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ORIGINAL CONTRIBUTIONS

Is Routine Preoperative Esophagogastroduodenscopy Screening Necessary Prior to Laparoscopic Sleeve Gastrectomy? Review of 1555 Cases and Comparison with Current Literature

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Abstract
Background Controversy exists as to whether routine preoperative esophagogastroduodenoscopy (p-OGD) in bariatric surgery should be routinely undertaken or undertaken selectively based on patients' symptoms. As very few studies have focused on the role of p-OGD prior to the increasingly common laparoscopic sleeve gastrectomy (LSG), we assessed the role/impact of p-OGD in LSG patients.
Methods Retrospective review of records of all LSG patients operated upon at Hamad General Hospital, Qatar (2011–2014, n = 1555). All patients were screened by p-OGD. Patient characteristics were analyzed, and p-OGD findings were categorized into four groups employing Sharaf et al.'s classification (Obes Surg 14:1367–1372, 23). We assessed the impact of p-OGD findings on any change in surgical management or lack thereof.
Results p-OGD findings indicated that 89.5% of our patients had normal or mild findings and were asymptomatic (groups 0 and 1, not necessitating any change in surgical management), and no patients had gastric cancer or varices (group 3). A total of 10.5% of our sample were categorized as group 2 patients who, according to Sharaf et al. (Obes Surg 14:1367–1372, 23), might have their surgical approach changed. All patients diagnosed preoperatively with hiatal hernia (HH) had LSG with crural repair and their symptoms resolved postoperatively.
Conclusion Due to effectiveness and best utilization of resources, routine p-OGD screening in patients scheduled for LSG may require further justification for asymptomatic patients especially in regions with low upper GI cancers. p-OGD findings had low impact on the management of asymptomatic patients. Crural repair plus LSG was effective for hiatal hernia.

Keywords Sleeve gastrectomy · Preoperative esophagogastroduodenoscopy · OGD · GERD · Gastroesophageal reflux disease · Hiatal hernia · *H. pylori*

Introduction

Routine preoperative esophagogastroduodenoscopy (p-OGD) screening in patients undergoing bariatric surgery remains controversial [1]. Some authors recommend routine p-OGD screening in order to detect suspicious gastric lesion/s, where it may be advantageous in such cases to alter the management in order to remove the potential for future development of gastric pathology [2].

Likewise, others recommend routine p-OGD screening in order to detect asymptomatic benign (e.g., peptic ulcers, hiatus hernia), premalignant (e.g., Barrett's esophagus), or malignant (e.g., esophageal or gastric cancers) lesions. The potential overlooking of asymptomatic lesions in bariatric procedures where the distal stomach and/or duodenum is excluded and becomes unreachable by OGD (e.g., Roux-en-Y gastric bypass, duodenal switch, biliopancreatic diversion) could potentially lead to missing some benign or malignant lesions in the bypassed stomach [3–6] that may otherwise could have been detected by p-OGD [7–9].

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In addition, some studies have shown that p-OGD findings of large hiatus hernia (>5 cm) or Barrett's esophagus (both usually accompanied by preoperative GERD symptoms) may result in a change in surgical approach from laparoscopic sleeve gastrectomy (LSG) to Roux-en-Y gastric bypass (RYGB) as the conversion to or performing RYBG from the start will resolve GERD symptoms [10] and will preserve a potential gastric conduit for possible esophagectomy in the future [11].

In contrast, other researchers have proposed that routine p-OGD screening prior to bariatric surgery provides low yield of anatomic findings, that the upper gastrointestinal symptoms (UGI) may not correlate with the findings [2], and that the clinical consequences of a p-OGD are low [though Wolter recommended performing routine endoscopy prior to bariatric surgery to avoid missing malignant lesions] [12]. Accordingly, Schigt et al. [4] suggested that routine p-OGD screening is not needed, and in agreement, others [13, 14] reported that routine p-OGD may be undertaken subject to the presence/absence of suggestive symptoms as conducted in the general population. Indeed, Azagury et al. [14] recommended routine p-OGD screening not to be included in investigating asymptomatic patients and advocated the non-endoscopic investigation of such patients to avoid the invasiveness of the procedure and to decrease costs.

Moreover, routine p-OGD carries sedation and analgesia risks, and their attending cardiopulmonary complications that comprise up to 60% of overall OGD complications [15, 16], especially in obese persons with higher risk for airway adverse events [17, 18]. Significant bleeding and esophageal perforation are rarer OGD risks [15, 19], but are associated with significant mortality (4–14%) [20–22]. Furthermore, the cost of p-OGD is a relevant factor in preoperative assessment [12].

While there exists research on the value of routine p-OGD screening prior to RYGB [2, 3, 12, 14, 23–25], and prior to laparoscopic adjustable gastric banding [3, 10, 13], much fewer studies have focused on the value of routine p-OGD screening particularly prior to LSG [3, 4, 10, 12, 26–29]. Certainly, a recent report confirmed that the role of p-OGD in LSG is less clear [12], despite the increasing worldwide popularity of LSG. Such unequivocal evidence about the value of p-OGD supports the recent *American Society for Gastrointestinal Endoscopy* (ASGE) guidelines that confirm that the decision to perform p-OGD should be individualized in bariatric surgery patients after thorough discussion with the surgeon, taking into consideration the type of bariatric procedure performed [30]. In addition, with the sole exception of Abd Ellatif et al. [31] undertaken in Egypt, to the best of our knowledge, there are no studies conducted in the Eastern Mediterranean Region that have investigated the value of routine p-OGD screening prior to LSG, despite that LSG is a very popular procedure in this region of the world due to the high obesity rates among both genders [32, 33]. These considerations highlight the importance of the current study and its findings in contributing to the evidence base.

Aims of the Study

Given the uncertainty as to whether routine p-OGD should be performed for all patients scheduled for LSG, and the lack of such studies internationally and particularly from the Eastern Mediterranean Region to contribute to the evidence base, therefore, the current study examined the p-OGD findings of 1555 patients who underwent LSG at Hamad General Hospital, Doha, Qatar (February 2011–July 2014). We assessed the utility of routine p-OGD prior to LSG, including the prevalence of abnormal p-OGD findings in LSG patients, and the influence of such findings on perioperative management. The specific objectives were to

- Retrieve the p-OGD findings of patients who undertook primary LSG and categorize the findings into four patient groups using Sharaf et al.'s categorization [23].
- Determine, for each of the four patient groups, whether the p-OGD findings would/would not have warranted change/postpone of surgery and compare our findings with the international literature.
- Assess whether routine p-OGD screening is required for all LSG patients.

In addition to these objectives, we also sought to assess the efficacy of LSG plus crural repair in treatment of hiatus hernia and GERD symptoms.

Method

Ethics, Study Design, Procedures, and Data Collection

The current study was implemented at Hamad General Hospital (HGH) in Doha, Qatar, which is part of Hamad Medical Corporation (HMC, equivalent of Ministry of Health). HGH is a modern, 603-bed facility providing highly specialized and complex care and offering a wide range of medical and clinical services. The Medical Research Centre at Hamad Medical Corporation approved the study (IRB Protocol #16202/16). We retrospectively searched, retrieved, and systematically reviewed the demographic, clinical, and p-OGD data extracted from the electronic medical records of all patients who had undergone primary LSG for morbid obesity at HGH (February 2011–July 2014, $N = 1555$). In our bariatric center, history is taken by a qualified bariatric staff (consultant/specialist), using a standardized format.

The established procedure at HMC during the period of the study, in accordance with the European guidelines (EAES)

[34], is that all LSG patients undergo routine p-OGD. The established procedure at HMC also includes Campylobacter-like organism test (CLO test) in order to detect their *Helicobacter pylori* status. All CLO-positive patients are given standard triple therapy: amoxicillin and clarithromycin (2 weeks) and proton pump inhibitor (2 months). We also give our patients proton pump inhibitor (PPI) for 3 months routinely after LSG.

Categorization of p-OGD Findings

In order to gauge the value of p-OGD screening in LSG, we employed Sharaf et al.'s classification [23] that is premised on predetermined criteria to categorize our p-OGD findings into four groups. These four groups included

Group 0: no abnormal p-OGD findings, i.e., normal.
Group 1: abnormal p-OGD findings that do not necessitate changing the surgical approach or postponing surgery (e.g., mild esophagitis, gastritis and/or duodenitis, esophageal web).
Group 2: abnormal p-OGD findings that change the surgical approach or postpone surgery (e.g., mucosal/submucosal mass lesions, ulcers, severe erosive esophagitis, gastritis, and/or duodenitis, Bezoar, hiatal hernia, peptic stricture, Zenker's or esophageal diverticula, arteriovenous malformations).
Group 3: p-OGD findings that signify absolute contraindications to surgery (e.g., upper gastrointestinal cancers and varices).

When there was more than one OGD finding, the most clinically significant lesion was considered the primary diagnosis, upon which all subsequent statistical analyses were based. Of the 1555 LSG patients who undertook routine p-OGD screening prior to their LSG surgery, we were unable to obtain the p-OGD findings of 186 patients who were hence excluded from the analysis. Hence, the current analysis included data from the remaining 1369 patients for whom p-OGD was available.

Results

Table 1 depicts the sample characteristics. Females comprised about 70% of the sample, and mean age and BMI of females and males were almost similar (Table 1).

Of the 1555 LSG patients, we could not retrieve p-OGD findings for 186 patients. Those 186 patients had mean age of 34.1 and mean BMI of 47. Their postoperative histopathology specimens showed no benign or malignant tumors. Due to missing p-OGD data, those 186 patients were excluded from further analysis. Table 2 shows the p-OGD findings of the remaining 1369 patients categorized into four groups [23]. Of these, 49.4% had p-OGD findings that were consistent with group 0 criteria (i.e., no abnormal pathology detected), and about 40.1% of patients exhibited p-OGD findings consistent with group 1 criteria (i.e., mild disease). Group 0 and group 1 patients were all asymptomatic. None of our patients had p-OGD findings that fitted group 3 (i.e., absolute contraindications to surgery, e.g., cancer/esophageal varices).

Table 1 Characteristics of 1555 LSG patients

Gender	*N* (%)	Age (years)		BMI (*M* ± SD)
		M ± SD	Range	
Male	471 (30.3)	35.3 ± 11.4	13–74	48 ± 9.1
Female	1084 (69.7)	36 ± 10.3	14–65	46.3 ± 8.1

M mean, *SD* standard deviation

A few (10.5%) of our patients exhibited p-OGD findings consistent with group 2 criteria, with the majority of these patients having hiatal hernia or gastric polyp/s. In terms of symptoms, all hiatal hernia patients (n = 96) complained of mild regurgitation; all patients with severe gastritis complained of epigastric burning sensation, while the remaining group 2 patients were asymptomatic. All patients who were p-OGD diagnosed with hiatal hernia had LSG and posterior crural repair, and their GERD symptoms resolved postoperative, and none needed to be maintained on our routine postoperative PPI for more than 3 months. Four of these had hiatal hernia of >4 cm, where the patients were offered LSG or RYGB, and opted for LSG. Two patients with severe gastritis received triple therapy, and their symptoms resolved with medical treatment. Postoperative assessment of histopatholgic specimens showed 11 GIST tumors, all benign and all were completely excised by LSG. Only one case of GIST was detected by p-OGD as a submucosal mass.

Discussion

There exists much inconsistency about the role of p-OGD in LSG [3, 4, 10, 12, 26–29]. We assessed the value of p-OGD among 1369 LSG patients, categorized into four groups (groups 0–3) employing predetermined criteria [23]. The prevalence of abnormal p-OGD findings (i.e., findings consistent with Sharaf's et al.'s groups 1 and 2) was 50.6% among our 1369 patients. This in agreement with the published literature that confirms the large variation in p-OGD findings among bariatric patients, ranging from 10 to 88% [13, 35]. Below, we discuss the value of p-OGD for each of the four groups individually.

Value of p-OGD for Group 0 Patients

A total of 49.4% of our patients fulfilled group 0 criteria (i.e., p-OGD detected no abnormal pathology) (Table 2). These

Table 2 p-OGD findings categorized into four groups ($N = 1555$)

	Number	Percentage
Total number of patients scheduled for LSG	1555	
p-OGD findings unavailable (missing in medical record/s)	186	
p-OGD findings available	1369	100
Group 0: normal	675	49.4
Group 3: absolute contraindications to surgery (cancer/esophageal varices)	0	0
Group 2: abnormal findings that change the surgical approach/postpone surgery (i.e., severe disease or masses)	144	10.5
Hiatus hernia	96	
Gastric polyps	26	
Gastric ulcer	6	
Duodenal ulcer	4	
Duodenal polyp	3	
Esophageal polyp	2	
Severe gastritis	2	
Gastric submucosal lesion	1	
Others (esophageal ulcer, longitudinal mucosal fold, whitish lesion in duodenum, esophageal polypoid mass)	4	
Group 1: abnormal findings that do not change surgical approach/postpone surgery (i.e., mild disease)	550	40.1
Gastritis	220	
GERD without severe esophagitis, Barrett's esophagus, or hiatus hernia	139	
Gastric erosions	129	
Gastritis and duodenitis	24	
Duodenal erosion	20	
Duodenitis	8	
Thick gastric folds	4	
Esophagitis	3	
Esophageal erosion	3	

Using Sharaf et al.'s (2004) criteria

patients had no preoperative UGI symptoms suggestive of gastric pathology; hence, these patients were projected to have a considerably low risk of any probable unexpected p-OGD finding. The value of p-OGD for such LSG patients is undeniably questionable, and as providing low-cost high-quality care is increasingly critical, it is difficult to justify the incurred costs that were invariably accompanied with nil diagnostic yield/very low likelihood of a positive finding. In our case, there was zero clinical yield for this group, and we consider the value of p-OGD for these group 0 patients as "*no management change—costs seems not justified*."

Very sparse literature has evaluated the value of routine p-OGD screening before LSG, rendering direct comparisons of our findings with other research arduous. Table 3 compares our p-OGD findings (by group and subgroup analyses) with published findings from high-income and low-income countries. The prevalence of our group 0 patients (49.4%) agrees with The Netherlands, where there was no p-OGD abnormality (i.e., equivalent to our group 0 patients) in 48.9% of their bariatric surgery patients [4]. Nevertheless, our finding contrasted with others [23], where their prevalence of group 0 p-OGD findings, using the same classification system we employed, was only 10.3%, much less than our 49.4% group 0 patients. Likewise, our 49.4% was less than in India, where only 18.7% of bariatric patients had no p-OGD abnormality (i.e., equivalent to our group 0 patients) [3]. Such contrasts between our findings and others might be due to an array of nutritional, genetic, lifestyle, or environmental characteristics of the general population where the research is implemented (e.g., USA, India, Finland) [3, 23, 25], as well as the prevalence of abnormal gastric pathology within the given population due to various etiologies (e.g., *H. pylori* infection, smoking, alcohol) [36, 37]. In addition, the much smaller sample sizes of other studies (Table 3, n = 195, 283, 342, respectively) [3, 23, 25], when compared to ours (n = 1369), might have also played a role in the observed contrasts between our prevalence *vis-à-vis* the other reported prevalences.

Value of p-OGD for Group 1 Patients

About 40.1% (n = 550) of our patients exhibited group 1 p-OGD findings (abnormal findings detected by p-OGD that do not change surgical approach/postpone surgery) (Tables 2 and 3). These asymptomatic patients did not raise suspicion of UGI condition/s. p-OGD detected abnormal findings in these group 1 patients, and was hence informative. However, the actual utility (benefits) of such extra information uncovered by the p-OGD was nil, as none of these abnormal findings necessitated any change or postponement of surgery due to the treatment of *H. pylori*. Again, for our sample, the value of p-OGD for such LSG patients is questionable. However, out of our 550 group 1 patients, p-OGD detected 305 patients to have *H. pylori* infection, and hence were treated by triple therapy (2 weeks). At our institution, these *H. pylori*-positive group 1 patients did not require any postponement of surgery while receiving their triple therapy, as the time required for the triple therapy was shorter than our normal waiting time for LSG, unlike other published studies who may have shorter waiting list (Table 4).

Because of this reason, the abnormal p-OGD findings in this group did not represent actual benefits for us, as none of these abnormal findings led to postponement of surgery. Hence, in our case, there was zero clinical yield for this group, and we consider the value of p-OGD for these group 1 patients again as no management change—cost seems not justified.

This might not necessarily be the case elsewhere where the waiting time for LSG is <2 weeks. Our levels of group 1 patients were generally higher than other countries (Table 3);

Table 3 Group and subgroup comparison of p-OGD findings, *H. pylori* infection, and patient characteristics across the current and published studies

Variable	Current study	Lee et al. [28]	Praveenraj et al. [3]	Schigt et al. [4]	Perooma et al. [25]	Sharaf et al. [23]	Abd Ellatif et al. [31]
Year of publication		2016	2015	2014	2013	2004	2016
Period of data collection	2011–2014	2002–2014	2012–2014	2007–2012	2006–2010	2000–2002	2001–2015
Country	Qatar	China	India	Netherlands	Finland	USA	Egypt
Number of patients	1369	268	283	523	342	195	3219
H. pylori infection[a]	43.6	23.7	21	25.8[b]	12	–	15.3
Symptomatic patients[a]	10.5	–	3.5	40	–	31.8	28
p-OGD findings (%)[a,h]							
Group 0	49.3	49	19	48.9	55.8	10.3	75
Group 1	40.1	24	69[c]	50.9[d]	27.8[e]	28.2	18.2
Group 2	10.5	27	12		16.4	61.5	6.8
Barrett's esophagus[h]	Nil	Nil	0.35	1.33	0.9	3.1	1.2
Polyps (esophageal, gastric, duodenal)[h]	2.26[f]	5.59[f]	3.53[g]	0.38[f]	2.9[f]	Nil	0.12[f]
Hiatus hernia[h]	7	17.9	9.5	21.8	25.4	40	29.7
Group 3	Nil	Nil	Nil	0.2	Nil	Nil	Nil

p-OGD preoperative oesophagogastroduodenoscopy, – percentage not reported in the original study

[a] Cells represent percentages calculated as percentages of the total number of patients

[b] Test was undertaken only in 326 out of 523 patients and percentage calculated accordingly

[c] Hiatus hernia <5 cm are included in this group

[d] We added groups 1 and 2 together due to the different p-OGD classification used by the authors

[e] Severity of gastritis, duodenitis, and esophagitis was not explicitly stated by authors; hence, we included them in group 1, assuming that they were all not severe

[f] All were benign polyps

[g] Out of 10 patients, 9 were benign polyps and one was carcinoid tumor

[h] These particular subcategories of group 2 were selected to be presented in the table due to their special significance

however, our higher levels did not signify a critical issue as group 1 represents only mild disease.

Value of p-OGD for Group 2 Patients

Group 2 patients comprised 10.5% of our sample (i.e., those with abnormal p-OGD findings that could change/postpone surgery) (Tables 2 and 3). Preoperatively, only group 2 patients with hiatal hernia and/or severe gastritis patients were symptomatic (68% of group 2); the remaining group 2 patients were asymptomatic.

As for group 2 patients with hiatal hernia, when there are no UGI symptoms (i.e., asymptomatic hernia discovered during LSG), then hiatal hernia repair (HHR) can be undertaken during the same procedure, rendering routine p-OGD unnecessary [38]. On the other hand, if there are suggestive UGI symptoms (i.e., symptomatic), then we recommend p-OGD to be undertaken. Routine p-OGD successfully diagnosed all of our 96 patients who had hiatus hernia (7% of the total sample); all had UGI symptoms, and the routine p-OGD we undertook for such patients seems justified. Some authors advocate that routine p-OGD is necessary to detect patients that may have hiatal hernia, as the type of procedure might be changed (from LSG to RYGB) when HH is confirmed [3]. We disagree with these authors, as we did not change our LSG procedure for our 96 symptomatic HH patients, and our patient records confirm that all had smooth postoperative recovery with resolution of their GERD symptoms within 1-year follow-up, including patients with hiatal hernia >4 cm. Certainly, such effective LSG + crural repair approach that we used agrees with others [38–42]. Indeed, asymptomatic HH does not require routine p-OGD for two reasons: (1) the HH may be detected intraoperatively during LSG and effectively repaired without change in bariatric procedure [38] and (2) small asymptomatic HH may escape undetected by p-OGD anyway [38]. Table 4 shows the postponement, cancelation, or change of surgical approach due to p-OGD findings across the current and published studies, along with our comments on the value of routine p-OGD.

As regard to group 2 patients with Barrett's esophagus, our p-OGD-detected Barrett's esophagus was nil, agreeing with the globally low incidence of Barrett's esophagus (0% to an average of 2.1%, Lee et al. 2016; Bennett et al. 2016). Such nil/low incidence does not seem to justify routine p-OGD in asymptomatic patients, particularly as (1) 70% of Barrett's esophagus

Table 4 Postponement, cancelation, or change of surgical approach due to p-OGD findings across the current and published studies

Study/procedure	Postponement, cancelation or change of surgical approach	Comments
Current study LSG	Postponed: group 1 and group 2 — Nil postponement	No postponement was necessary as our surgery waiting list time is >2–4 weeks (sufficient time for *H. pylori* treatment if present) (see group 1 discussion)
	Change of surgical approach: 96 group 2 patients (66.7%) due to hiatal hernia	Type of surgery (LSG) was not changed for hiatus hernia (even if >4 cm), as we undertook LSG and simultaneous HHR with excellent outcome
Schigt et al. [4] RYGB and LSG	Postponed: 1.1% of patients were postponed	Unable to comment on value of routine p-OGD as the group/s that these patients belonged to are unclear, as authors used different classification to categorize the p-OGD findings
	Cancelation: 1 case of p-OGD detected esophageal carcinoma	Esophageal carcinoma has very low incidence, does not justify routine p-OGD for all asymptomatic patients (see group 3 discussion)
Sharaf et al. [23] RYGB, LASGB, BPD/BPD-DS	Postponed: 21.5% of patients, due to either medical treatment/waiting for biopsy result/waiting for *H. pylori* test result/repeat OGD in order to assess severity of inflammation after medical treatment	No postponement would have been necessary if surgery waiting list time is >2–4 weeks (sufficient time for *H. pylori* treatment, receiving biopsy results or repeat OGD)
	Change of surgical approach: 40% of patients had hiatal hernia and crural repair	–
Praveenraj et al. [3] LSG and RYGB	Postponed: 12% of group 2 patients had their surgery postponed for medical treatment	No postponement would have been necessary if surgery waiting list time is >2–4 weeks (sufficient time for *H. pylori* treatment)
	Change of surgical approach: total of 3 patients (1.06%) changed from LSG to RYGB	
	2 patients with large hiatus hernia >5 cm	No surgical approach change would have been necessary for hiatus hernia >5 cm as LSG and simultaneous HHR can be carried out as we undertook with 4 of our patients with excellent outcome (see group 2 discussion)
	1 patient with Barrett's esophagus	Change of surgical approach is justified as RYGB is recommended for Barrett's esophagus [11]; however, we do not recommend routine p-OGD screening for Barrett's among asymptomatic patients (see group 2 discussion)
Abd Ellatif et al. [31] LSG, RYGB, and MGB	6.8% of patients had p-OGD finding that affected their surgery course:	
	Hiatal hernia patients had crural repair/reduction of hernia	Unable to comment on value of routine p-OGD as it is unclear what the planned surgery for these patients was
	Gastritis, esophagitis, gastric/duodenal ulcers or Barrett's esophagus had their surgery postponed due to either medical treatment/waiting for biopsy result/waiting for *H. pylori* test result/repeat endoscopy	No postponement would have been necessary if surgery waiting list time is >2–4 weeks (sufficient time for *H. pylori* treatment, receiving biopsy results or repeat OGD)
Lee et al. [28] LSG and gastric band	Postponed: 27% (n = 20) of group 2 patients due to medical treatment	No postponement would have been necessary if surgery waiting list time is >2–4 weeks (sufficient time for *H. pylori* treatment)
	Change of surgical approach: 27% (n = 20) of group 2 patients	
	18 patients had concomitant hiatal hernia	No surgical approach change would have been necessary for hiatus hernia (even if >5 cm) as LSG and simultaneous HHR can be carried out as we undertook with 4 of our patients who had large hiatus hernia with excellent outcome
	2 patients had their surgery changed from LSG to RYGB (reasons not mentioned)	–
Peromaa et al. [25] RYGB	Postponed: zero	–
	Change of surgical approach: zero	–

RYGB Roux-en-Y gastric bypass, *LASGB* laparoscopic adjustable silicone gastric banding, *BPD/BPD-DS* biliary-pancreatic diversion/biliary-pancreatic diversion-duodenal switch

patients had UGI symptoms [43] and (2) others have recommended that OGD screening for Barrett's esophagus/early adenocarcinoma could be done in patients with symptomatic chronic GERD plus ≥1 esophageal adenocarcinoma risk factor [44].

In terms of group 2 patients with polyp/s, our p-OGD detected that polyp incidence was low (2.26%) in line with others (Table 3), and all our polyps were benign, supporting other research [3, 4, 25, 28, 31]. Such low incidence and benign nature of our polyps do not seem to justify routine p-OGD in asymptomatic patients. In support, Praveenraj et al. [3] found that even when 1 of their 10 p-OGD-detected polyps was a carcinoid tumor, there were no signs of invasion/distant metastasis and it was completely excised endoscopically. Moreover, even in asymptomatic patients with a significant lesion that was missed due to not undertaking routine p-OGD, the merit of having a stomach remnant post LSG that is still accessible by OGD (unlike RYGB where the stomach remnant is unreachable postoperatively) enables the surgeon to undertake OGD and detect the lesion after the surgery. Collectively, given all the above evidence, we consider the value of p-OGD for these group 2 patients as "*possible surgical management change—costs seem justified for symptomatic patients*."

Value of p-OGD for Group 3 Patients

Group 3 encompassed patients with p-OGD findings that signify absolute contraindications to surgery (e.g., upper gastrointestinal cancers and varices) [23]. A bariatric surgery systematic review reported that p-OGD detected esophageal and gastric cancers in 0.2 and 0.4%, respectively, of the reviewed literature [11]. For instance, in the Netherlands, p-OGD detected one esophageal carcinoma, resulting in cancelation of the patient's bariatric surgery [4]. In Germany, two patients were scheduled for LSG, when p-OGD detected distal esophageal adenocarcinoma, but as both patients were early stage cancer (T1a N0 M0), they both had endoscopic mucosal resection and their surgeries changed to RYGB [12]. Across our sample, we observed zero group 3 patients (Tables 2 and 3). Generally, the incidence of upper gastrointestinal cancers is rare, and hence seems not justifying routine p-OGD in asymptomatic patients. For example, Wolter et al. (2017) reported that p-OGD detected two cases of esophageal cancer out of 801 patients, of which one was asymptomatic and the other is asymptomatic. Thus, we consider the value of p-OGD for these group 3 patients as possible surgical management change—cost seems justified for symptomatic patients as disease is very rare.

Value of p-OGD with Respect to Associated *H. pylori* Infection

All our LSG patients undertook routine p-OGD and CLO test. Recent ASGE guidelines [30] confirm the conflicting evidence about the value of preoperative *H. pylori* testing and treatment, with respect to UGI surgical outcomes. ASGE recommends that *H. pylori* testing should be individualized, as evidence exists for both an association [45] or no association [26, 46, 47] between *H. pylori* and post-LSG complications. It has also been proposed that LSG itself may even lead to *H. pylori* eradication [29]. Table 3 details and compares the *H. pylori* infection rates of our study and across the relevant bariatric literature. However, until clear guidelines of the value of routine *H. pylori* testing prior to LSG become available, and since we recommend p-OGD (and CLO) to be done only for symptomatic patients (see Table 5 below), we suggest for asymptomatic patients an accurate, less costly, and less invasive test than p-OGD: *H. pylori* stool antigen test [48].

Summary of Value of Routine p-OGD for Groups 0, 1, 2, and 3

Table 5 summarizes the value of routine p-OGD by patient groups in terms of the relationship between UGI symptoms, change in management, and cost justification. For our sample, the presence of UGI symptoms was suggestive and forecasting for p-OGD findings that led to surgical management change, and therefore, we are in general agreement with others [31] that p-OGD is to be only done for patients with UGI symptoms. In support to our findings, recent systematic review and meta-analysis, which included 4511 patients, mentioned that routine preoperative OGD is not warranted [49],

Table 5 Value of routine p-OGD for our 1369 cases categorized by patient groups: relationship between symptoms, change in management, and cost justification

Group	Suggestive UGI symptoms	p-OGD findings	Change in management	Costs justified?
0	Not present	Normal	No	Costs seem unjustified
1	Not present	Abnormal	No	Costs seem unjustified
2	Present in 68%[a]	Abnormal	Possibly yes (only for hiatal hernia patients where HHR was added)	Costs seem justified for symptomatic patients
3	No patients in our sample	–	–	–

[a] UGI symptoms were present in 68% of group 2 patients (those who had hiatus hernia or severe gastritis)

especially the unclear benefit of *H. pylori* eradication before LSG [26] and p-OGD may actually even miss cancerous lesions [50]. Moreover, the number of p-OGD required to screen for significant findings as Barrett's esophagus is high, taking into account their low incidence [49].

This study has some limitations. The measurement of GERD could have been more precise as (1) our assessments of GERD symptoms before and after surgery were subjective (self-reported) and (2) the retrospective nature of our study (based on patient records) was not conducive that we apply predefined criteria for GERD. Future research should benefit from preoperative and postoperative manometry, and/or 24-h pH monitoring would have been useful in objectively quantifying the changes in GERD post-LSG and HHR. Randomized controlled trials where p-OGD is the intervention could test and confirm any associations between UGI symptoms, p-OGD findings, and consequential change of management. Nevertheless, our large sample size (1369 patients), our focus on solely LSG rather than other bariatric procedures, and detailed and meticulous in comparison with relevant published studies add unique value to the current evidence.

Conclusion

A total of 89.5% of our patients were asymptomatic, and routine p-OGD findings confirmed that these patients were either normal or had mild disease not necessitating any changes in the surgical management. Hence, p-OGD findings had low impact on the management of asymptomatic patients. In the current era of cost-effectiveness and best utilization of hospital resources, routine p-OGD screening in patients scheduled for LSG may require further justification for asymptomatic patients. However, populations with high incidence of esophageal/gastric malignancies may require routine p-OGD before LSG. Further randomized controlled trials are needed to examine the real impact of routine p-OGD on LSG. Crural repair plus LSG is effective for hiatal hernia.

Compliance with Ethical Standards

Statement of Informed Consent Does not apply. The informed consent was waived (IRB-approved, HIPAA-compliant retrospective study).

Statement of Human and Animal Rights 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.

Ethical Approval For this type of study, formal consent is not required as it is a retrospective study.

Conflict of Interest The authors declare that they have no conflict of interest.

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