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ORIGINAL CONTRIBUTIONS

Preoperative Endoscopy Prior to Bariatric Surgery: a Systematic Review and Meta-Analysis of the Literature

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Abstract
Background There is debate regarding preoperative endoscopy (EGD) in patients undergoing bariatric surgery. Some centers perform EGD routinely in all patients; others perform EGD selectively. The objective of this study was to perform a systematic review and meta-analysis of the existing literature to estimate how frequently preoperative EGD changes management.
Methods Our review yielded 28 studies encompassing 6616 patients. Baseline characteristics including age and body mass index (BMI) were included. Patients were grouped based on EGD findings into two groups: Group 1—findings which did not significantly change management (e.g., mild/moderate duodenitis, Grade A/B esophagitis, mild/moderate gastritis, *H. pylori* infection, hiatal hernia <2 cm); Group 2—findings which delayed, altered, or cancelled surgery (e.g., severe duodenitis, Grade C/D esophagitis, gastric varices, hiatal hernia >2 cm, mass/carcinoma). A general estimating equation (GEE) model accounting for the correlated data within each study was used to calculate confidence intervals around the estimate of how frequently surgery was delayed or altered.
Results Mean age was 41.4 ± 2.9 years, the majority was women, and mean preoperative BMI was 47 ± 3.2 kg/m^2. Overall 92.4 % (n = 6112) had a normal EGD or findings that did not change clinical management and 7.6 % (n = 504); 95 % CI [4.6, 12.4 %] had findings that delayed/altered surgery. The revised estimate was 20.6 %; 95%CI [14.5, 28.2 %] if all esophagitis (regardless of grade) were categorized into Group 2. The approximate incidence of Barrett's esophagus and carcinoma were 0.1 and 0.08 %, respectively.
Conclusion A selective approach to preoperative EGD may be considered, based on the patients' symptoms, risk factors, and type of procedure planned.

Keywords Endoscopy · Bariatric surgery · Preoperative · Gastroscopy · EGD

Introduction

There is frequent debate regarding the role of preoperative endoscopy (EGD) prior to bariatric surgery. Some centers routinely perform EGD in all patients prior to bariatric surgery, while other centers utilize EGD selectively. The 2008 guidelines of from the American Society of Gastrointestinal Endoscopy (ASGE) recommended that that preoperative EGD should be performed in all patients with upper gastrointestinal symptoms and should be considered in patients without symptoms in order to exclude large hiatal hernias that may alter the surgical approach [1]. More recently, the ASGE in conjunction with the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) recommended that the decision to perform preoperative EGD should be "individualized" in bariatric surgery patients [2]. The American Society of Metabolic and Bariatric Surgery (ASMBS) recommends that all clinically significant gastrointestinal symptoms should be evaluated prior to bariatric surgery with imaging studies, upper gastrointestinal series, or EGD [3]. Alternatively, the European Association for Endoscopic Surgery (EAES) recommends either preoperative evaluation with an upper GI series or endoscopy prior to all bariatric surgeries regardless of symptoms, and the European Society of Gastrointestinal

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Endoscopy (ESGE) currently has no formal recommendations [4].

Although there is no clear standard for patient symptoms requiring preoperative EGD, surgeons may consider preoperative EGD in patients with symptoms of gastroesophageal reflux disease/esophagitis (including heartburn, regurgitation, dysphagia, or any postprandial symptoms that suggest foregut pathology) and/or patients undergoing gastric bypass with a family history of gastric cancer. The objective of this study was to perform a systematic review and meta-analysis of the existing literature to estimate how frequently preoperative EGD changes management.

Materials and Methods

After institutional review board approval, the study was registered on the PROSPERO international prospective register of systematic reviews (CRD42014009024). To identify relevant articles, a medical librarian trained in systematic review methodology searched the PubMed/MEDLINE (1946–present), Embase (1974–present), Cochrane Library, Web of Science (1900–present), BIOSIS (1926–present), Biological Abstracts (1969–present), and the Clinical Trials registries through April 2014. The NYAM Grey Literature, Open Grey, and OIAster databases were searched for gray literature of reports and additional information. *Obesity Surgery*, *Surgery for Obesity & Related Diseases*, *Surgical Endoscopy*, *American Journal of Surgery*, *Annals of Surgery*, and *Surgical Endoscopy* were hand searched for additional citations.

gastric bypass OR roux-en-y OR greenville gastric bypass OR Gastrojejunostom* OR Gastroileal bypass OR Stomach bypass OR Gastroplasty OR bariatric surgery OR sleeve gastrectomy OR gastric banding OR gastric band OR vertical band gastroplasty OR VBG OR vertical banding gastroplasty) AND (Obesity OR Morbid obesity OR Overweight OR bariatric OR adiposity OR body weight excess OR metabolic syndrome OR fat overload syndrome) AND (Endoscopy OR Endoscop* OR EGD OR esophagogastroduodenoscopy) AND (Preoperative Period OR preoperative OR pre-operative OR perioperative OR peri-operative OR preop* OR pre-op* OR preoperative testing OR pre-operative testing OR peri-operative testing OR screening test*

Fig. 1 Terms of primary search strategy.

The primary search strategy included several key terms in order to capture all relevant articles and abstracts (Fig. 1). These search terms were generated in conjunction with the surgeons, gastroenterologists, and the medical librarian. Articles (1731) were identified and 1255 articles remained

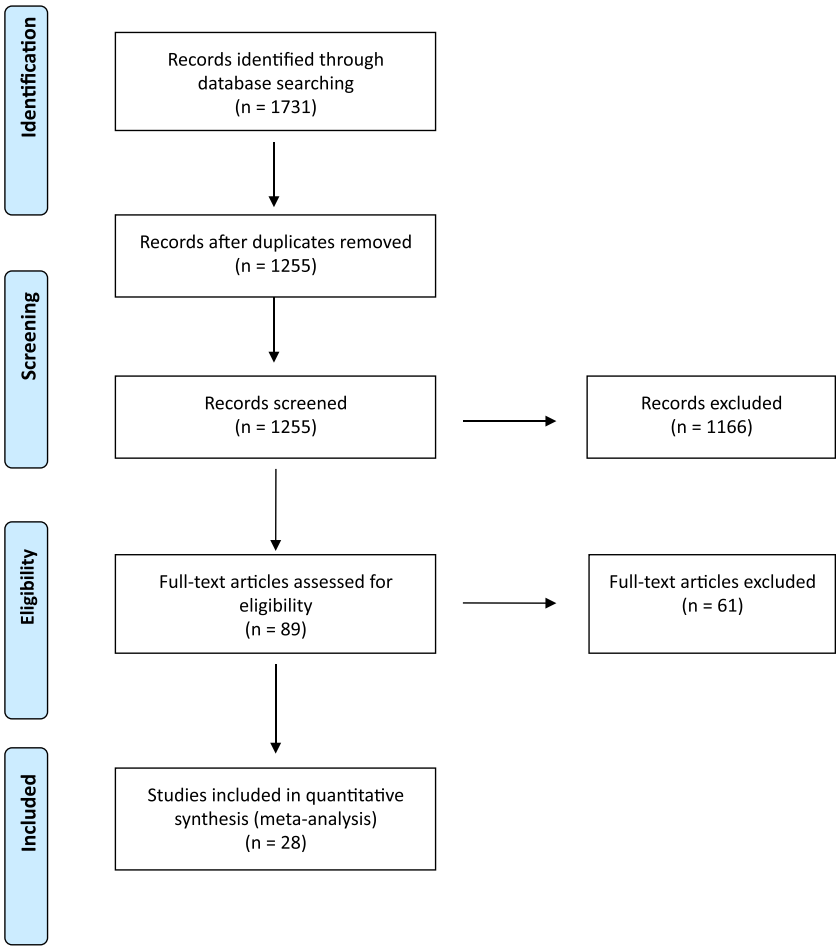

Fig. 2 Flow chart outlining search methods and excluded records

after duplicates were removed. The titles and abstracts were screened for applicability. The full text of the remaining 89 articles was reviewed for eligibility with 28 articles chosen for analysis (Fig. 2).

Several articles in the literature utilize multiple groupings, with many patients duplicated in these groups, making analysis difficult. Furthermore, some studies reported selective preoperative EGD based on patient symptoms and/or surgeon preference, while others reported routine preoperative EGD. For the purposes of this review, it seemed most clinically useful to group negative findings and findings that did not change management together and to also group findings that delayed surgery and those that canceled surgery together. Therefore, patients were classified into two distinct groups based on preoperative EGD findings (Table 1): Group 1 included EGDs with negative findings or findings which did not significantly alter management (small hiatal hernia, mild/moderate gastritis, Los Angeles Grade A/B esophagitis [5]). Group 2 was defined as findings that delayed, altered, or cancelled surgery (large hiatal hernia, Los Angeles Grade C/D esophagitis, esophageal stricture, malignancy, etc.). Since some bariatric surgeons may treat all esophagitis, regardless of severity, a second calculation was performed with all esophagitis categorized in Group 2.

Given the significant heterogeneity of the existing studies, a general estimating equation (GEE) model was used to calculate a confidence interval, accounting for the correlated data within each study.

Table 1 Definition of two groups based on preoperative EGD findings

Group 1: EGD with negative findings or findings that did not alter management	Group 2: EGD with findings that delayed, altered, or cancelled surgery
No abnormal findings	Arteriovenous malformation
Duodenitis (mild/moderate)	Barrett's esophagitis
Esophageal ring	Bezoar
Esophageal web	Cancer
Esophagitis (LA Grade A/B)	Duodenal diverticulum
Gastritis (mild/moderate)	Duodenal ulcer
Helicobacter pylori	Duodenitis (severe)
Hiatal hernia < 2 cm	Esophageal diverticulum
	Esophageal dysmotility
	Esophageal stricture
	Esophageal varices
	Esophagitis (LA Grade C/D)
	Gastric polyps
	Gastric varices
	Gastritis (severe)
	Hiatal hernia >2 cm
	Mass Lesion
	Ulcer
	Submucosal lesion

LA Los Angeles Classification[5]

Results

A total of 28 studies (18 scientific publications and 10 abstracts) encompassing 6616 patients undergoing EGD prior to bariatric surgery were included in the analysis (Table 2). The vast majority of studies (25/28) performed preoperative EGD routinely. Three studies utilized selective preoperative EGD initially but converted to routine preoperative EGD over the course of the study. The mean age of all the patients was 41.4 (±2.9) years and most of the patients were women, reflecting the typical demographics of bariatric surgery patients. The mean preoperative body mass index (BMI) was 47 (±3.2) kg/m^2. Overall, 92.4 % ($n = 6{,}112$) of the patients had a normal EGD or findings that did not change clinical management and 7.6 % ($n = 504$) had findings that delayed or altered surgery.

The patient-level data (when available) is shown in Table 3. EGD findings included gastritis (35 %), hiatal hernia (20 %), esophagitis (18 %), and Barrett's esophagus (0.1 %). Four patients (0.08 %) were found to have carcinoma.

There was significant heterogeneity within the studies, likely reflecting variation in deciding when to delay/cancel surgery (Fig. 3). The GEE model, accounting for the correlated data within each study, calculated the 95 % confidence interval of the 7.6 % estimate to be 4.6 to 12.4 %. The GEE model was repeated after categorizing all esophagitis (regardless of grade) into Group 2. The revised estimate was 20.6 %, 95 % CI [14.5 %, 28.2 %].

Sensitivity analysis was performed regarding the abstract-only data to assess any potential difference from the published articles. The GEE model found no significant difference in the abstract-only data ($p = 0.678$).

Discussion

Many bariatric surgery centers routinely perform EGD prior to bariatric surgery to potentially identify and treat lesions that may affect the surgery or even cancel the procedure entirely. The data regarding the benefit of routine preoperative EGD is variable and the surgical and gastrointestinal societies have issued potentially conflicting recommendations. This systematic review and meta-analysis of the existing literature was performed to estimate how frequently preoperative EGD changes management. We found that overall 7.6 %, 95 % CI [4.6 %, 12.4 %] of preoperative EGD had findings that delayed or altered surgery, and up to 20.6 %, 95 % CI [14.5 %,

Table 2 Systematic review of preoperative EGD findings

Investigator	Year	Number	Level of Evidence	Age	% male	Pre-op BMI	Group 1	Group 2
Akwaa	2008	65	Retrospective	34.6	35.4	57	65	0
Asiyanbola	2003	90	Retrospective	–	–	–	90	0
Azagury	2006	321	Retrospective	40.4	18	45.5	305	16
Bangura	2011	389	Retrospective	–	–	–	386	3
D'Hount	2013	654	Retrospective	39.5	–	42.8	578	76
de Moura Almeida	2008	162	Retrospective	36.7	30.2	44.1	113	49
De Oliveria	2005	154	Retrospective	35	13	45.1	154	0
Dietz	2012	126	Retrospective	42.1	17.4	51.2	122	4
Frigg*	2001	104	Retrospective	39	16	45	103	1
Kazantsev	2005	81	Retrospective	43	11	46	61	20
Korenkov	2006	145	Retrospective	39.8	27	48.3	143	2
Kuper	2010	69	Retrospective	43.4	37	47.6	46	23
Loewen	2008	447	Retrospective	40.6	14.9	47	445	2
Mong	2008	272	Retrospective	43.3	13	48	236	36
Munoz	2008	626	Retrospective	38.5	28	42	591	35
Peromaa-Haapisto	2013	407	Retrospective	–	39.2	–	396	11
Pilone	2013	78	Retrospective	–	–	–	78	0
Ruiz Marin	2012	187	Retrospective	–	30	46.2	177	10
Sanchez-Santos	2011	200	Retrospective	39.3	15.6	48.1	190	10
Schigt	2010	99	Retrospective	44.9	26.4	45.2	97	2
Schigt	2013	662	Retrospective	44.2	20.5	45.6	655	7
Schirmer	2002	536	Retrospective	–	–	–	510	26
Sharaf	2004	195	Retrospective	41.2	22.5	48.9	90	105
Teiveilis	2007	42	Retrospective	42	12.5	51.4	40	2
Vanek*	2006	94	Retrospective	44.5	–	49	81	13
Verset	1997	147	Prospective	37	–	45.3	118	29
Wang	2013	105	Retrospective	–	54	45.1	91	14
Zeni*	2006	159	Retrospective	41.1	18	49.7	151	8
Total		6616					6112 (92.4 %)	504 (7.6 %)

BMI body mass index

Group 1—EGD with negative findings or findings which did not significantly alter management; Group 2—EGD with findings that delayed, altered or canceled surgery

*All studies utilized routine preoperative EGD except when noted

28.2 %] of all grades of esophagitis were categorized in group 2.

Many centers advocate for routine preoperative EGD prior to bariatric surgery. The justification for this is that the increased prevalence of gastrointestinal diseases in the morbidly obese population may impact the perioperative therapy or even the surgical procedure [6]. Others favor a more "selective" approach, since the majority of abnormal EGD findings (e.g., *Helicobacter pylori* and hiatal hernia) can be diagnosed with other modalities [7, 8]. However, even in patients with upper gastrointestinal symptoms, it is unclear that preoperative EGD is beneficial, as studies have shown that the presence of symptoms cannot be considered a valuable guide to indicated endoscopy [9]. Furthermore, EGD may also be associated with complications such as bleeding, infection or perforation, or cardiopulmonary events secondary to sedation or anesthesia—which constitute up to 60 % of all adverse events associated with EGD [10].

There is also considerable debate regarding the clinical significance of some preoperative endoscopic findings, including *H. pylori* infection and esophagitis. Although most surgeons treat *H. pylori* prior to gastric bypass to mitigate the risk of marginal ulcer postoperatively [11], the evidence is unclear regarding the benefit of *H. pylori* eradication prior to sleeve gastrectomy [12]. Another clinical issue with routine eradication of *H. pylori* prior to bariatric surgery is that obese

Table 3 Endoscopic findings in 4511 patients undergoing bariatric surgery

EGD findings	Number of patients ($N = 4511$)	Percent
Gastritis	1562	34.6 %
Hiatal hernia	889	19.7 %
Helicobacter pylori	888	19.7 %
Esophagitis (all grades)	786	17 %
Duodenitis	226	5 %
Gastric ulcer	97	2 %
Duodenal ulcer	14	0.3 %
Barrett's esophagus	45	0.1 %
Carcinoma	4	0.08 %

patients have a significantly lower rate of eradication compared to controls, which could ultimately delay access to bariatric surgery [13, 14].

Perhaps more relevant, especially given the recent popularity of laparoscopic sleeve gastrectomy (LSG) [15], is the endoscopic finding of reflux esophagitis. Some surgeons may consider severe esophagitis or Barrett's esophagus a contraindication to LSG [16]. For these surgeons, preoperative EGD may be warranted, as our estimate of EGD findings that delayed or altered surgery increased to 20.6 % when all grades of esophagitis were grouped together. Nevertheless, objective evaluations of reflux pre- and post-LSG show that the vast majority of reflux improves after LSG [17]. In addition, the number of preoperative EGD required to screen to find Barrett's esophagus is high, especially given low incidence in this review (0.1 %) and reported in other studies [18].

In the past, surgeons advocated for routine preoperative EGD to rule out malignancy of the stomach prior to gastric bypass, as the remnant stomach would no longer be accessible to endoscopic surveillance [7]. However, the incidence of gastric malignancy in the US is very rare and preoperative EGD may miss cancerous lesions [6]. In this review, cancer was found in 0.08 % of patients.

This meta-analysis is limited by the source data that is not a randomized group of patients, but rather a collection of mainly retrospective reports in the literature. The analysis is also limited by the fact that the vast majority of studies utilized routine preoperative EGD, precluding a comparison between studies that report routine EGD vs. selective EGD. We manually reviewed all studies in the analysis to identify any additional patient-level factors.

There is also significant heterogeneity in the existing literature due to the varying protocols across institutions regarding the relevance of various preoperative EGD findings. Due to the heterogeneity, the GEE model was created to estimate confidence intervals, accounting for the correlated data within each study. Sensitivity analysis was also performed to determine whether the data from the abstracts affected our findings and we found no difference ($p = 0.678$).

How should a practicing bariatric surgeon interpret this data, especially given the shortcomings of the source data? Surgeons will need to balance the risks of a potentially unnecessary invasive procedure that may increase "dropout" prior to bariatric surgery with the possibility of missing an

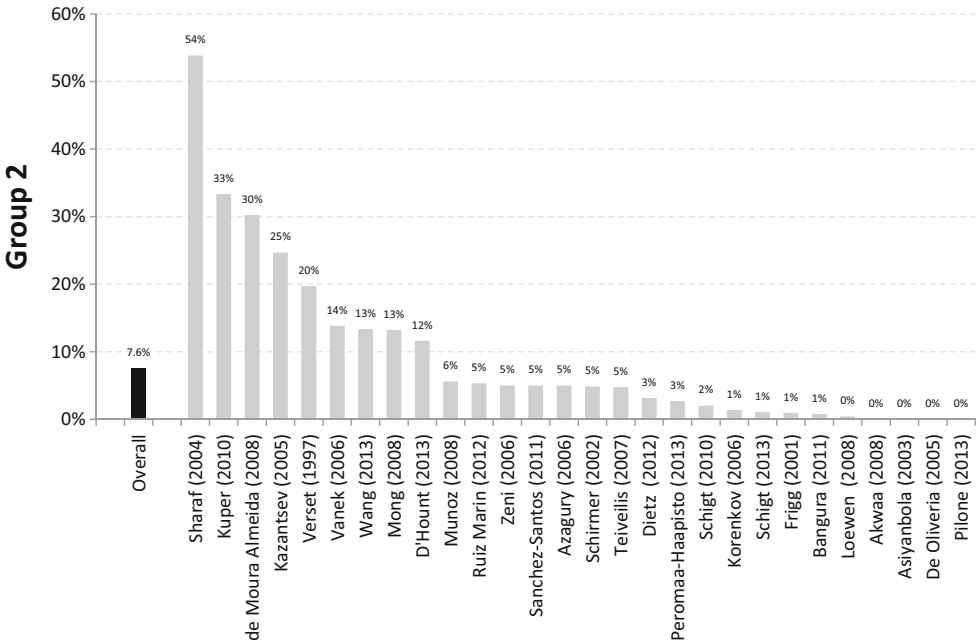

Fig. 3 There was significant heterogeneity within studies

important asymptomatic endoscopic finding that may ultimately require revision surgery (e.g., severe esophagitis in patients undergoing LSG). From our perspective, routine preoperative EGD is not warranted based on the current evidence. Although a significant percentage of LSG revisions are due to intractable reflux, it is unclear that preoperative EGD would make a difference, as "de novo" reflux may develop after LSG [17].

Conclusion

This systematic review and meta-analysis of the existing literature found that overall 7.6 %, 95 % CI [4.6 %, 12.4 %] of preoperative EGD had findings that delayed or altered surgery. If all esophagitis (regardless of grade) were categorized into Group 2, this increases to 20.6 %, 95%CI [14.5 %, 28.2 %]. A selective approach to EGD may be considered, based on the patients' symptoms, risk factors, and type of procedure planned.

Compliance with Ethical Standards

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

Ethical Approval All procedures performed in the studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

Informed Consent Does not apply

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