Is belching increasing after bariatric bypass surgery in the long term period?

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Abstract

Background and aims: **Gastric bypass surgery effectively treats obesity; however, its association with belching, which occurs in other bariatric surgeries, remains unclear. Hence, we aimed to evaluate belching occurrence after gastric bypass surgery.**

Methods: **We enrolled 12 healthy volunteers and 17 patients (12 and 5 underwent Roux-en-Y gastric bypass and mini-gastric bypass surgeries 24 (18–54) months prior, respectively). Gastrointestinal symptoms were assessed. Gastroscopy was performed, followed by the 24-hour pH-impedance analysis.**

Results: **Age and sex were not statistically different between the two groups (P > 0.05). Patients had a significantly higher mean DeMeester score than the healthy controls (9.11 ± 19.40 vs. 6.04 ± 5.60, P = 0.048), but the pathologic acid reflux (DeMeester score > 14) rate was similar in both groups (11.8% vs. 8.3%). Regarding the impedance, symptom-association probability was positive in 11.8% of patients. The patients also had higher alkaline reflux rates (6% vs. 0%); additionally, 50% of them experienced belching based on the questionnaire, and 25% had esophagitis based on gastroscopy. Furthermore, patients had a significantly higher number of gas reflux (123.24 ± 80 vs. 37.2 ± 21.5, P = 0.001) and supragastric/gastric belches (182 ± 64/228 ± 66.69 vs. 25.08 ± 15.20/12.17 ± 17.65, P = 0.001). Supragastric belching was more frequent than gastric belching in the controls, whereas gastric belching was more frequent in the patients.**

Conclusion: **Belching increases after gastric bypass surgery in a long-term period. Gastric belching was more frequent than supragastric belching in these patients.** (Acta gastroenterol. belg., **2021,** 84**, 601-605**).

Keywords: Bariatric bypass surgery, belching, impedance.

Abbreviations: RYGB, Roux-en-Y gastric bypass; GERD, Gastroesophageal reflux disease; MGB, Mini Gastric bypass; PPI, proton pump inhibitor; LES, Lower esophageal sphincter; DMS, DeMeesterScore; SAP, symptom association probability.

Introduction

Obesity and type 2 diabetes are the leading causes of morbidity and mortality worldwide. The global prevalence of type 2 diabetes among adults is 6.4%; meanwhile, the prevalence of obesity in men and women is 18% and 20%, respectively, and is increasing rapidly (1,2). Obesity is a broad-spectrum disease that can result in diabetes, cardiovascular diseases, various cancer types, nonalcoholic fatty liver disease and subsequent liver cirrhosis, and hepatocellular carcinoma. Lifestyle modifications, diet, and exercise do not give sustainable results in treating obesity (3). Given that pharmacological treatments are not effective alone, gastric bypass surgery is encouraged because it is one of the most effective methods in treating both obesity and type 2 diabetes. This surgery not only ensures weight loss in obesity cases but also reduces mortality and morbidity risks, with positive effects on related diseases such as diabetes, hyperlipidemia, and hypertension (4). The most common bariatric surgeries are Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy, which accounts for nearly 50% of all bariatric procedures (5). Gastric belches reportedly occur after sleeve gastrectomy (6). Increased gastrointestinal symptoms such as gas, bloating, and diarrhea after gastric bypass surgery have also been reported (7). However, belching after gastric bypass surgery remains unreported. Thus, using the impedance method, this study aimed to evaluate belching occurrence after gastric bypass surgery.

Material and methods

Patients and procedures

This prospective study was conducted between December 2016 and June 2017 in Gastroenterohepatology Department's motility laboratory of İstanbul University Medical Faculty. All patients who underwent bariatric surgery and consulted our gastroenterohepatology outpatient clinic within the study period were enrolled. The inclusion criteria were 18-70 years of age and a history of bariatric surgery performed 24 (18-54) months prior to the study, whereas the exclusion criteria were the presence of a serious systemic disease and/or biliary tract disease and the use of systemic treatments. The patients took oral multivitamin tablets daily. Ultimately, we included 17 patients with morbid obesity and 12 healthy volunteers. Of the 17 patients, 12 underwent RYGB surgery, and five underwent mini-gastric bypass (MGB) surgery. We asked all patients regarding the occurrence of belching, gastroesophageal reflux disease (GERD), and other dyspepsia symptoms in their anamnesis. Since it was also stated in the Lyon consensus that there was no difference between questioning in accordance with a

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questionnaire form or with an anamnesis, we made our symptomatological questioning with anamnesis in this study. All patients underwent gastroscopy and then 24-hour pH-impedance analysis, which was also performed in healthy volunteers. During the pH-impedance analysis, proton pump inhibitor was discontinued for two weeks before the procedure in both groups.

Ambulatory 24-hour pH-impedance and manometry

During pH-impedance, a mobile recording device (Ohmega impedance pH recorder; MMS, Enschede, Netherlands) and a single-use pH-impedance catheter (Unisensor) were used. The catheter had eight impedance rings and a pH measurement loop (VersaFlex Z-Impedance pH meter disposable catheters; Alpine Biomed, Fountain Valley, CA, USA). We inserted the pH-impedance catheters transnasally and positioned them 5 cm down from the lower esophageal sphincter (LES) by using the pH step-up method to record the pH and the impedance at 3, 5, 7, 9, 15, and 17 cm proximal to the LES in the esophageal body. We informed all patients about the device and the steps to be applied to the device when symptoms occurred during reflux, cough, food intake, and changing of position. We asked them to maintain their daily routine activities. The catheters were removed after 24 hours. We uploaded the records to a personal computer. An expert (FA) analyzed the esophageal pH-impedance. The 24-hour trace analysis was performed manually and automatically using the MMS system. Impedance reduced by 50% compared with the baseline, and the upward spreading along at least three impedance rings starting 3 cm above the LES indicated gastroesophageal reflux. Reflux detected by impedance was categorized according to pH differences.

Acid reflux was defined as a pH value below 4 for at least 4 seconds, while weak-acid reflux was considered when the pH decreased by at least 1 for at least 4 seconds and remained between 4 and 7; in contrast, alkaline reflux was defined as a pH value above 7 (8).

In each reflux episode, the gas–liquid pattern was divided into liquid reflux, gas reflux, and liquid–gas-mixed reflux according to pH-impedance measurements. In each patient, we measured the total number of acid, weak-acid, and alkaline refluxes, the total time spent within 24 hours under pH 4, and the total reflux episodes in standing and lying positions below pH 4. The DeMeester score (DMS) and symptom-association probability (SAP) were also evaluated. While evaluating for SAP positivity, we considered that the healthy volunteers had normal values and *P* values of less than 0.05 according to Zerbib et al.'s studies (9). The gastric belch is defined by an increase in impedance (≥ 1000 Ω) that moves in the oral direction, and supragastric belching is defined as a rapid rise in impedance (≥ 1000 Ω) moving in an abnormal direction, followed by a return to baseline moving in the opposite direction according to previously published criteria by Bredenoord et al. (10)

Statistical analysis

All statistical data were analyzed using the SPSS version 22.0 for Windows. Categorical variables were compared by chi-square and Fisher's exact tests. Continuous variables are expressed as mean and standard deviation. Student's *t* test and Mann–Whitney *U* test were used in analyzing these values. The relationship between the variables was assessed by Spearman correlation analysis. Furthermore, *P* values of less than 0.05 were considered statistically significant.

The ethics committee of our faculty approved this study (Approval No.: 2017/371). Informed consent was obtained from all study participants.

Results

In the patient group, females were predominant (76.5% [n = 13] vs. 41.7% [n = 5]), while age was not statistically different between the groups (43.17 ± 10 years vs. 45.2 ± 10 years, *P* > 0.05). In addition, 82% of the patients had insulin resistance, and 47% had diabetes.

Body mass index (BMI) was 28.5 ± 3.9 kg/m^2 in the control group and 53.01 ± 6.7 (38.2-63.1) kg/m^2 in the patient group. Six months after the bariatric surgery, the BMI of the patient group decreased to 38.47 ± 5.6 (26-47) kg/m^2.

The patients had a significantly higher mean DMS than the healthy controls (9.11 ± 19.40 vs. 6.04 ± 5.60, *P* = 0.048). The pathological acid reflux rate with a DMS above 14 was similar in both groups (11.8% vs. 8.3%, *P* > 0.05). Since the AET over 6% was defined as GERD according to Lyon consensus criteria (11), we evaluated AET in our patient and control group. In patient and control group the rate of AET above 6% was 11.8% and 8.3% respectively (p=0.633).In the impedance study, 11.8% of the patients were positive for SAP. The alkaline reflux rate was also higher among the patients (6% vs. 0%). According to our symptom questionnaire that we asked in anamnesis, abdominal pain, bloating, gas, regurgitation, heartburn, belching, nausea, and vomiting occurred in 22.2%, 66.7%, 55.6%, 33.3%, 22.2%, 44.4%, 44.4%,

Table 1. — **24-hour pH impedance results**

	Gastric bypass (n=17)	Control (n=12)	P value
Gas reflux number (Mean ± SD)	123.24± 80	37.2± 21.5	0.001
Supra gastric belching (Mean ± SD)	182± 64	25.08± 15.2	0.001
Gastric belching (Mean ± SD)	228± 66.6	12.1± 17.6	0.001
pH-impedance (%, n) **Acid reflux** **Weak acid reflux** **Alkaline reflux** **Normal**	 52.9 (9) 41.2 (7) 5.9 (1) 0	 0 66.7 0 33.3	0.01
SAP positivity (%)	11.8	-	

SAP: Symptom association probability.

Table 2. — **Impedance results and demographic characteristics in RYGB and MGB procedures**

	RYGB(n=12)	MGB(n=5)	Control(n=12)
Age (years, mean ± SD)	43.25 ± 8.895	50.2 ± 12.558	43.17 ± 10.633
Gender (female, %)	8 (66.7%)	5 (100%)	5 (41.7%)
Normal impedance results (%)	0	0	33
Pathologic acid reflux (%)	50 (6)	60 (3)	0
Weakly acidic reflux (%)	41.7 (5)	40 (2)	66
Alkaline reflux (%)	8.3 (1)	0	0
De Meester score, (Mean ± SD)	6.6 ± 16.7	16 ± 30	6.04 ± 5.6
Gas reflux episodes per 24h (Mean±SD)	123.83 ± 89.5	128 ± 67.5	37.25 ± 21.5
Acid gas reflux episodes per 24h (Mean ± SD)	0.5 ± 1.44	0.5 ± 1	0.91 ± 1.3
Weakly acidic gas reflux episodes per 24h (Mean±SD)	73.08 ± 58.9	97.7 ± 68.9	0
Non-acid gas reflux episodes per 24h (Mean ± SD)	50.2 ± 79.6	29.7 ± 36	36.2 ± 20.9
SAP (%)	16.7	0	0

RYGB, Roux-en-Y gastric bypass; MGB, Mini gastric bypass; SAP, Symptom association probability, MGB vs RYGB P>0.05 for all parameters; MGB vs control, gas reflux p=0.009, weakly acidic gas p=0.001; RYGB vs control, gas reflux p=0.006, weakly acidic gas p=0.001.

Table 3. — **Symptom frequencies**

%	RYGB(n=12)	MGB(n=5)
Gas	55.6	50
Abdominal pain	22.2	-
Bloating	66.7	50
Vomiting	25	-
Nausea	44.4	33.3
Reflux symptoms **Regurgitation** **Retrosternal burn**	33.3 33.3 22.2	50 50 25
Belching	44.4	50

RYGB, Roux-en-Y gastric bypass; MGB, Mini gastric bypass.

and 25% of patients who underwent RYGB, respectively. Additionally, gas, bloating, nausea, regurgitation, heartburn, and belching occurred in 50%, 50%, 33.3%, 50%, 25%, and 50% of patients who underwent MGB procedure, respectively. The questionnaire revealed that 50% of the patients experienced belching, while gastroscopy detected esophagitis in 25%. The number of gas reflux (123.24 ± 80 vs. 37.2 ± 21.5, P = 0.001) and supragastric/gastric belches was significantly higher among the patients (182 ± 64/228 ± 66.69 vs. 25.08 ± 15.20/12.17 ± 17.65, P = 0.001). Supragastric belching was more common than gastric belching in the controls; conversely, gastric belching was more common than supragastric belching among the patients (Table 1 and 2). Table 3 lists the gastrointestinal symptoms.

Discussion

Our study is the first study to evaluate the frequency of belching and GERD after gastric bypass surgery in a long-term period. According to the impedance data, gastric belching was frequent in our patient group. In addition, gastroesophageal reflux, especially weak-acid and alkaline refluxes, increased in the long-term follow-up of these patients.

In a previous study evaluating patients before and after sleeve gastrectomy through pH-impedance analysis, the total time below pH 4 and the number of non-acid reflux episodes increased significantly in the postoperative period compared with those in the preoperative period. However, the number of acid reflux extending to the proximal esophagus remained unchanged, whereas the number of non-acid reflux increased significantly. These findings may be associated with increased intragastric pressure and decreased gastric compliance (12). Unfortunately, we did not compare our pH-impedance analysis before and after the gastric bypass surgery. Although we aimed to examine the effect of gastric bypass surgery on belching and GERD in a long-term period rather than to reveal the difference before and after the surgery, we considered this aspect as a limitation of this study.

A previous study reported that esophageal acid exposure significantly increased after sleeve gastrectomy. Compared with the preoperative state, esophageal acid exposure was increased by 9.8% in the upright position and 15% in the supine position. Prolonged acid exposure (>5 minutes) postoperatively was also reported. This condition can be explained by the start of a new acid reflux episode before the acid in the previous reflux episode was cleared (13).

In a study evaluating patents before and after laparoscopic RYGB through pH-impedance analysis, weak-acid reflux was significantly increased in patients with and without preoperative GERD. However, patients with preoperative GERD showed a normal acid reflux exposure in the esophagus. After laparoscopic RYGB, GERD symptoms improved, and acid exposure decreased (14).

If bariatric surgery is needed for a patient with known GERD, gastric bypass surgery is the preferred procedure because it can help prevent reflux. Our 24-hour pH-impedance data revealed that pathological acid reflux and weak-acid reflux occurred in 50% and 41.7% of the patients undergoing RYGB and in 60% and 40% of the patients undergoing MGB in the long-term period. In the healthy control group, none experienced pathological

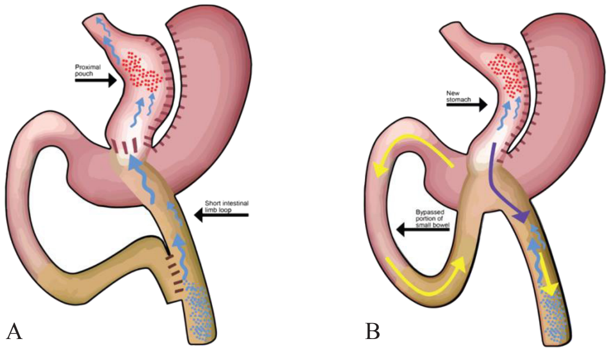

Figure 1. — Schematic presentation of surgery. A, Roux-en-Y gastric bypass; B, Mini gastric bypass. Red spots indicates acid, blue spots indicates air. Yellow arrow shows the route of digestive juice. Blue arrow shows the air.

acid reflux, but 66% had weak-acid reflux. Possible mechanisms of increased weak-acid reflux after gastric bypass surgery include changes in the anatomy of the upper gastrointestinal tract (Figure 1). Weak-acid reflux through the Roux limb might be associated with Roux limb dysmotility. Furthermore, some studies investigating the electrical or mechanical activity of the Roux-en-Y-limb have revealed several motor abnormalities (15). According to our results, gastric/supragastric belch may increase the weak-acid reflux. Hydrochloride acid, pepsinogen, intrinsic factor, and mucus are released from the oxyntic glands, mostly located in the corpus and fundus, which cover 80% of the gastric mucosa, and gastrin is released from pyloric glands located in the antrum (distal, 20%) (16). In RYGB and MGB procedures, the anatomy of the upper gastrointestinal tract changes, leading to gastric acid reduction, but through the lack of vagotomy, pouch distention, and adaptive mechanisms, gastric acid may increase over time (17). In our study, the patients did not undergo vagotomy, suggesting to be the cause of acid secretion in the neo-stomach.

In our study, gas reflux and supragastric/gastric belches were significantly more common among the patients than the controls. In the healthy controls, supragastric belching was more frequent than gastric belching; conversely, gastric belching was more frequent than supragastric belching among the patients. In the impedance study, SAP was positive in 11.8% of the patients. Our previous impedance study involving patients with irritable bowel syndrome found that supragastric belching was more common in the patient group than in the healthy control group, but gastric belching was similar in both groups (18). In gastric belching, the air passes from the stomach to the esophagus and is discharged through the mouth, whereas in supragastric belching, the swallowed air can get trapped before it reaches the stomach and exits through the mouth (18).

Possible explanatory mechanisms for increased gastric belching in patients who underwent gastric by-pass surgery are the absence of antral barrier and LES function, altered upper gastrointestinal tract anatomy, neurohumoral changes (13,15,19,20), altered microbiota, and disconnected intestinal pacemaker activity (20).

In our study, patients who underwent MGB procedure had a higher mean DMS than those who underwent RYGB procedure. The SAP positivity rate was 16.7% in the RYGB group (n = 12) and 0% in the control and MGB groups.

The RYGB and MGB procedures are among the mechanically restrictive and malabsorbing combined surgical procedures (17). Recent studies have suggested that weight loss and improvement in metabolic problems are mainly caused by changes in intestinal microbiota rather than mechanical and malabsorptive causes. According to the "Air Hypothesis," the swallowed air freely reaches to the intestinal loops and colon after the RYGB and MGB procedures, and the anaerobic bacteria predominantly located in these areas are replaced by aerobic bacteria (19). Although this hypothesis explains the mechanism of intestinal gas and bloating, it may also affect the upper gastrointestinal system.

According to the impedance studies, belching can occur via two mechanisms: supragastric and gastric. However, given that the anatomy of the upper digestive system is altered in individuals who have undergone bariatric surgery, dyspeptic complaints such as belching and GERD should be assessed. In this case, perhaps, a new terminology, such as neo- gastric belching, is necessary to show that not only the terminological difference but also different pathophysiological mechanisms may play a role in belching in the upper gastrointestinal digestive system with altered anatomy (Figure 1).

In conclusion, belching increased after gastric bypass surgery in a long-term period, and gastric belching was more frequent than supragastric belching in patients who underwent such surgery.

Conflict of Interest Disclosure

We have no disclosures.

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