irrespective of endoscopic pathology, while 46% of them perform conversion to RYGB in esophagitis C and D and BE. In total, 4.1% of experts perform conversion to RYGB only in the presence of BE.

Appropriate time of conversion of SG to RYGB, due to esophagitis C and D, is recommended 6 months, 12 months, and 3 months after conservative treatment by 41.7%, 39.5%, and 12.5% of experts, respectively. This interval between conservative management and conversion from SG to RYGB due to BE is recommended 6, 3, 1, and 12 months by 30.2%, 26.0%, 23.9%, and 15.6% of experts, respectively.

Approximately 44.2%, 28.4%, and 26.3% of experts recommend performing revisional/conversional surgery in presence of MU after RYGB/OAGB after 6 months, 12 months, and 3 months of conservative PPIs treatment, respectively, and 58.3% of experts recommend to exclude

Zollinger-Ellison syndrome, prior to revisional/conversional surgery in MU after RYGB/OAGB.

Finally, Table 2 summarizes the most important answers to this experts' survey.

Discussion

This International Experts' Survey regarding "Perioperative Interventions to Prevent Gastroesophageal Reflux Disease and Marginal Ulcers after Bariatric Surgery" represents the current best knowledge of 96 prominent experts from 41 countries covering all IFSO-Chapters. Since clear evidence and guidelines regarding the prevention of GERD and MU are missing in the current literature, the survey aimed to provide guidance for best clinical practice. Nevertheless, there is no clear homogeneity in most of the answers, underlining the importance of the further study.

Postoperative Acid-Suppressive Agent Prophylaxis

The only high percentage of agreement in this survey was achieved regarding postoperative acid-suppressive agent prophylaxis. Acidity may play a crucial role in developing GERD and MU, and bariatric surgeons recommend acid-suppressive agents after MBS. We should remember that preclinical and clinical research indicates that SG accelerates liquid and solid gastric emptying, whereas its effects on gastrointestinal acidity and gastric and pancreatic secretions remain largely unknown and GERD is an important long-term complication. On the other hand, RYGB accelerates liquid gastric emptying and diminishes gastric acid secretion [16], but MU is a significant long-term complication, which is reported in 1–16% of the patients [11].

GERD is an important comorbidity in patients with obesity, and the incidence of GERD, esophagitis, and BE has an important impact after MBS. Bevilacqua et al. recently analyzed the New York State Database, including 48,967 patients regarding the incidence of GERD, esophagitis, BE, and esophageal adenocarcinoma after bariatric surgery and found that 30.3% had a diagnosis of GERD prior to surgery [17].

Proton pump inhibitors are the first-line therapy for gastroesophageal reflux disease and peptic ulcer disease. On the other hand, by reducing the secretion of hydrochloric acid produced by the stomach, PPIs may promote the growth of the gastrointestinal microflora, increase bacterial translocation, affect the gastrointestinal microbiome, and weaken the immune system [18].

Since concern about the overuse of PPIs has been growing and related side effects in the long-term may include a higher risk of fractures, clostridium difficile infections and diarrhea, community-acquired pneumonia, vitamin B12

Table 2 Opinions of the expert survey: “Perioperative Interventions to Prevent Gastroesophageal Reflux Disease and Marginal ulcers after Bariatric Surgery”**Postoperative acid-suppressive agent prophylaxis**

- 1 Most experts prescribe postoperative acid suppression agents after SG, RYGB, and OAGB (95.8%, 89.4%, and 93.5%)
- 2 PPI 40 mg/daily is the most prescribed dosage after the three most common MBS
- 3 Pantoprazole, omeprazole, and esomeprazole are the most common PPI after MBS
- 4 Experts recommend PPI for 3 months after SG (31.5%), for 3 months after RYGB (37.2%), but for 6 months after OAGB (35.6%)
- 5 After gastric bypass surgery, experts recommend life-long PPI prophylaxis in smokers (65.6%) and life-long avoidance of NSAIDs (72.9%)

Helicobacter pylori eradication

- 1 Two-thirds of experts (68.5%) perform helicobacter pylori eradication prior to MBS
- 2 The most recommended therapy for helicobacter pylori eradication (69.2%) is *Clarithromycin triple therapy* (PPI, clarithromycin, and amoxicillin (metronidazole if the patient is allergic to amoxicillin))
- 3 Urea breath test, stool antigen test, and endoscopic biopsy-based test are the most common eradication confirmation tests performed by the experts prior to surgery (65.6%)
- 4 In the case of resistant helicobacter pylori, 40.8% of experts repeat helicobacter pylori eradication prior to MBS

Esophagogastroduodenoscopy (EGD)

- 1 Two-thirds of experts (67.7%) routinely perform EGD and biopsy before MBS
- 2 Two-thirds of experts (69%) recommend EGD for the detection of GERD/Barrett after SG
- 3 Less than two-thirds of experts (59.3%) believe that there is no need to do follow-up EGD for detecting marginal ulcers after gastric bypass procedures
- 4 Most experts (95%) recommend EGD after medical treatment of marginal ulcers, to be performed 6 weeks after medical treatment (33%)
- 5 Follow-up EGD is recommended 1 year after SG (36.5%), while 28% of experts recommend follow-up EGD only in symptomatic patients
- 6 Follow-up EGD after RYGB is recommended only in symptomatic patients (65.6%)
- 7 Follow-up EGD is recommended 1 year after OAGB (30.7%), while 38.4% of experts recommend follow-up EGD only in symptomatic patients

Surgical considerations

- 1 Two-thirds of experts (63.5%) believe that the correct gastric pouch volume in RYGB should be 25–50 mL
- 2 About 47% of experts indicate conversion of SG to RYGB due to GERD, in all symptomatic patients, irrespective of endoscopic pathology, while 46% of them perform conversion to RYGB in esophagitis C and D and Barrett’s esophagus
- 3 Appropriate time of conversion of SG to RYGB, due to esophagitis C and D, is recommended 6 months (41.7%), 12 months (39.5%), and 3 months after conservative treatment (12.5%)
- 4 Appropriate time of conversion of SG to RYGB, due to Barrett’s esophagus, is recommended 6 months (30.2%), 3 months (26%), and 1 month after conservative treatment (23.9%)
- 5 Revisional/conversional surgery in marginal ulcers after RYGB/OAGB is considered after 6 months (44.2%), 12 months (28.4%), and 3 months (26.3%) of conservative PPI treatment
- 6 58.3% of experts recommend to exclude Zollinger-Ellison syndrome, prior to revisional/conversional surgery in marginal ulcers after RYGB/OAGB

deficiency, and hypomagnesemia, deprescribing PPIs is recommended worldwide. In the general population, a chronic use of PPI is recommended only in patients with BE, chronic NSAID users with bleeding risk, severe esophagitis, and documented history of bleeding GI ulcer [19].

Therefore, long-term use of PPI should also be avoided after MBS. Furthermore, we should question the expert opinion of lifelong PPI prophylaxis in GERD (17%) in smokers and SG (49% of experts) or any type of gastric bypass (65.6%).

Different studies underline the importance of postoperative GERD, with a higher risk of postoperative esophagitis after SG. Interestingly, no significant difference in the development of BE by MBS has been seen by Bevilacqua et al. [17] and neither in the recently published 10-year data of the

SLEEVEPASS trial by Salminen et al. with the same rate of BE in SG and RYGB (4%) at 10 years [20]. In a multi-variable regression analysis, the postoperative diagnosis of BE was associated with male sex, age ≥ 65 , white race, and tobacco use [17].

Finally, Genco et al. showed, comparing the different bariatric surgical procedures adjustable gastric banding, SG, RYGB, and OAGB, that the overall prevalence of erosive esophagitis was the greatest in the SG group, and BE was found only in patients who had undergone SG. Interestingly, the prevalence of biliary-type reflux into the esophagus was higher in patients who underwent SG (74.7%), compared with the other procedures [21]. It is still not determined if only acid reflux leads to BE or if biliary-type reflux might be of concern [22].

All these data [17–19] question the lifelong PPI prophylaxis in GERD after SG.

In our survey, most experts recommend PPIs for 3 months after SG and for 3 months after RYGB. Surprisingly, PPIs prophylaxis after OAGB is recommended mostly for 6 months. This might be due to the concern for increased risk of MU incidence after OAGB [8].

A survey by Mahawar et al. including 86 bariatric surgeons showed similar routine use of PPIs prophylaxis, with variation in drugs, dosages, and duration after OAGB [8]. Importantly, as analyzed and published by different authors [8, 14, 23], the experts recommend life-long PPIs prophylaxis in smokers (65.6%) and life-long avoidance of NSAIDs (72.9%) after gastric bypass surgery; hence, the recent experts' consensus on patient selection in OAGB has an agreement on the statement that OAGB is a suitable option in patients who need to use long-term NSAIDs [3].

Finally, the last enhanced recovery after surgery (ERAS) guidelines (Update 2021) recommend PPIs prophylaxis for at least 30 days after RYGB with a strong recommendation grade and conclude that there is not enough evidence to provide a PPIs recommendation after SG [24].

Helicobacter pylori (H-pylori) Eradication

H-pylori eradication is widely performed to improve gastric mucosal inflammation, promote ulcer healing, and reduce the incidence of gastric cancer. Nevertheless, current literature discusses the negative consequences, including the increase of antimicrobial resistance of H-pylori due to indiscriminate antibiotic use and gut microbiota dysbiosis, which is potentially induced by H-pylori treatment [25].

In one study, active H-pylori infection was independently associated with nonalcoholic steatohepatitis (NASH) and fibrosis in patients with severe obesity [26]; therefore, H-pylori infection might have more severe consequences in patients with a higher degree of comorbidities related to obesity.

A review by Smelt et al. showed that H-pylori infection was associated with an increased risk of developing MU and postoperative complications [27]. Further studies confirm that the presence of H-pylori in the surgical resection specimens was significantly associated with the development of postoperative complications, mostly staple line leaks ($p=0.01$) and that it is therefore important to detect its presence and eradicate it before MBS [28].

In our study, only two-thirds of experts perform H-pylori eradication prior to MBS, and that only 40.8% repeat eradication in the case of resistant H-pylori.

The most recommended therapy for H-pylori eradication was clarithromycin-based triple therapy. Numbers published by the European Registry on H-pylori management showed pretreatment resistance rates of 23% to clarithromycin, 32%

to metronidazole, and 13% to both. Furthermore, only quadruple therapies lasting at least 10 days achieved over 90% eradication rates [29].

Since in patients with obesity a tailored quadruple concomitant therapy based on body weight seems to be more effective than the standard quadruple concomitant therapy [30], more studies and guidelines on eradication prior to MGB are needed.

Esophagogastroduodenoscopy (EGD)

Surprisingly, only two-thirds of experts (67.7%) routinely perform EGD and biopsy prior to MBS and only two-thirds of experts (69%) recommend EGD for the detection of GERD/BE after SG. Follow-up EGD is recommended 1 year after SG (36.5%), while 28% of experts recommend follow-up EGD only in symptomatic patients. IFSO Position Statement 2020 on BE [31] and IFSO Position Statement on the Role of EGD prior to and after MBS [15] recommend: "Given the current evidence suggesting higher incidence rates of BE following SG compared to the general population, a single screening endoscopy at 1 year postoperatively and then every 2–3 years, depending on its outcome, is recommended." EGD should be undertaken routinely for all patients after MBS at 1 year and then every 2–3 years for patients who have undergone SG or OAGB to enable early detection of BE or upper GI malignancy until more data is available to confirm the incidence of these cancers in practice." On the other hand, considering the guidelines of the American Gastroenterological Association, the endoscopic follow-up for BE without dysplasia is 3–5 years, 6 to 12 months for those found to have low-grade dysplasia, and every 3 months for patients with high-grade dysplasia who receive no invasive therapy [32]. Furthermore, the yearly progression rate of BE to adenocarcinoma is 0.06–0.3% and short segment BE with an app. 20-fold less risk to progress to adenocarcinoma compared to long-segment BE [33].

This discrepancy between recommendations in guidelines and clinical practice highlights the need for further studies.

Surgical Considerations

Regarding the technical aspects of MBS and the timing of revision, there was an apparent variability in the experts' recommendations. However, the gastric pouch size of 25 to 50 ml was emphasized by a majority of 63.5% of the experts. Gastric pouch size has been linked to the formation of MU as every centimeter increase in the stapler pouch parameter was associated with a 14% increased relative risk of MU formation [34]. Additionally, Ayuso et al. deduced that an increase of 5 mm³ in the gastric pouch volume is correlated to a 2.4 times additional risk of MU development [35].

SG to RYGB conversions have been recently reported by a meta-analysis of 17 studies ($n=556$) in which the pooled conversion rate due to reflux disease was 30.6% [36]; the details of the conversion reasoning and timing were missing in most studies. While 47% of our experts chose symptomatology as the main reason for SG to RYGB conversions, 46% abided by Lyon's Consensus [37] for reflux as an indication for conversion (esophagitis LA grade C and D and/or Barrett's). A Barrett's diagnosis was an alarming factor to many experts as more of them chose to convert SG earlier than if esophagitis LA grades C and D only were to be present. In patients with severe obesity and preexisting Barrett's esophagitis, RYGB was protective against progression to a neoplastic form on endoscopic monitoring [38]. These findings were confirmed in SG patients who had Barrett's since the conversion to RYGB induced remission in 8 out of 10 patients [10]. The timing of revision for MU in gastric bypass patients lacks any supportive evidence in the available literature and might correlate more with the available alternative medical and endoscopic options for MU treatment in specific institutions. While very scarce data exist (limited to case reports), in cases with refractory or recurrent MU, ruling out Zollinger-Ellison Syndrome before bypass revision is reasonable [39]. This was corroborated by 58.3% of our experts.

The weaknesses and limitations of this International Experts' Survey are mainly the difference in surgical technique, characteristics of patients with obesity, and different lifestyle and nutrient habits, including experts from 41 different countries. Nevertheless, when thinking about perioperative standards, it is important to provide considerations on an international baseline. Generalizability might only be possible with strong results. On the other hand, the heterogeneity of some answers underlines the importance of further studies in this field.

Conclusion

This international experts' survey underlines important perioperative interventions for the prevention of GERD and MU after MBS, including postoperative acid-suppressive agent prophylaxis, H-pylori eradication, EGD, and surgical considerations. Some pathways are accepted by two-thirds of international experts; others still show variability. Heterogenous responses regarding follow-up EGD, complication management, and revisional and conversional bariatric surgery underline the need for more scientific work and international guidelines.

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Data Availability Data available on request from the authors.

Declarations

Ethical Approval Statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to Participate Informed consent does not apply.

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