Prevalent Esophageal Body Motility Disorders Underlie Aggravation of GERD Symptoms in Morbidly Obese Patients Following Adjustable Gastric Banding

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Hypothesis: Preexisting gastroesophageal reflux disease (GERD) and esophageal motility disorders may affect the outcome of laparoscopic adjustable gastric banding (AGB).

Design: Prospective cohort study.

Setting: Tertiary referral center.

Patients: Between January 1, 1996, and December 31, 2002, AGB procedures were performed in 587 patients (mean body mass index, 46.7 [calculated as weight in kilograms divided by the square of height in meters]). The study population was composed of patients with preoperative GERD (assessed by a symptom-score questionnaire) and was divided into group 1 (those with preoperative GERD symptoms only) and group 2 (those with preoperative and postoperative GERD symptoms).

Interventions: Laparoscopic AGB was performed according to the pars-flaccida technique.

Main Outcome Measures: All patients underwent preoperative and annual postoperative symptom scoring, endoscopy, esophageal barium swallow tests, esophageal manometry, and 24-hour pH monitoring.

Results: Mean follow-up time was 33 months (range, 12–49 months). A total of 164 patients (27.9%) were diagnosed as having preoperative GERD symptoms. In 112 (68.3%) of these patients GERD symptoms vanished postoperatively (group 1), whereas 52 patients (31.7%) remained symptomatic after undergoing laparoscopic AGB implantation (group 2). Preoperatively, group 2 patients showed significantly poorer esophageal body motility compared with group 1 patients (20.8% vs 12.8% defective propagations; \(P = .007\)). In group 2 the mean symptom scores for dysphagia (0.4 vs 0.9) and regurgitation (0.6 vs 1.4) deteriorated significantly following laparoscopic AGB implantation, respectively. Eighteen patients (34.6%) in group 2 developed esophageal dilatation.

Conclusions: Adjustable gastric banding provides a sufficient antireflux barrier in most of the obese patients with GERD. However, in patients with preoperatively defective esophageal body motility, AGB may aggravate GERD symptoms and esophageal dilatation. Alternative bariatric surgical procedures should be considered in these patients.

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During the last decade obesity has become a health crisis of epidemic dimensions. According to definition, more than 20% of the Western European population and more than 30% of the American population are affected by obesity to some extent.1,2 Various surgical treatment options have been described, and good results are documented for several laparoscopic restrictive or malabsorptive procedures.3-6 In Europe, the adjustable gastric band (AGB) has become the preferred method for surgical treatment of morbidly obese patients.7

Obesity is often associated with concomitant esophageal disease, such as esophageal motility disorders, hiatal hernia, and, particularly, gastroesophageal reflux, that accounts for 75% of esophageal diseases.8-11 Generally, at our hospital the AGB was considered for all patients irrespective of coexistent functional disorders of the foregut. Short-term results have demonstrated a beneficial effect of AGB on reflux symptoms, thus providing a sufficient antireflux barrier.12,13 However, impaired esophageal peristalsis and lacking relaxation of the lower esophageal sphincter (LES) leading to achalasia-like esophageal dilatation occurred in a subgroup of patients.13 The underlying pathomechanism of foregut motility disorders and the development of esophageal aperistalsis is still unknown. A published report in the literature stated that aggravated postoperative GERD symptoms and esophageal...
Table 1. Demographic Data of Patients With Morbid Obesity Undergoing Adjustable Gastric Banding

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (N = 587)</th>
<th>Group 1 (n = 112†)</th>
<th>Group 2 (n = 52†)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>39 ± 8.8</td>
<td>39 ± 10.4</td>
<td>41.0 ± 9.9</td>
</tr>
<tr>
<td>Sex, female/male</td>
<td>499/88</td>
<td>94/18</td>
<td>42/9</td>
</tr>
<tr>
<td>Body weight, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative</td>
<td>129.6 ± 27.2</td>
<td>126.3 ± 19.4</td>
<td>122.2 ± 16.3</td>
</tr>
<tr>
<td>Postoperative</td>
<td>86.7 ± 15.7</td>
<td>81.4 ± 15.9</td>
<td>80.3 ± 17.8</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative</td>
<td>46.7 ± 9.8</td>
<td>45.5 ± 7.0</td>
<td>43.7 ± 5.8</td>
</tr>
<tr>
<td>Postoperative</td>
<td>28.2 ± 5.1</td>
<td>28.2 ± 9.1</td>
<td>28.7 ± 5.6</td>
</tr>
</tbody>
</table>

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters).
*Data are given as the mean ± SD unless otherwise indicated.
†Group 1 is composed of patients having preoperative gastroesophageal reflux disease (GERD) with postoperative symptom clear-out; group 2 patients reported GERD symptoms preoperatively and postoperatively.

METHODS

All patients with morbid obesity (N=587) who underwent AGB at the Medical University Hospital, Innsbruck, Austria, between January 1, 1996, and December 31, 2002, were prospectively enrolled in this study and their data collected in a database. Adjustable gastric banding implantation was considered for patients with a body mass index (BMI) of 40 or higher or 35 or higher with obesity-related comorbidities, such as bone and joint problems, cardiovascular diseases, or diabetes mellitus. The study population was defined using a BMI of 28.2±5.1; 164 patients (27.9%) were diagnosed as having obesity-associated preoperative gastroesophageal reflux disease (GERD) with postoperative symptom clear-out; group 2 patients reported GERD symptoms preoperatively and postoperatively. Preoperative clinical workup including gastroscopy, stationary esophageal manometry, and 24-hour pH monitoring. All patients were followed up with a standardized protocol to check for weight loss and individual discomfort, including GERD symptoms. In addition, patients with GERD had a second clinical workup to assess GERD symptoms. All patients had endoscopic, radiographic, and manometric evaluation of the esophagus either 1 or 2 years postoperatively. Patients were then divided into 2 groups according to their postoperative GERD symptom status. Group 1 consisted of patients who had GERD symptoms preoperatively but no symptoms after AGB. Group 2 consisted of patients who reported preoperative and postoperative GERD symptoms.

GASTROSCOPY, ESOPHAGEAL MANOMETRY, AND 24-HOUR pH MONITORING

Gastroscopy was performed by using a scope (Olympus GIF-Q; Olympus, Vienna, Austria). Reflux esophagitis was defined according to the Savary-Miller scale. Patients suffering from GERD or reflux esophagitis grade 1 were operated on, while patients with high-grade esophagitis were pre-treated with proton pump inhibitors prior to surgery. Stationary esophageal manometry with a water-perfused catheter having 5 channels was performed. Poor LES function was diagnosed when resting pressure measured at the respiratory inversion point was less than 8 mm Hg or intra-abdominal length of the LES was less than 1.2 cm. In addition, relaxation of the LES was evaluated and considered to be incomplete if it was below 90% or the duration was shorter than 7 seconds (95th percentile in our laboratory). Esophageal peristalsis was analyzed in 10 swallows of 5 mL of water. Simultaneous and interrupted waves as well as amplitudes below 30 mm Hg in the distal esophagus were termed “defective propagations.” Poor esophageal peristalsis was diagnosed when more than 10% of the contraction waves were defective. Twenty-four-hour esophageal pH monitoring was performed as described by DeMeester et al. A DeMeester score of more than 14.7 indicated abnormal acid reflux.

SURGICAL PROCEDURE

All patients were operated on at our department using the Swedish AGB (SAGB; Johnson & Johnson, Obtech, Vienna, Austria). Laparoscopic AGB was performed according to the pars-flaccida technique of Forsell and Hellers, where the band is placed 1 to 3 cm below the lower esophageal junction. A gastric pouch of maximal 15 to 20 mL was created and the band secured with 3 to 4 nonabsorbable gastrosurgical sutures. A total of 13 patients had to be converted from the laparoscopic to an open approach. Mean postoperative hospital stay was 3 days (range, 2-7 days). A swallow test using contrast medium was performed on postoperative day 2 to confirm correct band placement.

STATISTICAL ANALYSIS

Data are provided as mean ± SD. Tests for statistically significant differences between preoperative and postoperative results were conducted using the paired and unpaired t test as appropriate. Comparison of categorical and ordinal variables for preoperative and postoperative results was calculated by means of the x² test and Kruskal-Wallis 1-way analysis of variance, respectively. P<.05 was considered statistically significant.

RESULTS

DEMOGRAPHICS

Table 1 gives the demographic data of all patients (N=587). After a complete mean follow-up of 33 months (range, 12-49 months) patients achieved a mean body weight reduction of 42.9±11.5 kg, giving a mean BMI of 28.2±5.1; 164 patients (27.9%) were diagnosed as having obesity-associated preoperative gastroesophageal reflux symptoms (groups 1 and 2). No statistically significant differences in demographic data were seen between the 2 groups (Table 1).

GERD SYMPTOMS

Of 164 patients with GERD, 112 patients (68.3%) no longer reported GERD symptoms (heartburn, dysphagia, regurgitation) postoperatively (group 1), while 52
patients (31.7%) had ongoing or aggravated GERD symptoms following AGB (group 2).

In group 2 the mean severity score for heartburn initially decreased from 1.3 to 1.1 within 24 months after AGB placement (P = .03), but long-term follow-up showed a higher mean severity score (1.7, P = .44) vs preoperative. Mean rating of regurgitation (0.6 and 1.4, preoperative vs postoperative, P = .001) and dysphagia (0.4 and 0.9, preoperative vs postoperative, P = .03) revealed statistically significantly higher scores during long-term follow-up compared with preoperative values.

GASTROSCOPY, ESOPHAGEAL MANOMETRY, AND 24-HOUR pH MONITORING

There were no statistically significant differences in grading of preoperative esophagitis between patients of groups 1 and 2. Preoperative esophageal manometry and pH measurements are summarized in Table 2. Statistically significant differences between groups 1 and 2 were found for distal esophageal amplitudes (56.5 ± 45.3, P = .03), the percentage of defective esophageal contraction waves (12.8 ± 20.8, P = .007), and the percentage of interrupted esophageal waves (3.4 ± 8.5, P = .047). No preoperative difference in LES relaxation and pressure or in DeMeester scores was found between the groups.

Postoperatively, LES relaxation significantly deteriorated in group 2 patients (99.1 ± 2.2 vs 82.3 ± 11.7, P = .02). In addition, the percentage of simultaneous esophageal waves (2.3 ± 5.8 vs 28.4 ± 30.0, P = .002) and interrupted esophageal waves (5.4 ± 9.3 vs 28.5 ± 29.9, P = .009) yielded a total of 45.8% ± 32% defective esophageal propagations (P = .03 vs preoperative). Lower esophageal sphincter pressure (15.5 ± 6.3 mm Hg) and distal esophageal amplitudes (38.5 ± 18.6 mm Hg) did not significantly differ postoperatively. The DeMeester score was found to be pathological in 43% of the patients.

The frequency of simultaneous esophageal contractions following AGB increased significantly in asymptomatic group 1 patients (2.8 ± 8.0 vs 14.5 ± 22.0, P = .01). This resulted in a higher percentage of defective esophageal propagations postoperatively (12.8 ± 19.3 vs 35.9 ± 29.4, P = .02). In group 1 patients LES pressure (18.1 ± 11.3 mm Hg), sphincter relaxation (74.2% ± 13.8%), and distal esophageal amplitudes (50.6 ± 20.8 mm Hg) did not reveal significant differences postoperatively. In 23% of the patients the DeMeester score turned to pathological values. In group 1 eleven patients (9.8%) showed impaired preoperative esophageal body motility that remained unchanged in all of these patients after surgery. Defective esophageal propagations were assessed in another 17 patients (15.2%) following AGB.

BARIUM SWALLOW

Postoperatively, 18 patients (34.6%) in group 2 developed esophageal dilatation with an esophageal diameter of at least 3 cm (range, 3-6.5 cm), while 20 patients (17.9%) in group 1 developed esophageal dilatation after AGB. Immediate complete deflation of the balloon resulted in subsequent normalization of the esophageal diameter. Gradual stepwise filling of the device was tolerated anew in all but 3 patients, who required debanding thereafter.

**COMMENT**

Morbidity due to excess body weight is treated most effectively by many bariatric procedures. Only a minority of specialized general and gastrointestinal surgeons perform bariatric surgery. However, most physicians encounter morbidly obese patients who would be considered candidates for operative treatment. In the future, problems or complications that are directly related to a bariatric procedure will be seen more often. Hence, a tailored operative procedure is required for each patient to avoid predictable complications.

In Europe, laparoscopic AGB has gained popularity because it does not involve a gastrointestinal bypass, is technically easy to perform and adjustable to the individual patient’s demands, and is effective in terms of stable weight loss. Concerns have been voiced about whether patients having GERD are suitable candidates for this treatment. There is little evidence in the literature that alternative bariatric procedures such as the Roux-en-Y gastric bypass, the vertical banded gastroplasty, and the biliopancreatic diversion are superior to AGB regarding gastroesophageal reflux control. Although randomized control studies comparing these procedures by means of 24-hour pH manometry and esophageal manometry are lacking, single reports discuss the value of bypass procedures after failure of AGB. The observation that GERD is common among obese patients and confirmed by our data that reveal 27.9% of patients reporting preoperative GERD symptoms.

Postoperatively, 68.3% of these patients were asymptomatic. Vanishing of GERD symptoms might be explained by the strengthened LES after laparoscopic AGB implantation as described by our group. Therefore, implantation of the AGB probably acts directly to reduce gastroesophageal reflux. Rapid and major improvement in GERD symptoms occurred after laparo-

### Table 2. Preoperative Manometric Findings and DeMeester Scores in Group 1 and Group 2 Patients*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1†</th>
<th>Group 2‡</th>
<th>P Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>LES relaxation, %</td>
<td>98.3 ± 4.4</td>
<td>98.0 ± 3.8</td>
<td>.78</td>
</tr>
<tr>
<td>LES pressure, mm Hg</td>
<td>11.7 ± 7.4</td>
<td>11.9 ± 4.6</td>
<td>.91</td>
</tr>
<tr>
<td>Distal esophageal propagation, mm Hg</td>
<td>56.5 ± 18.2</td>
<td>45.3 ± 18.4</td>
<td>.03</td>
</tr>
<tr>
<td>Low-amplitude waves, %</td>
<td>3.4 ± 6.2</td>
<td>8.5 ± 10.1</td>
<td>.047</td>
</tr>
<tr>
<td>Distal esophageal amplitude, mm Hg</td>
<td>12.8 ± 19.3</td>
<td>20.8 ± 9.8</td>
<td>.007</td>
</tr>
<tr>
<td>Defective esophageal propagation, %</td>
<td>2.8 ± 8.0</td>
<td>6.5 ± 12.8</td>
<td>.24</td>
</tr>
<tr>
<td>Simultaneous waves, %</td>
<td>4.5 ± 11.8</td>
<td>13.0 ± 19.0</td>
<td>.08</td>
</tr>
<tr>
<td>DeMeester score</td>
<td>12.6 ± 10.0</td>
<td>13.5 ± 8.8</td>
<td>.74</td>
</tr>
</tbody>
</table>

Abbreviation: LES, lower esophageal sphincter.

*Data are given as the mean ± SD unless otherwise indicated.
†Group 1 is composed of patients having preoperative gastroesophageal reflux disease (GERD) with postoperative symptom clearout.
‡P value was calculated by means of the unpaired t-test.

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esophageal body motility to predict functional outcome. AGB. This indicates that our grouping of patients ac-
ders and had ongoing interruption of propagation after
asymptomatic GERD who had preoperative GERD. We
was observed in patients with symptomatic as well as
of esophageal body motility as well as of LES relaxation
in morbidly obese patients, in particular interrupted propa-
gation of heartburn in our patient population may be caused
from entering the esophagus. A previous report describes
a reduction in the amount of acid in the esophagus after
surgery to prevent dysphagia.25,26
The prevalence of defective esophageal contraction waves
in morbidly obese patients, in particular interrupted propaga-
tions, may account for the esophagus not building up
enough pressure to overcome the outflow resistance cre-
ated by the implanted AGB. This observation is similar to
that made in antireflux surgery, where it is recommended
that patients with altered body motility be treated by par-
tial Toupet fundoplication instead of a complete 360° Nis-
sen fundoplication to prevent dysphagia.25,26
Higher postoperative LES pressure prevents gastric juice
from entering the esophagus. A previous report describes
a reduction in the amount of acid in the esophagus after
uncomplicated AGB in morbidly obese patients with ab-
normal preoperative esophageal acid exposure.27 The symp-
tom of heartburn in our patient population may be caused
by esophageal stasis rather than acid reflux.
During long-term follow-up, a significant worsening
of esophageal body motility as well as of LES relaxation
was observed in patients with symptomatic as well as
asymptomatic GERD who had preoperative GERD. We
can only speculate why patients became asymptomatic
despite partially altered postoperative esophageal body
motility. Eleven patients in asymptomatic group 1 were
initially seen with impaired preoperative motility disor-
ders and had ongoing interruption of propagation after
AGB. This indicates that our grouping of patients ac-
cording to their postoperative symptom score is not quite
correct, but instead should be based on preoperative
esophageal body motility to predict functional outcome
following AGB. This fact stresses the value of a compre-
hensive preoperative gastrointestinal workup including
upper gastrointestinal tract functional testing in pa-
tients undergoing laparoscopic AGB. The patients in-
clude, however, another 15% whose GERD symptoms im-
proved after AGB but whose esophageal motility worsened
from normal preoperative values. To date, we have no
predictive factors that would foretell changes in esoph-
ageal function in this subgroup of patients. These pa-
tients should be considered asymptomatic refluxers, and
other tests are warranted to select this subpopulation of
morbidly obese patients. On the other hand, a sophisti-
cated postoperative follow-up including dietary advice,
prevention of stoma stenosis by overfilling of the bal-
loon, and repeated barium swallow tests will diminish
the risk for functional alterations in patients with
primarily normal esophageal motility.
Although a variety of complications can be demon-
strated by radiological means, Mortele et al28 concluded
that AGB meets the criteria for a low-risk laparoscopic
alternative treatment for morbid obesity since a low post-
operative complication rate was found radiologically in
a comparably short follow-up period. One of the most
severe complications following AGB is esophageal dilat-
tation that was found in 34.6% of postoperatively symp-
tomatic patients in our study. This is in accord with the
manometric findings of defective esophageal contrac-
tions. Most of the patients develop dilatation within the
first 2 postoperative years, as described in a short fol-
low-up study of our patient population.24 In asymptomatic
patients a dilatation rate of 17.9% was observed and
can be attributed to altered esophageal motility. This un-
derlines the importance of preoperative gastroesopha-
geal functional testing. Band deflation caused a reduc-
tion in esophageal diameter within 3 months in all but 3
patients, who finally required debanding and alterna-
tive bariatric procedures.

CONCLUSIONS
We demonstrate that GERD is common in morbidly obese
patients and that symptoms diminish in most of these pa-
tients following AGB. However, patients with preoperative
alteration of esophageal body motility have poor postoper-
ative outcome with regard to GERD symptoms and esoph-
ageal function. Therefore, in all morbidly obese patients con-
sidered as candidates for AGB, a profound medical history
and a comprehensive gastroesophageal function test is war-
ranted. Alternative bariatric procedures, primarily laparo-
sopic gastric bypass, should be considered in patients with
defective preoperative esophageal body motility.

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REFERENCES


