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ORIGINAL CONTRIBUTIONS

The Role of Routine Upper Gastrointestinal Endoscopy Before Bariatric Surgery

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Abstract
Background Obesity remains a major health concern for which surgery has proven to be the most effective treatment in the long term. Routine upper gastrointestinal endoscopy (UGE) is recommended before surgery, but few studies have evaluated its impact on postoperative complications.
Methods We studied a cohort of 613 patients submitted to UGE before being listed for bariatric surgery between May 2004 and May 2015. A logistic regression analysis was performed to evaluate potential predictors of postoperative complications.
Results Three hundred forty-five patients (56.3 %) presented abnormal endoscopic findings. *Helicobacter pylori* (Hp) was the strongest predictor of an abnormal endoscopy (OR 10.343, 95 % CI [3.970–26.943], $p < 0.001$). Of the 342 patients who underwent surgery, 43 (12.6%) developed a postsurgical complication and 2 (0.6%) patients died. In regression analysis, endoscopic ulceration was the only predictor of postoperative complications (OR 11.10, 95 % CI [1.80–68.467], $p = 0.01$). All patients with gastroduodenal ulcers were infected with Hp.
Conclusions UGE before bariatric surgery can identify a wide range of abnormal findings. Gastric and duodenal ulcers appear to be the major findings associated with postoperative complications. Routine Hp eradication may potentially reduce the risk of postoperative complications and should be attempted in all patients before surgery.

Keywords Obesity · Bariatric surgery · Upper gastrointestinal endoscopy · *Helicobacter pylori*

Introduction

The incidence of obesity among children, adolescents, and adults is rapidly rising in both developed and developing countries [1, 2]. By 2010, overweight and obesity were estimated to cause 3.4 million deaths, 3.9 % of years of life lost, and 3.8 % of disability-adjusted life-years worldwide [3]. In addition, obesity increases the risk of hypertension, dyslipidemia, diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, and cancer [4, 5]. Bariatric surgery has shown to be effective in reducing and maintaining weight loss, with potential benefits in improving cardiovascular risk factors [6, 7]. Current guidelines recommend that all patients undergo upper gastrointestinal endoscopy (UGE) before bariatric surgery [8]. Several studies have shown that preoperative UGE can identify a wide range of abnormal findings, including hiatal hernia, esophagitis, and gastric and duodenal ulcers [9, 10]. Others have questioned the need for routine UGE, stating that most findings are clinically

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irrelevant and that selective endoscopy in patients with upper gastrointestinal symptoms could reduce the number of exams by over 80 % [11].

Nevertheless, it remains unclear which findings should delay or contraindicate surgery. The aim of this study was to evaluate potential predictors, including abnormal endoscopic findings, of postoperative complications.

Material and Methods

Study Design and Patients

We performed a retrospective analysis of the data of 613 patients undergoing UGE in our center from May 2004 to May 2015 as a preoperative evaluation. All patients had an indication for bariatric surgery (body mass index (BMI) > 40 kg/m^2 or BMI > 35 kg/m^2 and one or more significant obesity-related comorbid conditions). Preoperative exams were performed in a dedicated endoscopy unit by experienced endoscopists or by supervised residents. When deemed necessary, histologic samples were collected and analyzed by our pathology team. In patients with gastric inflammation, biopsies were taken from the antrum and corpus to assess the presence of *Helicobacter pylori* (Hp). Patients were offered treatment for Hp, but confirmation of eradication was not routinely assessed. Three hundred forty-two patients (55.8 %) underwent surgery (Fig. 1). The type of surgical procedure included gastric sleeve (229), banding (95), and bypass (18). All surgical procedures were performed by dedicated surgeons from our center. Two hundred and one patients did not undergo surgery by the end of the study period. The reasons included discontinuation of follow-up, psychological or medical contraindications, and patient refusal to comply with medical treatment or to undergo surgery. Data relative to demographics, preoperative BMI, endoscopic findings, and postoperative complications were collected and recorded by the authors. Patients lacking information required for the study were excluded.

Statistical Analysis

We used a Kolmogorov-Smirnov test to evaluate normal distribution of continuous variables. Continuous variables were expressed in mean ± standard deviation (SD) or interquartile range (IQR), depending on normal or non-normal distribution. Normal distribution continuous variables were compared using Student's *t* test for independent samples and Mann-Whitney test for continuous variables with

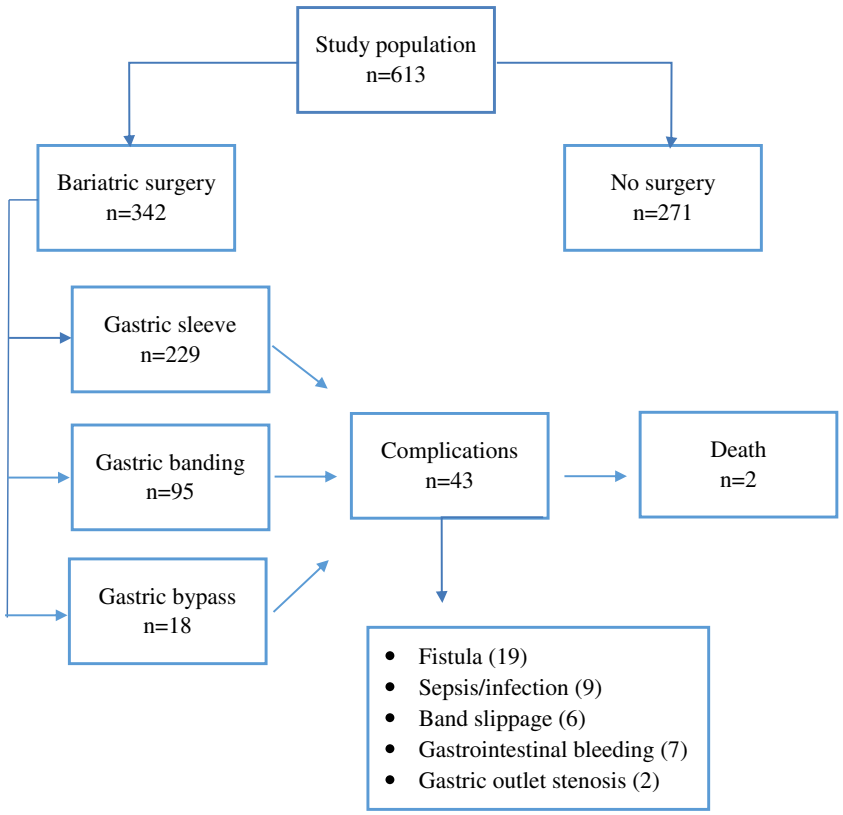

Fig. 1 Flow chart of procedures and results

non-normal distribution. Categorical variables were described using frequencies and percentages, and chi-square contingency tables were used to compare proportions between groups. To identify predictors of abnormal UGE, a logistic regression analysis with abnormal endoscopy as dependent variable was used. For analysis of predictors of postoperative complications, we ran several logistic regression analysis testing each complication as a dependent variable. Variables significant in univariate analysis were included in a multivariate analysis. As we did not confirm Hp eradication following treatment, this variable was excluded from the regression. Significance level was chosen at 0.05. Statistical analysis was performed using SPSS v. 21.0.

Results

Preoperative Cohort

We included 613 patients in our analysis, 77.8 % female, with mean age of 46.5 ± 11.6 years and mean BMI of 44.7 ± 4.2 kg/m^2. UGE presented at least one abnormal finding in 345 patients (56.3 %). Esophageal, gastric, and duodenal findings were reported in 22.2, 41.8, and 11.4 % of patients, respectively (Table 1). Three hundred twenty-two biopsies from 295 patients (48.1 %) were collected for histopathological examination (Table 2). Most findings consisted of chronic gastritis (82.4 %). Hp infection was present in 48.3 % of gastric biopsies. Histology diagnosed 3 patients (1.0 %) with non-dysplastic Barrett's esophagus and 1 patient (0.4 %) with low-grade gastric MALT lymphoma (which went in remission following Hp treatment). In a logistic regression analysis (Table 3), Hp was the strongest independent predictor of an abnormal endoscopy (OR 10.304, 95 % CI [4.577–23.195], p <0.001).

Table 1 Findings at upper gastrointestinal endoscopy in the morbidly obese patients. Most findings were mild and benign

Endoscopic findings	*n* (%)
Normal endoscopy	268 (43.7)
Esophagus	136 (22.2)
•Hiatal hernia	105
○1–2 cm	48
○3–6 cm	55
○7–10 cm	2
•Peptic esophagitis—grade A/B/C [12]	32/14/1
•Suspected Barrett's esophagus	3
Stomach	256 (41.8)
•Gastritis—non-erosive/erosive	119/111
•Ulcers—grade I/II/III [13]	0/0/9
•Polyps	29
Duodenum	70 (11.4)
•Erythematous bulbopathy	32
•Erosive bulbopathy	33
•Ulcers—grade I/II/III [13]	0/0/3
•Mucosal irregularity	2

Peptic esophagitis was classified according to Los Angeles classification [12]. Ulcers were classified according to Forrest classification [13]

Postoperative Cohort

Three hundred forty-two patients (55.8 %) underwent bariatric surgery. Forty-three patients (12.6 %) developed a postoperative complication, and 2 patients (0.6 %) died (Fig. 1). In logistic regression analysis (Table 4), the only variable that significantly predicted postoperative complications was gastric ulceration (OR 11.10, 95 % CI [1.80–68.47], p < 0.001). Postoperative fistulas were associated with both gastric (OR 13.29, 95 % CI [2.07–85.24], p = 0.006) and duodenal (OR 19.94, 95 % CI [1.19–333.46], p = 0.037) ulceration. Postoperative sepsis was only predicted by gastric ulceration (OR 10.28, 95 % CI [1.03–102.63], p = 0.047). There was a slight influence of age in the advent of gastrointestinal bleeding (OR 1.10,

Table 2 Abnormal findings at histopathological examination of tissue biopsies of endoscopies performed prior to surgery

	n
Esophagus	3
•Non-dysplastic Barrett	3
Stomach	259
•Chronic gastritis	243
•Atrophic gastritis	21
•Intestinal metaplasia	16
•Hp infection	114/236
•MALT lymphoma	1
•Hyperplastic	1
•Inflammatory	2
•Fundic gland polyp	1
•Leiomyoma	1
Duodenum	61
•Non-specific inflammation	20
•Gastric heterotopy	1

Biopsies of a region of mucosal irregularity showed small lymphoid cell infiltration, with predominance of CD20+ and lymphoepithelial focal permeation suspicious of MALT lymphoma. The lesion regressed following Hp eradication therapy

Hp Helicobacter pylori

Table 3 Univariate and multivariate analyses for the prediction of abnormal endoscopic findings

Predictive factor	Normal endoscopy	Abnormal endoscopy	Univariate analysis, odds ratio [95 % CI]	*p* value	Multivariate analysis, odds ratio [95 % CI]	*p* value
Age (mean/SD)	44.6 ± 12.1	48.1 ± 10.8	*1.027 [1.013–1.042]*	*<0.001*	*1.030 [1.000–1.060]*	*0.05*
BMI (mean/SD)	45.3 ± 6.6	45.1 ± 6.9	0.994 [0.953–1.037]	0.792	n.s.	
Male gender (*n*/%)	52 (18.7)	84 (25.2)	1.466 [0.993–2.165]	0.054	n.s.	
Hp infection	8 (13.3)	106 (60.2)	*9.843 [4.408–21.976]*	*<0.001*	*10.304 [4.577–23.195]*	*<0.001*

The numbers in italics represent the values that are significant

Hp Helicobacter pylori, *n.s.* not significant

95 % CI [1.01–1.20], $p = 0.036$). We found no predictors of gastric outlet stenosis, band slippage, or death. The type of surgical procedure did not influence the rate of postoperative complications. Of note, all gastric and duodenal ulcers were found in patients with preoperative evidence of infection with Hp.

Discussion

The role of UGE before bariatric surgery remains controversial. The reasons supporting this recommendation include high prevalence of endoscopic findings in bariatric patients across studies, fear of missing a significant lesion before surgery (ex. cancer), inability to screen the stomach and duodenum with standard endoscopy after some procedures, and the potential to change the surgical procedure based on some findings (ex. large hiatus hernia). In accordance with our results, abnormal endoscopic findings have been reported in 10 to 90 % of patients across studies (Table 5). Nevertheless, excessive and unnecessary interventions have been brought forth by mild and insignificant endoscopic findings [9, 17, 19]. Zeni [9] performed a partial gastrectomy for a suspicious polypoid lesion later proved to be benign; Azagury [19] submitted 2 patients to a partial gastrectomy for fundic gland polyposis (for which prophylactic gastrectomy in the absence of a history of familial polyposis is not recommended) and delayed another surgery due to a submucosal esophageal lesion (which remained stable after 4.5 years). This had led many authors to limit endoscopy to patients with symptoms of gastrointestinal disease [22]. This may be inadequate, as several studies have reported pathologic endoscopic findings in asymptomatic patients [17, 19]. Other authors have abandoned routine UGE before surgery [14]. There is a paucity of data regarding which endoscopic findings should delay, change, or contraindicate surgery. Ours is one of the first studies addressing this matter. We found gastric and duodenal ulcers to be the only significant predictors of postoperative complications. Most surgeons still advocate crural tightening in patients with a significant hiatal hernia before gastric banding in order to prevent band slippage. Surprisingly, the evidence for this recommendation comes from a single study including 50 patients, in which 4 of the 5 patients with band slippage had a hiatus hernia [26]. The size of the hiatus hernia was not provided by the authors. We found no association between hiatus hernia size and band slippage. The role of Hp infection has been a matter of debate over the years. In some studies, Hp has been associated with an increased risk of postoperative marginal ulcers [17]. This has not been confirmed in other studies [27, 28]. In a study of asymptomatic patients scheduled for RYGB, patients with a positive rapid urease test were more likely to have an abnormal endoscopy than those who tested negative (94 versus 51 %) [21]. Likewise, we found Hp infection to be the most important predictor of an abnormal UGE. Furthermore, all patients presenting with gastroduodenal

Table 4 Logistic regression analysis for the prediction of postoperative complications

Predictive factor	Univariate analysis Odds ratio [95 % CI]	*p* value
Age (mean/SD)	1.010 [0.981–1.041]	0.501
BMI (mean/SD)	0.859 [0.734–1.005]	0.058
Male gender (*n*/%)	0.907 [0.402–2.064]	0.822
Esophagitis	1.771 [0.682–4.601]	0.241
Large hiatal hernia (>4 cm)	1.278 [0.110–3.165]	0.538
Gastritis	1.145 [0.590–2.221]	0.690
Gastric ulcers	*11.10 [1.80–68.467]*	*0.010*
Duodenitis	1.628 [0.630–4.204]	0.314
Duodenal ulcers	7.071 [0.434–115.196]	0.169
Abnormal endoscopy	1.091 [0.575–2.068]	0.790
Sleeve vs. banding	0.537 [0.274–1.054]	0.071
Banding vs. bypass	0.757 [0.347–1.653]	0.485
Sleeve vs. bypass	1.068 [0.231–4.929]	0.933

The numbers in italics represent the values that are significant

Table 5 Studies addressing gastrointestinal screening before bariatric surgery. Most studies are retrospective and report variable results

Year	Patients (*n*)	Study format	Evaluation	Abnormal exams (%)	Hp prevalence (%)	Author suggestion
1997 [10]	147	Retrospective	UGE	31–37	N/A	Endoscopy is mandatory even in asymptomatic patients
1997 [14]	657	Retrospective	GI series	40.2	N/A	Endoscopy is not justified
2001 [15]	148	Retrospective	UGE and GI series	68.9	25.6	Preoperative studies are essential even in asymptomatic patients
2002 [16]	536	Retrospective	UGE	4.9	30.1	Endoscopy is important
2004 [17]	195	Retrospective	UGE	89.7	N/A	Endoscopy is cost-effective
2004 [18]	171	Retrospective	GI series	48.0	N/A	GI series is not needed
2006 [9]	169	Retrospective	UGE	66.7 (1 GIST)	30.1	Endoscopy is recommended
2006 [11]	145	Prospective	UGE	10	30.1	Selective use in symptomatic patients
2006 [19]	319	Retrospective	UGE	46	39	Selective use of endoscopy
2007 [20]	162	Retrospective	UGE	77.2	37.5	All patients should perform endoscopy
2008 [21]	447	Retrospective	UGE	31.5	15	Endoscopy is not needed
2013 [22]	412	Retrospective	UGE	44.2	12	Endoscopy is not needed
2015 [23]	331	Retrospective	UGE	22.6	30	Findings led to a variation in the surgical technique
2015 [24]	283	Retrospective	UGE	81	21	High proportion of endoscopic abnormalities even in asymptomatic patients. Change in surgical approach and surveillance for malignancy in a few cases
2015 [25]	159	Retrospective	UGE	76	22	High prevalence of findings with significant impact on perioperative management in two thirds of the cases
Current study	613	Retrospective	UGE	56.3	48.3	Selective endoscopy is more adequate

Hp Helicobacter pylori, *GI* gastrointestinal, *GIST* gastrointestinal stromal tumor, *UGE* upper gastrointestinal endoscopy

ulceration in the preoperative UGE had evidence of active Hp infection. As we did not confirm eradication of Hp, we can only hypothesize that these patients might have had incomplete ulcer healing or persisting Hp infection. As stated by other authors, the treatment for most lesions found on UGE includes proton pump inhibitors and/or Hp eradication. This strategy could potentially reduce the costs with endoscopy considerably [19]. Further investigation is required to assess if routine Hp eradication could decrease the rate of postoperative complications and potentially present an alternative to preoperative UGE.

The main strengths of our study include its fairly large sample size, which represents one of the largest to date assessing bariatric patients. Limitations include its retrospective nature, with all the data retrieved from clinical charts, and the absence of confirmation of Hp eradication, which could have elucidated its role in decreasing postoperative complications. Finally, as this information was not routinely provided in the patient's clinical charts, we could not assess how many patients had a change in their surgical procedure owing to abnormal endoscopic findings.

Conclusion

Preoperative endoscopy identifies a wide range of abnormal endoscopic findings, but only gastric and duodenal ulcerations were associated with postoperative complications. By reducing gastroduodenal ulceration, Hp eradication might potentially decrease the incidence of postoperative complications.

Author Contributions Samuel R. Fernandes, MD and Liliane C. Meireles, MD made the preparation and critical review of the manuscript. Luís Carrilho-Ribeiro, MD PhD and José Velosa, MD PhD did critical review of the manuscript.

Compliance with Ethical Standards This article does not contain any studies with human participants or animals performed by any of the authors.

For this type of study, formal consent is not required.

Conflict of Interest The authors declare that they have no competing interests.

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