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Routine Screening Endoscopy before Bariatric Surgery: Is It Necessary?

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Background: Routine esophagogastroduodenoscopy (EGD) prior to bariatric surgery has not been consistently shown to change the management of the patient. A study was performed to estimate the proportion of patients undergoing bariatric surgery evaluation who had abnormal findings on preoperative EGD that resulted in alteration of management and, second, to evaluate potential risk factors for occurrence of abnormal findings on the EGD.
Methods: An observational, retrospective study in which all 232 patients who were cleared to undergo bariatric surgery and who underwent preoperative EGD between 2006 and 2013 were included at a single tertiary dedicated bariatric center for weight loss management. Abnormal findings on screening EGD and medical or surgical management alteration based on the EGD findings were reviewed.
Results: Abnormal findings on screening EGD were found in 143 patients (61.6%). Thirty-five patients had medical management altered (15.1%), while four patients (1.7%) had surgical management altered. Being aged >55 years and the presence of gastroesophageal reflux disease were associated with occurrence of an abnormal finding on screening EGD.
Conclusions: While abnormalities on preoperative EGD are often found in patients undergoing bariatric surgery evaluation, rarely do the findings change surgical management. Alternative methods for screening for common GI conditions should be considered in appropriate patients.

Introduction

Obesity, defined as a body mass index (BMI) of ≥ 30 kg/m^2, is a chronic disease that is now a well-established pandemic affecting many countries. According to the World Health Organization (WHO), 700 million adults worldwide are predicted to be obese by 2015, an increase from 400 million in 2005.[1] In the United States, more than one-third of adults are obese.[2,3] Obesity is associated with a significant increase in mortality, as well as increased risk for many disorders, including heart disease, stroke, type 2 diabetes mellitus, dyslipidemia, hypertension, sleep apnea, cancer, and others.[2,4] While weight-loss interventions through rigid diet and exercise programs are available, many obese patients fail these more conservative methods. The field of bariatric surgery has become mainstream care over the past three decades for the management of the most severe cases of obesity.[5] Current national policies for a patient to qualify for bariatric surgery are a BMI ≥ 40 or a BMI ≥ 35 and either high-risk comorbid conditions, such as severe cardiopulmonary problems and severe diabetes mellitus, or obesity-induced physical problems that affect quality of life.[6]

Currently, the most commonly performed bariatric operations in the United States include the Roux-en-Y gastric bypass, the laparoscopic adjustable gastric band, the vertical sleeve gastrectomy, and the bilio-pancreatic diversion with duodenal switch.[7] Bariatric surgery has been shown to be effective in reducing comorbidities related to obesity as well as overall mortality. Patients being evaluated as potential candidates for bariatric surgery undergo thorough, comprehensive evaluations conducted by a multidisciplinary team aimed at evaluating surgical, medical, and psychological conditions.[8] Because of alterations in foregut anatomy created with these bariatric operations, a routine preoperative esophagogastroduodenoscopy (EGD) is performed in patients at many centers, a recommendation endorsed by several specialty societal guidelines, albeit to varying extents.[8–11] Many of these routine preoperative EGDs are of low yield, with findings that either do not change the course of surgical management or are unremarkable. The costs associated with

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these endoscopic procedures (i.e., endoscopy professional and facility fees, sedation, fee for anesthesiology team, and pathology) contribute substantially to healthcare expenditures that could be avoided if patients were more selectively identified.

The three primary aims of this study in patients who were evaluated for bariatric surgery were to (1) estimate the proportion who had abnormal findings on presurgery screening EGD, (2) estimate the proportion who had their surgical or medical managements altered by the findings on presurgery EGD, and (3) evaluate potential risk factors for occurrence of abnormal findings on presurgery EGD.

Methods

Patients and study design

The study was approved by the Mayo Clinic Foundation Institutional Review Board. This was an observational, retrospective study in which all 232 patients who were cleared to undergo bariatric surgery and who underwent presurgery endoscopy screening at the Mayo Clinic in Jacksonville, Florida, between August 2006 and May 2013 were included. All patients were evaluated in a dedicated bariatric center and fulfilled the criteria for bariatric surgery. Each had a BMI ≥ 40 or had a BMI ≥ 35 with obesity-related comorbidities. At our center, patients undergoing bariatric surgery evaluation routinely undergo a preoperative EGD. Those patients who underwent EGD at an outside facility were excluded from this study.

Information was collected regarding demographics (age at EGD, gender, BMI at EGD, BMI at surgery, race), comorbid conditions (current smoking, obstructive sleep apnea, hypertension, coronary artery disease, diabetes mellitus, asthma/chronic obstructive pulmonary disease [COPD], depression, anxiety, or other psychiatric disease, gastroesophageal reflux disease [GERD], arthritis, hypothyroidism, and chronic liver disease), and symptoms at the time of preendoscopy visit (abdominal pain, heartburn, acid regurgitation, nausea with or without vomiting, dysphagia, odynophagia, diarrhea, anemia, and iron deficiency). Endoscopy information, including type of sedation, abnormal findings on endoscopy (any abnormal finding and specific types), and type of surgical operation, were gathered. Our center performs laparoscopic adjustable gastric band, Roux-en-Y gastric bypass, and vertical sleeve gastrectomy; the bilio-pancreatic diversion with duodenal switch was not performed at our institution during the study period. Data were collected on alteration of medical or surgical management based on EGD findings.

Statistical analysis

Continuous variables were summarized with the sample median, 25th percentile, 75th percentile, and maximum. Categorical variables were summarized with number and percentage. The proportions of patients who had any abnormal finding on screening EGD, specific types of abnormal findings on screening EGD, their medical management altered by screening EGD findings, or their surgical management postponed or cancelled by screening EGD findings were all estimated along with 95% confidence intervals (CIs). Associations between variables known prior to the EGD and the outcome of occurrence of any abnormal finding on EGD were evaluated using single variable and multivariable logistic regression models. Multivariable models were adjusted for any variable associated with any abnormal finding on EGD with a p-value of ≤ 0.05 in single variable analysis. Odds ratios (ORs) and 95% CIs were estimated. For easier interpretation of results, continuous variables (age at EGD and BMI at EGD) were considered as three-level categorical variables based on approximate sample tertiles in logistic regression analysis. We used the results of the multivariable association analysis to create a risk score that effectively stratifies patients according to their risk of occurrence of an abnormal finding on screening EGD. Area under the receiver operating characteristic curve (AUC) was estimated for this risk score, along with a 95% CI, where an AUC of 0.5 indicates predictive ability equal to that of chance alone and AUC of 1.0 indicates perfect discrimination. No adjustment for multiple testing was made in these exploratory analyses, and p-values of ≤ 0.05 were considered statistically significant. Due to the fact that only four patients had their surgical management altered by the findings of the screening EGD, we were not able to perform any association analysis to identify factors that may predict this outcome. Statistical analysis was performed using SAS (v9.2; SAS Institute, Inc., Cary, NC).

Results

A summary of characteristics of the 232 study patients is provided in Table 1. Median age at EGD was 51 years (range 23–77 years), and the majority of patients were women (82.3%). Median BMI at EGD was 42.4 (range 33.5–72.2). The most common comorbid conditions were obstructive sleep apnea (57.8%), hypertension (56.9%), GERD (44.8%), and arthritis (40.5%). Slightly more than one-third of patients had gastrointestinal symptoms at the time of the preendoscopy visit, with the most common symptoms being heartburn (28.9%), acid regurgitation (18.5%), abdominal pain (6.5%), and nausea with or without vomiting (4.7%). Most patients (81.5%) underwent upper endoscopy with conscious sedation. The remainder required anesthesia assistance. The most common type of bariatric procedure was Roux-en-Y gastric bypass (66.6%) followed by vertical sleeve gastrectomy (20.2%) and laparoscopic adjustable gastric band (13.2%).

Abnormal findings on screening EGD are displayed in Table 2. Of the 232 study patients, 143 (61.6% [95% CI 55.0–67.9%]) had one or more abnormal findings on screening EGD. The most common abnormal findings were small hiatal hernia (23.7% [95% CI 18.4–29.7%]), esophagitis (19.4% [95% CI 14.5–25.1%]), gastric erosion (11.2% [95% CI 7.5–16.0%]), gastric polyp (9.5% [95% CI 6.0–14.0%]), Barrett's esophagus without dysplasia (9.5% [95% CI 6.0–14.0%]), and gastritis (biopsy proven; 9.1%).

Thirty-five patients (15.1% [95% CI 10.7–20.4%]) had their medical management altered by screening EGD findings, while four patients (1.7% [95% CI 0.5–4.4%]) had their surgical management cancelled or postponed. Of medical management alterations, 28 patients (12.1% [95% CI 8.2–17.0%]) had proton pump inhibitor therapy or histamine 2 receptor blocker therapy initiated, and eight patients (3.4% [95% CI 1.5–6.7%]) received *Helicobacter pylori* treatment; one patient had both of these medical management alterations. For surgical management, one patient (0.4%

Table 1. Patient Characteristics

Variable	*Summary (N = 232)*
Demographic information	
Age at EGD	51 (23, 41, 59, 77)
Gender (Male)	41 (17.7%)
BMI at EGD	42.4 (33.5, 39.8, 48.7, 72.2)
BMI at surgery	41.5 (33.0, 38.8, 47.3, 69.9)
Race	
Caucasian	184 (79.3%)
African American	40 (17.2%)
Asian	4 (1.7%)
Other	4 (1.7%)
Comorbid conditions	
Obstructive sleep apnea	134 (57.8%)
Hypertension	132 (56.9%)
GERD	104 (44.8%)
Arthritis	94 (40.5%)
Diabetes mellitus	85 (36.6%)
Depression, anxiety, or other psychiatric disease	77 (33.2%)
Hypothyroidism	35 (15.1%)
Asthma/COPD	23 (9.9%)
Coronary artery disease	15 (6.5%)
Current smoker	9 (3.9%)
Other significant comorbidity	11 (4.7%)
Symptoms at time of pre-endoscopy visit	
Any symptoms	84 (36.2%)
Heartburn	67 (28.9%)
Acid regurgitation	43 (18.5%)
Abdominal pain	15 (6.5%)
Nausea with or without vomiting	11 (4.7%)
Diarrhea	7 (3.0%)
Dysphagia	4 (1.7%)
Odynophagia	0 (0.0%)
Anemia	9 (3.9%)
Iron deficiency	6 (2.6%)
Endoscopy and surgery information	
Type of endoscopy	
Conscious sedation	189 (81.5%)
Monitored anesthesia care	43 (18.5%)
Bariatric surgery	228 (98.3%)
Type of bariatric procedure	
Roux-en-Y gastric bypass	152 (66.6%)
Laparoscopic adjustable gastric band	30 (13.2%)
Vertical sleeve gastrectomy	46 (20.2%)

The sample median (minimum, 25th percentile, 75th percentile, maximum) is given for continuous variables.

EGD, esophagogastroduodenoscopy; BMI, body mass index; GERD, gastroesophageal reflux disease; COPD, chronic obstructive pulmonary disease.

[95% CI 0.0–2.4%]) had a postponement of their bariatric operation due to findings of Barrett's esophagus with low grade dysplasia, while three patients (1.3% [95% CI 0.3–3.7%]) had their bariatric operation cancelled due to findings of gastroesophageal varices; these three patients had previously known liver cirrhosis or suspicion of progression of liver fibrosis (Table 3).

Table 2. Abnormal Findings from EGD

Variable	*No. (%)*	*95% CI*
Any abnormal finding	143 (61.6%)	55.0–67.9%
Small hiatal hernia (≤4 cm or described as small)	55 (23.7%)	18.4–29.7%
Esophagitis	45 (19.4%)	14.5–25.1%
Gastric erosion	26 (11.2%)	7.5–16.0%
Gastric polyp	22 (9.5%)	6.0–14.0%
Barrett's esophagus without dysplasia (biopsy proven)	22 (9.5%)	6.0–14.0%
Gastritis (biopsy proven)	21 (9.1%)	5.7–13.5%
Helicobacter pylori gastritis	8 (3.4%)	1.5–6.7%
Large hiatal hernia (>4 cm or described as large)	7 (3.0%)	1.2–6.1%
Duodenitis (biopsy proven)	5 (2.2%)	0.7–5.0%
Gastroesophageal varices	4 (1.7%)	0.5–4.4%
Barrett's esophagus with dysplasia (biopsy proven)	2 (0.9%)	0.1–3.1%
Duodenal polyp	1 (0.4%)	0.0–2.4%
Duodenal erosion	1 (0.4%)	0.0–2.4%
Severe multiple ulcerations requiring repeat endoscopy before surgery	1 (0.4%)	0.0–2.4%
Large fundic vessel(s) requiring oversewing during surgery	0 (0.0%)	0.0–1.6%
Tumors that require further evaluation	0 (0.0%)	0.0–1.6%
Altered anatomy	0 (0.0%)	0.0–1.6%
Cancer	0 (0.0%)	0.0–1.6%

CI, confidence interval.

An evaluation of associations of variables known prior to the time of EGD with the outcome of any abnormal finding on EGD is shown in Table 4. In single variable analysis, there was evidence of an association between age and occurrence of an abnormal finding on screening EGD ($p = 0.004$); in comparison to patients younger than 45 years of age, risk of an abnormal finding was 1.88 times higher ([95% CI 0.97–3.64], $p = 0.061$) for patients aged between 45 and 55, and 2.98 times higher ([95% CI 1.57–5.71], $p = 0.001$) for patients older than 55 years of age. Additionally, patients with GERD were more likely to have an abnormal finding in single variable analysis (OR 1.81 [95% CI 1.05–3.11], $p = 0.033$). There were no other significant associations with occurrence of an abnormal finding in single variable analysis ($p \geq 0.097$). In multivariable analysis adjusting for both age at EGD and GERD, the association between age and occurrence of an abnormal finding remained consistent (Table 4), though the increased risk of an abnormal finding for patients with GERD was not quite statistically significant (OR 1.70 [95% CI 0.98–2.97], $p = 0.061$). There were no other notable associations with occurrence of an abnormal finding in multivariable analysis ($p \geq 0.13$).

Based on the significant or borderline significant associations of age at EGD and GERD with occurrence of an abnormal finding on screening EGD, we attempted to combine these two variables and create a risk score that could potentially be used to stratify risk of occurrence of an abnormal finding on screening EGD. For age at EGD, patients younger than 45 years of age were assigned a score of 0, patients who were between 45 and 55 years of age were assigned a score of

Table 3. Characteristics of the Four Patients Who Had Surgical Management Altered

Patient	Age	Sex	Race	BMI at EGD	Comorbid conditions	Symptoms/signs at time of pre-endoscopy visit	EGD findings	Management
1	53	F	Caucasian	52.7	NASH cirrhosis; OSA; HTN; DM; asthma; anxiety and depression; GERD; arthritis; hypothyroidism	Abdominal pain; nausea; diarrhea; anemia	Gastroesophageal varices	Surgery cancelled
2	57	F	Caucasian	48.2	HCV cirrhosis; OSA; anxiety and depression; arthritis	Abdominal pain; nausea; diarrhea	Gastroesophageal varices	Surgery cancelled
3	52	F	Caucasian	54.4	NASH cirrhosis; OSA; HTN; CAD; DM; arthritis	Abdominal pain; anemia	Gastroesophageal varices	Surgery cancelled
4	64	M	Caucasian	36.7	HTN; DM; arthritis	Heartburn	Barrett's esophagus with low grade dysplasia	Surgery postponed; patient lost to follow-up in bariatric clinic

NASH, nonalcoholic steatohepatitis; OSA, obstructive sleep apnea; HTN, hypertension; DM, diabetes mellitus; GERD, gastroesophageal reflux disease; CAD, coronary artery disease.

1, and patients who were older than 55 years of age were assigned a score of 2. Patients without GERD were assigned a score of 0, and those with it were assigned a score of 1. The individual age at EGD and GERD scores were then summed to create a risk score with possible values of 0, 1, 2, and 3. Unfortunately, this risk score was only mildly to moderately effective in identifying patients at the highest risk of experiencing an abnormal finding on screening EGD (AUC: 0.64 [95% CI 0.58–0.71]), which occurred in 47.1% (24/51) of patients with a risk score of 0, 53.7% (36/67) of patients with a risk score of 1, 67.1% (49/73) of patients with a risk score of 2, and 82.9% (34/41) of patients with a risk score of 3. Of interest, when evaluating the ability of age at EGD (the strongest predictor of abnormal findings on EGD) to stratify risk, estimated AUC was only slightly lower at 0.62 [95% CI 0.55–0.69]; 48.2% (40/83) of patients younger than 45 years of age had an abnormal finding, 63.6% (42/66) of patients aged between 45 and 55 had an abnormal finding, and 73.5% (61/83) of patients older than 55 years of age had an abnormal finding.

Discussion

In this study evaluating outcomes of prebariatric surgery screening EGD, more than 60% of the cohort had abnormal findings on EGD of varying severity. More specifically, based on 95% confidence limits for this estimate, for every 1,000 patients who undergo a screening endoscopy prior to bariatric surgery, between 550 and 679 will have at least one abnormal finding on EGD. Furthermore, we found that patients older than 55 years of age that have GERD were at a higher risk of having abnormal findings on EGD, although the latter finding did not quite remain significant in multivariable analysis. However, the risk score based on these two variables only moderately discriminated patients according to their likelihood of experiencing an abnormal finding on screening EGD (47% of patients with the lowest risk score of zero had an abnormal finding). Therefore, this was not effective in identifying those patients who would not need to undergo screening EGD before bariatric surgery. The identification of more predictors for abnormal EGD findings is needed in order for such a risk stratification system to be effective. However, despite the significant number of patients with some type of abnormal finding on EGD, a small proportion had medical management altered, and furthermore, $<2\%$ of patients had surgical management postponed or cancelled.

Prior studies have shown similar findings. In a study by Schirmer *et al*., out of 560 patients who underwent Roux-en-Y gastric bypass at a single institution, 4.9% (26 patients) had endoscopic findings that changed or altered the operative procedure.[12] These findings included esophagitis, gastroduodenal ulcers, hiatal hernia, and gastric polyps, all findings that did not lead to cancellation of any procedure.[12] Similarly, in a study by Sharaf *et al*., in a cohort of 195 patients who underwent EGD prior to bariatric surgery, 42 patients had clinically important findings that ultimately resulted in either alteration of the surgical procedure (e.g., reduction of hiatal hernia) or medical management prior to operation.[13] Similar findings were demonstrated in a study by Loewen *et al*., in which, out of 451 consecutively screened patients undergoing preoperative EGD, positive findings that lead to a

Table 4. Associations with Occurrence of an Abnormal Finding on EGD

	Single variable analysis		*Multivariable analysis*	
Variable	*OR [95% CI]*	p-*Value*	*OR [95% CI]*	p-*Value*
Demographic information				
Age at EGD	Overall test for difference: $p=0.004$		Overall test for difference: $p=0.007$	
<45 years	1.00 (reference)	N/A	1.00 (reference)	N/A
45–55 years	1.88 [0.97, 3.64]	0.061	1.82 [0.93, 3.54]	0.079
>55 years	2.98 [1.57, 5.71]	0.001	2.86 [1.49, 5.52]	0.002
Gender (male)	1.63 [0.79, 3.39]	0.19	1.67 [0.79, 3.56]	0.18
BMI at EGD	Overall test for difference: $p=0.097$		Overall test for difference: $p=0.30$	
<40	1.00 (reference)	N/A	1.00 (reference)	
40–45	0.57 [0.28, 1.17]	0.12	0.65 [0.31, 1.36]	0.25
>45	0.47 [0.23, 0.94]	0.032	0.57 [0.28, 1.18]	0.13
Race (non-Caucasian)	0.68 [0.36, 1.29]	0.23	0.98 [0.49, 1.94]	0.95
Comorbid conditions				
Current smoker	0.77 [0.20, 2.95]	0.70	0.94 [0.24, 3.74]	0.93
Obstructive sleep apnea	1.03 [0.60, 1.76]	0.91	0.89 [0.51, 1.55]	0.67
Hypertension	1.13 [0.66, 1.93]	0.66	0.88 [0.49, 1.57]	0.66
Coronary artery disease	1.77 [0.55, 5.74]	0.34	1.16 [0.35, 3.91]	0.81
Diabetes mellitus	1.33 [0.76, 2.32]	0.31	1.15 [0.64, 2.08]	0.64
Asthma/COPD	1.48 [0.58, 3.74]	0.41	1.51 [0.58, 3.95]	0.40
Depression, anxiety, or other psychiatric disease	1.46 [0.82, 2.60]	0.19	1.37 [0.75, 2.48]	0.30
GERD	1.81 [1.05, 3.11]	0.033	1.70 [0.98, 2.97]	0.061
Arthritis	1.59 [0.92, 2.76]	0.097	1.37 [0.77, 2.42]	0.29
Hypothyroidism	1.06 [0.51, 2.23]	0.87	1.01 [0.47, 2.20]	0.97
Other significant comorbidity	2.92 [0.62, 13.84]	0.18	3.44 [0.71, 16.69]	0.13
Symptoms at time of pre-endoscopy visit				
Any symptoms	1.02 [0.59, 1.77]	0.95	0.78 [0.41, 1.47]	0.43
Abdominal pain	1.77 [0.55, 5.74]	0.34	1.65 [0.49, 5.56]	0.42
Heartburn	0.97 [0.54, 1.75]	0.93	0.67 [0.33, 1.37]	0.27
Acid regurgitation	0.94 [0.48, 1.85]	0.86	0.65 [0.29, 1.43]	0.28
Nausea with or without vomiting	2.92 [0.62, 13.84]	0.18	2.77 [0.56, 13.59]	0.21
Diarrhea	1.58 [0.30, 8.30]	0.59	1.60 [0.29, 8.79]	0.59
Anemia	1.26 [0.31, 5.15]	0.75	1.20 [0.28, 5.19]	0.81
Iron deficiency	0.61 [0.12, 3.11]	0.56	0.64 [0.12, 3.55]	0.61

OR, odds ratio. ORs, 95% CIs, and *p*-values result from logistic regression models. Multivariable models were adjusted for any variable with a *p*-value of ≤ 0.05 in single variable analysis, which were age at EGD and GERD. An OR >1 indicates an increased likelihood of an abnormal finding on EGD when the given characteristic is present, while an OR <1 indicates a decreased likelihood of an abnormal finding on EGD when the given characteristic is present.

change in medical management were seen in 18% of the cohort, but no patients had bariatric surgery cancelled.[14] Peromaa-Haavisto *et al.* also demonstrated that the majority of lesions found on EGD from a cohort of 412 patients undergoing preoperative endoscopic assessment were insignificant and did not cancel or alter the operative plan[15] (unlike these studies, we were primarily interested in information on findings that led to cancelled or postponed surgical management).

Of the findings detected on preoperative EGD, the majority were benign or mild and of little clinical consequence. This is an important point, which raises the question of whether bariatric patients undergoing bariatric surgical evaluation should routinely undergo EGD for evaluation of pathology and foregut anatomy. This study also raises controversy on the actual definition of a true abnormal finding on EGD. Because of such variability in how institutions and clinicians define abnormalities on EGD, true abnormal findings on EGD are actually quite rare. In the United States, where the incidence of *H. pylori* is 0.5% compared to 3% to 10% in developing countries, routine or frequent biopsies taken of the stomach for *H. pylori* determination should be restricted unless clinically indicated.[16–18] Only eight patients were found to have *H. pylori* infection on gastric biopsies and were subsequently treated with an antibiotic regimen. Less expensive, nonendoscopic tests are now available with high sensitivity and specificity for *H. pylori* determination.[19]

Obesity is a well-recognized risk factor for GERD.[20–22] Our study did find an association of both older age and GERD with risk of finding an abnormality on EGD in prebariatric surgery patients. In patients with moderate or large hiatal hernias, concomitant repair is often performed at the time of the bariatric procedure, especially in the setting of laparoscopic adjustable gastric banding and sleeve gastrectomy because of the risk of worsening of GERD symptoms after bariatric surgery.[20,22] While EGD provides an estimate of the size of the hiatal hernia compared to intraoperative methods (particularly for small hiatal hernias), upper GI contrast studies detect the presence of hiatal hernias in obese patients, and furthermore, are less costly.[20] The gastroesophageal

junction is preserved in all three bariatric operations, and therefore patients with GERD and concern for esophagitis could still be evaluated endoscopically in the postoperative setting if clinically indicated. Furthermore, with the prevalence of gastric cancer and other foregut tumors being very low in this cohort and the United States, screening for malignancies should be stratified based on the patient's risk factors and clinical presentation.[23]

Of the four patients who had bariatric surgery postponed or cancelled (Table 3), three had high clinical suspicion for liver cirrhosis/advanced liver fibrosis, with known thrombocytopenia. All three patients had prior EGDs that showed varices, and therefore their preoperative EGD findings were not surprising. Therefore, a screening EGD in evaluation for bariatric surgery did not appear to be helpful in these three selected patients and, rather, was costly and did not complement data currently available at the time of the evaluation. Performing preoperative EGD in patients with low suspicion of portal hypertension, however, could be helpful with assessing the severity of the portal hypertension, which could help determine perioperative risk. Overall complication rates, mainly from gastrojejunostomy anastomotic leaks and postoperative small bowel obstructions, are low (<5%), and mortality rates are near zero, due to advances in surgical techniques and careful patient selection. However, performing bariatric surgery in cirrhotic patients is generally not favored due to the significant perioperative risks, particularly bleeding and hepatic decompensation. At our center, patients with portal hypertension rarely (if ever) are candidates for bariatric surgery without the support of the liver transplant team, should the patient's health deteriorate and the patient require an urgent liver transplantation. The fourth patient, a 64-year-old gentleman, was diagnosed with Barrett's esophagus with low grade dysplasia, and underwent treatment for that, with bariatric surgery being postponed. This patient had no prior EGDs, and, this was therefore a new diagnosis.

To provide a general cost estimate for a patient undergoing EGD with biopsy under conscious sedation in an ambulatory surgery center (ASC), physician and facility fees were estimated using the 2013 Medicare physician and ASC fee schedules using the Current Procedural Terminology (CPT) codes. We used CPT codes 43239 for upper GI endoscopy biopsy and 88305 for tissue exam by pathologist. Total reimbursement using the 2013 Medicare physician and facility reimbursement rates for EGD with biopsy under conscious sedation and tissue examination by pathologist was approximately US$600. The cost of performing routine endoscopy prior to bariatric surgery per clinically important lesion detected that altered surgical management was approximately US$34,800 per lesion.

While several previous studies have raised the issue of whether preoperative EGD in the bariatric population is useful and necessary, few have explored the financial issues associated with routine EGD, which is a major strength to this study.[13] Since the introduction of the fiber-optic gastroscope in 1963 and its continuous technological and imaging enhancements, EGD has replaced the upper GI barium study as the favored test to evaluate the foregut in many endoscopy centers and medical institutions. Between 2000 and 2009, there has been a 54% increase in all upper endoscopy volume in commercially insured patients in the United States and, similarly, a 52.5% increase in Medicare recipients.[24] Furthermore, an estimated seven million upper endoscopies were performed in the United States in 2009, with estimated total outpatient costs reaching $12.3 billion.[24] Gastrointestinal/endoscopy cases make up at least a quarter of total ASC cases, and between 2000 and 2009, the percentage of surgery centers offering gastroenterology procedures increased from 11% to 34%.[25] While EGD is routinely available, it is more costly, requiring not only fees for facility use, but also medications and ancillary staff. The use of monitored anesthesia care increases the cost, and fees associated with pathology (for which the majority of patients have biopsies performed during EGD) add even more. Although not explored in this study for the purpose of focusing only on the role of EGD in preoperative screening, the use of PPI therapy should not be taken lightly. Over time, medical therapy for findings such as esophagitis, gastritis, ulcers, and *H. pylori*, and symptoms of reflux can be extremely costly, and this is an area that deserves mention and future study in this patient population.

While the median age of the patient undergoing bariatric surgery evaluation in this cohort was 51 years, the majority of these patients would not be expected to have Medicare but rather commercial insurance, and therefore reimbursement rates are often higher. However, with major upcoming changes in healthcare policies, future reimbursement rates are being closely scrutinized. It is clear that the medical community will be obligated to make more cost conscious decisions in the future. In our study, we found that being aged >55 years was associated with an increased risk of an abnormal finding on EGD. By identifying risk factors and creating risk models for abnormal findings on EGD, the bariatric patient population could be better stratified, thus decreasing the number of EGDs performed routinely every year.

This study has several strengths. In addition to exploring findings on EGD that altered medical or surgical management, we identified patient risk factors that were associated with the occurrence of an abnormal finding on screening EGD (i.e., age >55 years and, to a lesser degree, the presence of GERD). Furthermore, unlike previous studies, we attempted to create a risk score to stratify the risk of occurrence of an abnormal finding on EGD. Although the risk score was only moderately effective, this study is one of few, if any, that explores the role of implicating a risk tool to stratify patients undergoing bariatric surgery evaluation into low- and high-risk groups with regards to findings on EGD. Limitations of this study are several, with its retrospective design being the main limiting factor. Second, many patients had prior EGDs performed at outside institutions and so were excluded from the study in order to limit recall bias and heterogeneity in endoscopy reporting and accountability. Furthermore, our study population only included patients who were cleared from a major comorbidity and financial standpoint for potential bariatric surgery and then proceeded to undergo screening with EGD, rather than taking all patients who were initially evaluated in the bariatric center. However, those patients who are denied the possibility of undergoing bariatric surgery do not end up undergoing EGD. Nevertheless, these inclusion criteria could have resulted in a reduction of our sample size, resulting in lower power to detect associations and a correspondingly higher possibility of a type II error (i.e., false-negative association). Third, we did not differentiate those patients who underwent pure bariatric surgery from those who underwent repair of a large hiatal or paraesophageal hernia followed by

bariatric surgery. Some would consider the addition of a hernia repair as an alteration in surgical management, due to the increased length of time and technical challenge this repair adds to the overall operation.

Conclusions

In summary, our study indicated that while abnormalities on preoperative EGD prior to bariatric operation are often found, the majority of these findings are of little clinical consequence, rarely change the surgical management, and furthermore, are costly when applied to all patients undergoing routine bariatric surgery evaluation. While older age and GERD were associated with an increased risk of finding an abnormality, these two variables alone do not appear to be effective in determining which patients would significantly benefit from EGD prior to the operation. In a society where healthcare policy is in the process of changing and healthcare costs are increasingly under examination, further studies are needed as we consider alternative methods for routine screening for common GI conditions in patients being evaluated for bariatric surgery and other procedures.

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