Endoscopic Findings in the Excluded Stomach After Roux-en-Y Gastric Bypass Surgery

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Hypothesis: After gastric bypass surgery performed because of morbid obesity, the excluded stomach can rarely be endoscopically examined. With the advent of a new apparatus and technique, possible mucosal changes can be routinely accessed and monitored, thus preventing potential benign and malignant complications.

Design: Prospective observational study in a homogeneous population with nonspecific symptoms.

Setting: Outpatient clinic of a large public academic hospital.

Patients: Forty consecutive patients (mean±SD age, 44.5±10.0 years; 85.0% women) were seen at a mean±SD of 77.3±19.4 months after Roux-en-Y gastric bypass surgery.

Intervention: Elective double-balloon enteroscopy of the excluded stomach was performed.

Main Outcome Measures: Rate of successful intubation, endoscopic findings, and complications.

Results: The excluded stomach was reached in 35 of 40 patients (87.5%). Mean±SD time to enter the organ was 24.9±14.3 minutes (range, 5-75 minutes). Endoscopic findings were normal in 9 patients (25.7%), whereas in 26 (74.3%), various types of gastritis (erythematous, erosive, hemorrhagic erosive, and atrophic) were identified, primarily in the gastric body and antrum. No cancer was documented in the present series. Tolerance was good, and no complications were recorded during or after the intervention.

Conclusions: The double-balloon method is useful and practical for access to the excluded stomach. Although cancer was not noted, most of the studied population had gastritis, including moderate and severe forms. Surveillance of the excluded stomach is recommended after Roux-en-Y gastric bypass surgery performed because of morbid obesity.

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The double-balloon enteroscope (Fujinon EN-450P5/20, Fuji Photo Optical Co Ltd, Omiya, Japan; diameter 8.5 mm and length 200 cm) was used along with a soft overtube (TS-12140, Fuji Photo Optical Co; outer diameter 12.2 mm and length 145 cm; Figure 2). Using the double-balloon technique, the enteroscope was inserted orally and advanced to the excluded stomach. All procedures were performed on an outpatient basis by 1 of us (R.K.), assisted by another endoscopist (A.V.S.-R. or R.K.I.). The patient was placed in the left lateral position; sedation was achieved using a combination of midazolam, fentanyl, and propofol if necessary, and supplementary oxygen was provided via a nasal catheter. Fluoroscopic guidance was used only in selected cases.

The primary goal of the procedure was to reach the excluded stomach. If achieved, the endoscopic findings were classified according to the Sidney classification of gastritis and compared with findings before gastric bypass surgery.

All data were reviewed and analyzed by the biostatistical team of the Department of Gastroenterology at São Paulo University Medical School. The t, χ², and Fischer exact tests were used to compare preoperative with postoperative findings and successful with failed endoscopy of the excluded stomach. P < .05 was considered statistically significant.

**RESULTS**

Demographic and clinical features of the study group are given in Table 1. They correspond to findings in a morbidly obese population who lost a substantial amount of weight but still were moderately obese after long-term follow-up.

The excluded stomach was reached in 35 of 40 patients (87.5%). Technical reasons for failure in the other 5 patients included a very long duodenobiliarypancreatic limb associated with bowel adhesions in 3 patients; stricture of the enteroanastomosis in 1 patient; and narrowing of the gastric banding area (functional pouch), which prevented passage of the overtube, in 1 patient. Fluoroscopic guidance was required in 11 of 40 patients (27.5%), and time to reach the excluded stomach was 5 to 75 minutes (mean±SD, 24.9±14.3 minutes).

Among the 5 unsuccessful procedures, the percentage of women (80.0%), duration of follow-up (mean±SD, 82.4±24.3 months), and preoperative and current body mass index (calculated as the weight in kilograms divided by height in meters squared; mean±SD, 53.0±7.9 and 30.6±3.7, respectively) were not statistically different. However, these 5 patients were older (mean±SD age, 52.6±7.0 vs 39.9±9.1 years; P = .02), a condition that may also have interfered with the outcome of the endoscopic intervention.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
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<tbody>
<tr>
<td>Age, y</td>
<td>44.5 ± 10.0 (22-61)</td>
</tr>
<tr>
<td>Female sex, %</td>
<td>85 (34/40)</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
</tr>
<tr>
<td>Preoperative</td>
<td>53.3 ± 8.2 (39.4-83.3)</td>
</tr>
<tr>
<td>Present</td>
<td>32.9 ± 6.4 (21.6-52.7)</td>
</tr>
<tr>
<td>Follow-up period, mo</td>
<td>77.3 ± 19.4 (36-134)</td>
</tr>
</tbody>
</table>

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared).

*Values are given as mean ± SD (range) unless otherwise indicated.
Findings for the esophagus and stomach pouch are given in Table 2, and those for gastric banding and gastrojejunal anastomosis are given in Table 3. In 39 patients, the Roux-en-Y anastomoses were examined; they were end-to-side in 26 patients and side-to-side in 13 patients. In the remaining patient, a jejunal stoma stricture was present and the type of reconstruction could not be identified.

The mucosa of the duodenobiliopancreatic limb was normal in all patients; however, in 3 patients, it seemed exceedingly long and with acute angles, owing either to redundant bowel or perhaps to abdominal adhesions. The excluded duodenum was endoscopically normal in 33 of 35 patients (94.3%). Erosive duodenitis was noted in 2 patients (5.7%). Endoscopic findings in the excluded stomach, along with those seen before bariatric surgery, are given in Table 4.

Table 2. Endoscopic Findings in 40 Patients

<table>
<thead>
<tr>
<th>Endoscopic Finding</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Esophagus Normal</td>
<td>31 (77.5)</td>
</tr>
<tr>
<td>Esophagitis Erosive</td>
<td>7 (17.5)</td>
</tr>
<tr>
<td>Nonerosive</td>
<td>2 (5.0)</td>
</tr>
<tr>
<td>Gastric pouch Normal</td>
<td>39 (97.5)</td>
</tr>
<tr>
<td>Erythematous gastritis</td>
<td>1 (2.5)</td>
</tr>
</tbody>
</table>

Table 3. Additional Observations in the Active Stomach Chamber in 40 Patients

<table>
<thead>
<tr>
<th>Observation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric banding Normal Silastic band</td>
<td>29 (72.5)</td>
</tr>
<tr>
<td>Partial migration to the lumen</td>
<td>6 (15.0)</td>
</tr>
<tr>
<td>Absent band</td>
<td>5 (12.5)</td>
</tr>
<tr>
<td>Gastrojejunal anastomosis Normal</td>
<td>37 (92.5)</td>
</tr>
<tr>
<td>Marginal ulcer or erosion</td>
<td>3 (7.5)</td>
</tr>
</tbody>
</table>

Table 4. Current vs Preoperative Disorders in the Main Gastric Chamber in 35 Patients

<table>
<thead>
<tr>
<th>Description</th>
<th>Preoperative</th>
<th>Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endoscopically normal b</td>
<td>25 (71.4)</td>
<td>9 (25.7)</td>
</tr>
<tr>
<td>Erythematous gastritis</td>
<td>6 (17.1)</td>
<td>10 (28.6)</td>
</tr>
<tr>
<td>Erosive and/or hemorrhagic gastritis</td>
<td>4 (11.5)</td>
<td>10 (28.6)</td>
</tr>
<tr>
<td>Atrophic gastritis c</td>
<td>0</td>
<td>6 (17.1)</td>
</tr>
</tbody>
</table>

a Values are given as number of patients (percentage).
b P < .005; all other P values were nonsignificant.
c Two patients (5.7%) also had suspect areas of intestinal metaplasia that were confirmed at histologic analysis.

Endoscopic examination of the proximal gastric pouch is easily performed during follow-up with standard upper GI tract endoscopy. The same is not true for the distal stomach because of the combined lengths of the esophagus (25 cm), proximal gastric pouch (5 cm), Roux-en-Y jejunum loop (100-150 cm), biliopancreatic jejunal limb (30-75 cm to the ligament of Treitz), and duodenum (20 cm), in addition to the excluded stomach itself (10-15 cm). Total extension is, therefore, in the range of 2 to 3 m.

These lengths were estimated during each push maneuver, when the enteroscope was being advanced into the intestine, according to the endoscopist’s experience, and were established as 10, 20, 30, or 40 cm. The distance was periodically recorded, and the segmental and total lengths were known at the end of the maneuver. Reliability of the measurements, experimentally tested with the Erlanger biosimulation model (Endo-Trainer; ECE Ltd, Erlangen, Germany, in cooperation with the Department of Surgery, University of Erlangen) in an animal model, tends to be acceptable.7

Using a pediatric colonoscope (Olympus PCF, Hamburg, Germany; length 140 cm), Sinar et al8 and Flickinger et al9 were able to examine the defunctionalized stomach in 53 of 78 attempts (65%) in a series of 68 patients who had undergone the Greenville gastric bypass procedure10 with an efferent Roux-en-Y limb of just 25 to 40 cm and a biliopancreatic limb of another 10 to 15 cm. Various types of gastritis were found in 87% of the patients. The retrograde endoscopic technique used in that study was successful because the combined lengths of the anatomical structures did not exceed that of the apparatus.

Virtual gastroduodenoscopy using computed tomography,11 is also an option. This technique was used in 5 consecutive patients, and the excluded stomach was filled with water in 3 patients and air in 2 patients after abdominal puncture.

Fobi et al12 advocate temporary placement of a 16F gastrostomy tube in the distal stomach at the time of the gastric bypass operation, thereby allowing feeding and decompression during the early postoperative period. A radiopaque marker near the gastrostomy site enables convenient radiologic localization for future percutaneous access. More specifically,12 a needle can be placed in the excluded stomach at the site of the radiopaque marker, and a guidewire and dilator introduced under fluoroscopic guidance. Then a pediatric gastroscope or a bronchoscope can be inserted and examination via biopsy or therapeutic procedures is feasible. Nevertheless, no consecutive series or statistics on long-term gastric changes could be found in the literature.12
Sundbom et al,\textsuperscript{13} using an ultrasound-guided technique, performed percutaneous gastrostomy directly into the excluded stomach in 3 patients with GI tract bleeding of unknown origin. One week later, the gastrostomy was dilated to 18F and endoscopically evaluated. Biopsy specimens of the gastric mucosa showed chronic gastritis in all 3 patients and intestinal metaplasia in 1 patient.

The present study analogously identified intestinal metaplasia in the antrum in 2 patients, which was confirmed at histologic analysis. These 2 patients, and most of the others (ie, the patients with normal endoscopy before surgery), had endoscopically normal stomachs before the bariatric procedure.

Additional results, obtained in different populations with various techniques and follow-up periods, were anticipated in a series of gastric bypass procedures reported by Park et al.\textsuperscript{14} Routine endoscopic procedures were unavailable; therefore, 3 independent groups of approximately 30 patients each were examined, respectively, before surgery and at 1 year and 2 years after surgery (ie, 34 patients before surgery, 33 patients at 1 year, and 24 patients at 2 years after surgery). Bile reflux was common in the distal stomach, as in our study, and approximately 40% of the patients exhibited gastritis in that chamber, always nonerosive and superficial. No atrophy or intestinal metaplasia was detected. Gastritis was even more frequent in the proximal gastric pouch, in contrast with our experience.

McNeely et al\textsuperscript{15} observed the distal stomach using a pediatric bronchoscope via percutaneous gastrostomy in a patient with massive GI tract bleeding, with normal findings at upper GI tract endoscopy and colonoscopy, in whom a technetium Tc 99m scan suggested bleeding from that organ. A peptic ulcer 1.5 cm in diameter with adherent clot in the greater curvature of the excluded stomach was found, and a partial gastrectomy was performed.

A new type of double-balloon enteroscope with a 2.8-mm working channel has been recently described, although, to our knowledge, no publication of its use is available yet. Such a device is adequate for therapeutic procedures, thereby avoiding unnecessary gastrectomy.

Serious complications of peptic ulcer in the excluded stomach after RYGBP surgery such as bleeding and perforation are rare but well demonstrated in large series. Printen et al\textsuperscript{16} described 8 patients (0.27%) with bleeding from the excluded stomach in a review of 3000 gastric bypass procedures. Similarly, Macgregor et al\textsuperscript{17} reported perforation of the excluded stomach in 11 of 4300 patients (0.26%) who had undergone RYGBP surgery.

The possibility of cancer in the long-term cannot be excluded and several cases of cancer in the excluded stomach occurring 5 to 22 years after gastric bypass surgery have been reported.\textsuperscript{18-21} This concern arises because many candidates for bariatric surgery are young, and bile reflux during decades and H pylori infection in some circumstances are deleterious conditions that may result in mucosal degeneration.\textsuperscript{22}

Initially described for small-bowel endoscopic examination,\textsuperscript{3,4} the double-balloon push-and-pull method was safe and generally effective for this use. The 2 latex balloons are located, respectively, on the tip of the enteroscope (first balloon) and on the movable overtube (second balloon). Until the jejunum is reached, both balloons are collapsed and the overtube is in a backward position. Then the overtube balloon is inflated and the enteroscope is introduced as far as possible, advancing into the jejunum (push maneuver). Subsequently, the first balloon is inflated and the second balloon, on the overtube, is temporarily emptied so that the overtube can be advanced until it reaches the tip of the enteroscope; then the overtube balloon is filled with air again. The pull maneuver consists of moving cranially both the enteroscope and the overtube, with the respective balloons inflated, so that a segment of small bowel gripped by the 2 balloons is coiled back and the consequent kinked loops are straightened, thus preparing for the next introduction (pull maneuver).

Initially, only the first balloon, on the enteroscope, is deflated, but not the balloon on the overtube because it is not a barrier for further introduction of the apparatus and it holds the kinked proximal bowel in position. As the first balloon collapses, the enteroscope is ready for further advancement, thus starting a new push maneuver. As these repetitive maneuvers straighten and shorten the bowel ahead by means of loop formation behind, they permit introduction far beyond the nominal 2 m of the apparatus.

At least 300 cm of normal small bowel is usually examined with the enteroscope, and advancement to the ileocecal valve is feasible.\textsuperscript{7,23} Gastric bypass surgery represents a special challenge, but provided there are no major adhesions or anatomical distortions, patients with total small bowel length up to 300 cm, including afferent and efferent limbs, are legitimate candidates for this endoscopic procedure.\textsuperscript{7,23}

The primary contributions of this study are the possibility of periodic assessment of patients even with long Roux-en-Y limbs, provided there are not many adhesions, and the opportunity for determination of gastritis in the distal chamber several years after surgery. No therapy was introduced in this initial series because clinical disorders in the study population were mild, common, and nonspecific and the endoscopic procedure was indicated as a follow-up maneuver, not to investigate serious symptoms. Bleeding, partial or total obstruction, and major systemic abnormalities were criteria for exclusion.

The finding of chronic gastritis raises the question of appropriate future management. A new protocol is being written for subjects with positive endoscopic results, including use of a proton-pump inhibitor for 4 weeks and a second endoscopic examination with biopsy. Available information is insufficient for estimation of the cost-benefit and risk-benefit ratios of endoscopic examination, as well as of the ideal frequency of subsequent procedures.

Initial endoscopy with biopsy of the excluded stomach is being used in all subjects who underwent RYGBP surgery more than 36 months previously, followed by a repeated endoscopy every 3 years. Additional examinations and treatments will be required if specific symptoms arise, such as GI tract bleeding, severe pain, and anorexia with unexpected weight loss, or if there are...
compelling signs of mucosal degeneration including severe dysplasia, atrophic gastritis or intestinal metaplasia, as well as gastric adenoma or polyposis. These recommendations seem reasonable until we have a more comprehensive understanding of the incidence and natural history of peptic lesions and of premalignant and malignant mucosal changes in the context of RYGBP surgery. Future evaluation and regular monitoring of this population on a yearly basis should elucidate the natural history of mucosal changes, along with their correlation with predisposing or aggravating conditions such as H. pylori infection, bile reflux, acid production, inflammatory phenomena, cancer markers, and bacterial overgrowth.

**CONCLUSIONS**

A series of consecutive patients who had undergone RYGBP surgery, who had predominantly normal gastric endoscopic findings before surgery, developed moderate or severe gastritis in the late follow-up period, almost exclusively in the excluded stomach. The double-balloon method resolved the problem of assessment of the distal stomach in most of these patients. Periodic surveillance of the excluded stomach is recommended after gastric bypass surgery.

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