

Gastric Banding Interferes With Esophageal Motility and Gastroesophageal Reflux

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Background: Gastroesophageal reflux and progressive esophageal dilatation can develop after gastric banding (GB).

Hypothesis: Gastric banding may interfere with esophageal motility, enhance reflux, or promote esophageal dilatation.

Design: Before-after trial in patients undergoing GB.

Setting: University teaching hospital.

Patients and Methods: Between January 1999 and August 2002, 43 patients undergoing laparoscopic GB for morbid obesity underwent upper gastrointestinal endoscopy, 24-hour pH monitoring, and stationary esophageal manometry before GB and between 6 and 18 months postoperatively.

Main Outcome Measures: Reflux symptoms, endoscopic esophagitis, pressures measured at manometry, esophageal acid exposure.

Results: There was no difference in the prevalence of

reflux symptoms or esophagitis before and after GB. The lower esophageal sphincter was unaffected by surgery, but contractions in the lower esophagus weakened after GB, in correlation with preoperative values. There was a trend toward more postoperative nonspecific motility disorders. Esophageal acid exposure tended to decrease after GB, with fewer reflux episodes. A few patients developed massive postoperative reflux. There was no clear correlation between preoperative testing and postoperative esophageal acid exposure, although patients with abnormal preoperative acid exposure tended to maintain high values after GB.

Conclusions: Postoperative esophageal dysmotility and gastroesophageal reflux are not uncommon after GB. Preoperative testing should be done routinely. Low amplitude of contraction in the lower esophagus and increased esophageal acid exposure should be regarded as contraindications to GB. Patients with such findings should be offered an alternative procedure, such as Roux-en-Y gastric bypass.

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WITH THE INCREASING prevalence of morbid obesity in the Western world and the emergence of laparoscopic techniques about 10 years ago, laparoscopic gastric banding (GB) has become one of the most commonly performed bariatric procedures. It is minimally invasive, is associated with a very low operative morbidity and almost no mortality, and often provides satisfactory weight loss. With time, however, a significant number of patients develop reflux symptoms and require proton pump inhibitors and/or band deflation. Others develop progressive esophageal dilation with pseudoachalasia. Little is known about the effects of GB on the gastroesophageal barrier or on esophageal motility. Results from the few existing studies are conflicting: some suggest that GB

acts as an antireflux procedure,^{1,2} and others report worsening of gastroesophageal reflux or no effect.³⁻⁵

The aims of this prospective study were to assess the evolution of gastroesophageal reflux and esophageal motility after GB using objective means and to try to find preoperative predictors of poor outcome regarding reflux or progressive esophageal dilation.

METHODS

Patients with a body mass index (BMI) in excess of 40 kg/m² or higher than 35 kg/m² with at least 1 severe comorbidity were selected for gastric banding after failure of conservative therapy and complete evaluation by a multidisciplinary team. This team included an endocrinologist, a psychiatrist, a dietician, a gastroenterologist, an anesthesiologist, and a bariatric surgeon. Other specialists were consulted as re-

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Table 1. Preoperative and Postoperative Results of Stationary Esophageal Manometry*

	Preoperative	After GB	P Value
LES pressure	16.23 (0.93)	16.73 (1.82)	.94†
Contraction amplitude (upper third)	59.7 (4.03)	53.9 (4.80)	.6†
Contraction amplitude (middle third)	68.7 (4.12)	66 (6.41)	.85†
Contraction amplitude (lower third)	94.3 (6.20)	66.9 (5.65)	<.001†
% Peristaltic contractions	95.4 (2.86)	89.8 (2.21)	.06‡
No. (%) of patients with nonspecific motility disorder	3 (7.5%)	8 (20%)	.07§

Abbreviations: GB, gastric banding; LES, lower esophageal sphincter.

*The results are expressed as the means (SEM) unless otherwise indicated.

†Wilcoxon signed rank test.

‡Paired *t* test.

§Fisher exact test.

quired. Indications and contraindications were according to the Consensus Development Conference panel of the National Institutes of Health and to the consensus on obesity treatment in Switzerland.^{6,7} Patients with a large (>2 cm) hiatus hernia were excluded. Symptoms potentially related to esophageal malfunction or gastroesophageal reflux (heartburn, regurgitation, dysphagia) were carefully assessed. Preoperative evaluation included gastrointestinal endoscopy, stationary esophageal manometry, and 24-hour pH monitoring. This report focuses on the patients who agreed to repeat all or part of these tests between 6 and 18 months postoperatively. The local ethics committee accepted the study protocol. Informed consent was obtained from all the patients.

Esophagogastroduodenoscopy was performed using a standard gastrofiberscope. A hiatus hernia was diagnosed if the distance between the Z-line and the hiatus opening was more than 1 cm. Esophagitis was graded according to the modified Savary-Miller classification.⁸ Esophageal biopsies were taken for diagnostic confirmation if a columnar-lined epithelium (Barrett esophagus) was suspected. Gastric biopsies were taken in case of abnormal finding, and usually to screen for the presence of *Helicobacter pylori* infection.

Esophageal manometry testing was performed using perfused 8-lumen catheters (SE-25381-4 + 4; Sedia, Givisiez, Switzerland). Esophageal body function was assessed with the 4 proximal pressure transducers. The distance between the transducers was 5 cm. The function of the lower esophageal sphincter (LES) was assessed by 4 pressure transducers placed at the same level, 1 in each quadrant. During the procedure, the patients performed 10 wet swallows and 10 dry swallows. Manometry data were analyzed with the Sedia NT Oes software.

Twenty-four-hour pH monitoring was performed with glass electrodes (F8-IR; Simtec, Basel, Switzerland). The distal tip of the probe was placed 5 cm above the gastroesophageal junction. The patient was monitored for 24 hours, and pH data were recorded on a data logger (Gastrograph; Simtec, Basel, Switzerland), downloaded onto a computer, and analyzed with the Gastro V1.7 software (MIC, Solothurn, Switzerland).

The LES pressure was considered normal between 10 and 45 mm Hg. Incomplete relaxation of the LES was defined as a less than 70% relaxation only. Nutcracker esophagus was diagnosed if the mean contraction amplitude was above 180 mm Hg in the lower esophagus. Nonspecific motility disorders were defined as amplitude of the contraction wave below

30 mm Hg in the lower esophagus and/or as the existence of more than 30% nonperistaltic contractions.

A Lapband (Bioenterics, Carpinteria, Calif) was used in 28 patients, and a Swedish Adjustable Gastric Band (SAGB; Obtech Medical for Ethicon Endosurgery, Zug, Switzerland) in 15 patients. All operations were performed laparoscopically under general anesthesia. The operative technique has been described elsewhere.⁹ Briefly, the Lapband was placed using the perigastric technique, and the SAGB was placed according to the pars flaccida technique.

Statistical analysis was performed using the statistical software package Systat 8.0 (SPSS Inc, Chicago, Ill). Differences between numerical variables were assessed using the *t* test or the Wilcoxon signed rank test, and differences between categorical variables were assessed using the χ^2 test or the Fisher exact test as appropriate. Simple Pearson correlation analysis was used to establish correlations. Differences were considered to be significant at $P < .05$.

RESULTS

A total of 43 patients initially agreed to participate in this study. There were 6 men and 37 women with a mean age of 39 years (range, 25-59 years). The mean preoperative weight was 113.7 kg (range, 79.4-161 kg), and the mean preoperative BMI was 42.2 kg/m² (range, 34.4-53.2 kg/m²). These values are similar to those of our entire series of 345 patients having undergone GB. The patient with a BMI of 34.4 kg/m² had severe insulin-requiring diabetes mellitus and underwent GB because of failure to achieve adequate control of the latter without weight loss. One month postoperatively, the position of the band was controlled by a barium swallow, and the position proved to be correct in all patients. The interval between GB and follow-up studies averaged 9.6 months (range, 6-17 months). At this time, the mean BMI was 33.8 kg/m², and the mean excess weight lost was 42.4% (range, 17.3%-77.6%). Complete preoperative and postoperative data were available for 36 patients for endoscopy, 40 patients for esophageal manometry, and 36 patients for 24-hour pH monitoring.

Thirteen patients had preoperative reflux symptoms, compared with 8 patients at follow-up (28.8% vs 17.7% respectively, $\chi^2 = 1.55$, $P = .31$). Of these 13 patients, only 2 (15.4%) remained symptomatic at follow-up. Among the 32 patients without preoperative clinical reflux, 6 (18.7%) developed new symptoms requiring proton pump inhibitors and/or band deflation after GB.

Preoperative endoscopy showed mild esophagitis (grade 1 or 2) in 8 patients (22.2%). Two of them had no symptoms. Postoperatively, esophagitis was found in a total of 13 patients (36.1%), 4 of them being symptomatic. These differences did not reach statistical significance. In the patients with preoperative esophagitis, the condition was unchanged at follow-up in 3 patients (37.5%), but only 1 remained symptomatic. It was completely healed in the remaining 5 patients (62.5%), although 1 still showed reflux symptoms. Conversely, 10 (38%) of the 26 patients with no preoperative esophageal lesion developed mild esophagitis after GB. Only 3 of the latter remained symptomatic.

Table 1 summarizes the results of esophageal manometry. The pressure of the LES did not change after surgery, and its relaxation remained complete. The am-

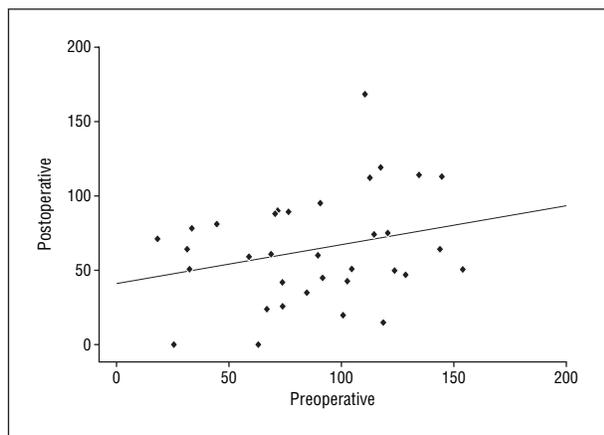


Figure 1. Relationship between preoperative and postoperative amplitude of contraction in the lower third of the esophagus ($r = 0.481$, $P = .001$).

plitude of contraction in the upper and middle thirds of the esophagus similarly were unaffected, but a significant decrease was noticed in the lower esophagus (94.3 mm Hg preoperatively vs 66.9 mm Hg postoperatively, $P < .001$). At this level, there was a significant correlation ($r = 0.48$, $P = .001$) between the preoperative and postoperative amplitudes of contraction (**Figure 1**). There was also a trend toward fewer peristaltic contractions after GB and a trend toward a nonspecific esophageal motility disorder in more patients.

The detailed results of preoperative and postoperative 24-hour pH monitoring are depicted in **Table 2** and **Table 3**. This study was entirely normal (all parameters within normal range) in only 14 patients before surgery, and in 21 patients at follow-up (38.8% vs 58.3%, $P = .05$, Fisher exact test). Sixty-one percent of the patients had abnormal preoperative 24-hour pH monitoring values, and several of them had more than 1 abnormal parameter. These preoperative findings are in accordance with our results in a much larger group of 345 morbidly obese patients, of whom 51.7% had an elevated preoperative De Meester score.¹⁰ Comparison of the mean preoperative and postoperative values did not show significant differences, except for the total number of reflux episodes, which dropped significantly at follow-up (although the mean value remained elevated). Significantly more patients, however, had a normal number of reflux episodes at follow-up. There was also a trend toward greater normal findings at follow-up regarding the total duration of reflux, reflux in the prone position, and the De Meester score. **Figure 2** shows the evolution of the latter in individual patients before and after GB. While most patients remained within the normal range or returned to normal values postoperatively, a small number developed massive reflux after surgery. There was a tendency for patients with a preoperative elevated De Meester score to also have abnormal postoperative findings, although the difference was not statistically significant (63.6% vs 40%, $P = .12$, Fisher exact test). Postoperative esophagitis was significantly more frequent in patients with an elevated postoperative De Meester score than in the remaining patients (85.7% vs 27.7% respectively, $P = .004$, Fisher exact test). We could not find any correlation between the preoperative manometric values and

Table 2. Results of Preoperative and Postoperative 24-Hour pH Monitoring*

	Preoperative	Postoperative	P Value
Total time with pH <4, %	4.58	4.84	.20
Time with pH <4 (prone), %	6.16	4.47	.17
Time with pH <4 (supine), %	2.07	5.03	.54
No. of reflux episodes	74.6	53.1	.03†
No. of reflux episodes >5 min	1.91	1.77	.50
Longest episode of reflux, min	9.55	16.02	.53
De Meester score	17.04	18.47	.23

*Comparison of the mean values.

†Wilcoxon signed rank test.

postoperative pH monitoring results. Patients with massive postoperative reflux had preoperative LES pressures and esophageal contraction amplitudes comparable to those of patients without postoperative reflux.

COMMENT

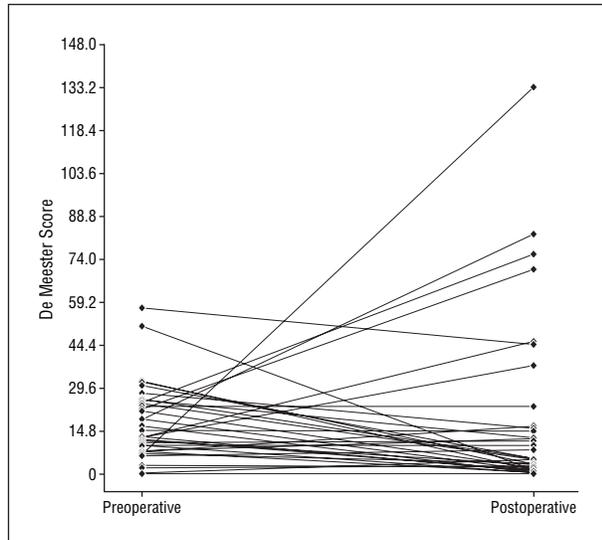
Obesity is commonly considered a precipitating factor for acid reflux and gastroesophageal reflux disease (GERD). As a consequence, weight loss is usually part of the recommendations for overweight subjects with GERD.^{11,12} In a study involving 345 morbidly obese subjects scheduled for bariatric surgery, we found a hiatus hernia in 52.6% of the patients, reflux esophagitis in 31.8%, and abnormal results in the 24-hour pH monitoring study in 51.7%.¹⁰ Others have found a high prevalence of abnormal endoscopic and radiographic findings in similar populations.¹³

Purely restrictive bariatric procedures, such as vertical banded gastroplasty and GB, divide the stomach into a very small upper gastric pouch and a large distal pouch. The upper pouch empties slowly into the distal stomach through a narrow opening. This mechanism should prevent reflux from the distal stomach into the pouch, and therefore into the esophagus. Controversy exists, however, regarding the overall effects of restrictive bariatric procedures on gastroesophageal reflux and GERD. Vertical banded gastroplasty has been shown to have antireflux properties,¹⁴ but reflux esophagitis is also one of the typical complications of the same operation.³ The effects of GB on reflux are even more controversial. Some authors have suggested that GB may severely worsen reflux, with a 75% prevalence of esophagitis and a roughly 5-time increase in the total esophageal acid exposure time after GB.³ On the other hand, gastric bands may act as an effective antireflux barrier in a similar way as the Angelchik prosthesis,¹⁵ and others have found reduced acid reflux after GB.^{1,2} Recently, De Jong et al⁵ found that GB decreased reflux when no gastric pouch developed, but reflux was enhanced in the presence of a gastric pouch. If reflux from the distal stomach is most certainly reduced after GB, reflux from the pouch into the esophagus may well be increased, especially when pouch dilation occurs. In fact, it has been demonstrated that reflux between the pouch and esophagus occurs in 56% of patients with a regular normal-sized pouch and in 50% of patients with a concentric pouch dilatation. These percent-

Table 3. Comparison of Abnormal Results From 24-Hour pH Monitoring

	Normal Value	No. (%) of Patients		P Value
		Abnormal Preoperative pH	Abnormal Postoperative pH	
Total time with pH <4, %	<4.8	14 (38.8)	9 (25)	.09*
Time with pH <4 (prone), %	<8.4	11 (30.5)	6 (16.7)	.09*
Time with pH <4 (supine), %	<3.4	8 (22.2)	10 (27.8)	.56
No. of reflux episodes	<51	21 (58.3)	10 (27.8)	.006*
No. of reflux episodes >5 min	<4	6 (16.7)	5 (13.9)	.74
Longest episode of reflux, min	<20	5 (13.9)	5 (13.9)	>.99
De Meester score	<14.8	17 (47.2)	11 (27.8)	.07*

*Fisher exact test.

**Figure 2.** Preoperative and postoperative De Meester score in individual patients.

ages increase to 67% with anterior pouch dilatation and 100% with posterior pouch dilatation.⁴

In the present study, we found an overall reduction in abnormal 24-hour pH monitoring findings between 6 and 18 months after GB. Despite this fact, the mean preoperative and postoperative values were similar, except for a significantly reduced mean number of reflux episodes. A few patients, however, developed massive postoperative reflux, and the prevalence of esophagitis increased slightly from 22.2% before GB to 36.1% after GB, although the difference was not significant. Moreover, 10 (38%) of our patients with normal preoperative endoscopic findings had developed esophagitis at follow-up. Postoperative 24-hour pH monitoring showed an elevated De Meester score in 30.5% of our patients, with massive reflux (De Meester score more than twice normal) in 19.4%. Patients with an elevated postoperative De Meester score were at higher risk to have esophagitis than patients with normal postoperative pH monitoring findings, but a few patients with no postoperative acid reflux also had postoperative esophagitis. Acid reflux is certainly a major contributor to postoperative esophagitis after GB, but it is probably not the only factor. Alimentary stasis in the esophagus also likely plays a role by producing mechanical irritation in some patients. Postoperative esophagitis in the long-term may

cause the development of Barrett esophagus and dysplasia or carcinoma.

Unfortunately, we could not find any preoperative predictor of postoperative acid reflux or esophagitis. The incidence of hiatus hernia, the LES pressure, and esophageal motility were similar in patients with and without abnormal postoperative pH study findings and/or esophagitis. The fact that motility in the lower esophagus was significantly altered postoperatively did not play any role, and there was no correlation between poor postoperative esophageal motility and postoperative reflux or esophagitis.

Øvrebø et al³ studied a small number of patients with GB using a Dacron prosthesis. They found a significant increase in reflux symptoms, in esophageal acid exposure, and in esophagitis between 1 and 3 years after surgery, with 81% of the patients requiring some medication. The gastric pouch, however, was likely greater in size than the pouch usually constructed with adjustable gastric banding. As more acid-secreting mucosa was included in the pouch, it is not surprising that acid reflux was more considerable. Others have shown that pouch dilatation is associated with an increased prevalence of reflux.⁴ In our patients, no pouch was found to be significantly dilated 1 month after surgery.

Weiss et al,¹ in a study similar to ours, found very different results. In a series of 43 patients evaluated preoperatively and 6 months postoperatively, the incidence of reflux symptoms dropped from 27.9% to 2.3%, the incidence of esophagitis decreased from 23.3% to 2.3%, and abnormally elevated De Meester scores declined from 34.9% to 0%. These authors also found significant differences in the preoperative and postoperative manometric findings, with an increase in the postoperative LES resting pressure and an increased incidence of pathologic LES relaxation during swallowing. Husemann¹⁶ also found an increased postoperative LES pressure and impaired LES relaxation after GB in a group of 20 patients. Korenkov et al¹⁷ found similar results regarding the LES pressure, but with normal LES relaxation and normal esophageal contractions. Iovino et al,² with a very small group of 11 patients with abnormal preoperative esophageal acid exposure, also found an increased resting LES pressure after GB together with an increased length of the LES, but relaxation and esophageal motility were comparable. No patients had postoperative esophagitis. In summary, the LES pressure increased postoperatively in all studies except ours. Results regarding postoperative

reflux are more conflicting, with some authors demonstrating improvement and others describing worsening, at least in some patients. We cannot explain the differences between the results of these studies and ours. Different band adjustment policies might play a role, as can the exact position of the band. Placement of the manometric probe at the level of the band rather than at the level of the LES could also account for falsely elevated postoperative LES pressure in some cases.

Our finding that the amplitude of esophageal contraction in the lower esophagus is significantly decreased between 6 and 18 months after GB has not been reported so far. This could represent progressive weakening of the esophageal musculature due to the relative obstruction created by the band, and it may represent the first stage of esophageal dilatation and pseudoachalasia, an increasingly reported late complication of GB.^{4,18,19} We found a significant correlation between preoperative and postoperative amplitudes of contraction in the lower esophagus. Others found progressive but significant motility disturbances in the lower esophagus in patients with a low preoperative resting LES pressure. They suggested that the latter could favor reflux after GB, and as such should be regarded as a contraindication for the procedure.¹⁹

Our results suggest that GB can interfere with esophageal motility and gastroesophageal reflux. We believe that morbidly obese patients in whom GB is foreseen as the surgical treatment should systematically be submitted to complete preoperative evaluation, including upper gastrointestinal endoscopy, stationary esophageal manometry, and 24-hour pH monitoring. Although we could not demonstrate a relationship between preoperative endoscopic or pHmetric findings and postoperative reflux, there was a trend for patients with an elevated preoperative De Meester score at pH monitoring to maintain abnormal or even worse values after GB. We therefore suggest that patients with abnormal preoperative pHmetric results are poor candidates for GB and should rather undergo Roux-en-Y gastric bypass, an operation that has been proven to treat both obesity and reflux in a very satisfactory way.²⁰⁻²⁴ Similarly, patients with poor preoperative esophageal motility should be excluded from GB and offered Roux-en-Y gastric bypass because the risk for these patients to develop late esophageal dilation seems maximal.

The relatively small number of studied patients may partially distort our findings or the conclusions of others. Further studies including many more patients will be necessary to improve our knowledge of the exact effects of GB on esophageal motility and on gastroesophageal reflux. Owing to the low patient agreement for repeat invasive testing, such studies might be difficult to perform. Meanwhile, GB should only be performed with great caution in morbidly obese patients with abnormal preoperative upper gastrointestinal testing results, as other procedures offer excellent results in terms of weight loss without some of the risks associated with GB.

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