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Effect of Omental Reattachment on Food Tolerance and Gastric Emptying in Laparoscopic Sleeve Gastrectomy

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Purpose: The study aims to evaluate the potential benefit of omental reattachment in laparoscopic sleeve gastrectomy (LSG) and its effect on food tolerance and gastric emptying (GE).
Patients and Methods: This prospective study included 40 morbidly obese adults scheduled for LSG from January 2017 to January 2018. They were randomly assigned into one of two groups: reattachment group ($n = 20$) had omental reattachment at the end of LSG and non-reattachment group ($n = 20$) had LSG without omental reattachment. Food tolerance was assessed using the Suter's questionnaire, and GE was studied radiologically 2–3 months after the operation.
Results: GE of liquids and solids was significantly faster in the non-reattachment group. Liquid emptying T½ in the reattachment group was 25.0 ± 6.2 min compared to 11.8 ± 3.0 min in the non-reattachment group ($p < 0.001$). Solid emptying T½ in the reattachment group was 49.0 ± 13.8 min compared to 28.4 ± 8.3 min in the non-reattachment group ($p < 0.001$). There was no significant difference between the two groups in percentage of excess weight loss ($p = 0.581$) and the total score of food tolerance ($p = 0.529$).
Conclusion: Reattaching the greater omentum to the new greater curvature of the gastric sleeve during LSG delays GE of liquids and solids as evidenced by gastric scintigraphy. This delay was not associated with food intolerance.

Keywords: sleeve gastrectomy, omental reattachment, food tolerance, gastric emptying

Introduction

Bariatric surgery has gained exponential popularity during the last two decades. Currently, gastric bypass and sleeve gastrectomy (SG) are widely adopted worldwide owing to their safety and good clinical outcome.[1,2] The latter is now the most frequently used bariatric procedure in the United States and the Asia/Pacific regions.[3]

Despite its easy technique and satisfactory weight loss effect, laparoscopic SG (LSG) has come under considerable investigation, concerning its impact on gastroesophageal function.[4] A recent review of publications on esophageal and gastric functions after SG has concluded that it profoundly affects gastric motility and gastric emptying (GE).[5]

LSG comprises resection of ~80% of the stomach, including the fundus, corpus, and antrum, to create a tube along the lesser curvature.[6] This extensive anatomical alteration of the stomach has a definite effect on GE. It was suggested that loss of fixation of the greater curvature of the stomach to the greater omentum with malpositioning of the sleeved stomach might lead to food intolerance.[7] Gastric omentopexy may resume the normal anatomical position of the stomach and therefore improve food tolerance and GE.[8]

The aim of the study is to evaluate the potential benefit of omental reattachment in LSG and its effect on food tolerance and GE.

Patients and Methods

This prospective study was conducted in Kasr Al-Ainy Teaching Hospital, Cairo University, in the period from January 2017 to January 2018. It included 40 morbidly obese patients scheduled for LSG. The study was approved by the local institutional review board and ethics committee. All patients provided informed consents after full explanation of the nature of the study procedures (including radioisotope scan) and the possible complications that could occur in the perioperative period.

Morbidly obese patients (body mass index [BMI] >40 or >35 kg/m^2 in the presence of comorbidity) with acceptable operative and anesthesia risk, aged 18–65 years, were included in the study. The patients were recruited after

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documented failure of nonsurgical measures to achieve clinically valuable weight loss for a minimum of 6 months. Patients with existing gastroesophageal reflux disease (GERD), gastrointestinal motility disorders, severe psychiatric illness, secondary/endocrinal cause of obesity, or longstanding heart/lung disease, as well as redo bariatric surgery, were excluded from the study.

After careful preoperative evaluation, patients were subjected to LSG. The operation was done after following a low-calorie preoperative diet for 1–2 weeks. The participants were randomly assigned into one of two groups: group A ($n=20$) had omental reattachment at the end of LSG and group B ($n=20$) had LSG without omental reattachment.

Surgical technique

After prophylactic antibiotics and under general anesthesia, elastic compression stockings were placed on the legs. The operation was done with the surgeon standing between the patient's legs. The cameraman was standing on the right side. The first assistant was standing on the left side. Laparoscopic technique began with CO_2 insufflations until the working pressure reached 14–16 mm Hg. The insufflation site was at Palmer's point, 2 cm below the left costal margin along the midclavicular line. The operation was carried out through five ports. The optical port (10 mm) was placed slightly above and to the left of the umbilicus. We used a 30-degree optic scope. After entering abdominal cavity, the position of Veress needle was inspected to exclude the possible organ injury. The abdominal cavity was explored. Two 12 mm ports were placed in the right and left hypochondria in the midclavicular line as the surgeon's working hands and a fourth 5 mm port was placed in left anterior axillary line for the first assistant. A fifth 5 or 10 mm port may be inserted in the epigastrium as a liver retractor according to the liver size.

The greater omentum was dissected close to the stomach using a Ligasure (Autosuture Bariatrics/Covidien) or an ultrasonic dissector (Harmonic; Ethicon Endosurgery, Cincinnati, OH) according to their availability. The dissection started 6 cm proximal to the pylorus up to the angle of His. The left crus and any posterior attachment of the stomach to the pancreas were freed completely. After dissection, the anesthesiologist passed a 36 Fr bougie into the stomach to guide the gastric division. A linear stapler was used to perform the SG. The greater curvature was transected by the first firing of the linear stapler about 3 cm from pylorus to the angle of His. The integrity of the staple line was confirmed by a methylene blue test. For the omental reattachment group, the omentum was sutured to the new greater curvature of the stomach at three or four points depending on the sleeve length, using absorbable 3.0 vicryl sutures (Fig. 1). An upper gastrointestinal (GI) series was done 24 h postoperatively to ensure an intact staple line and to exclude leak as shown in (Fig. 2) for the reattachment group, and a similar upper GI series for a patient after SG with no omental reattachment (Fig. 3).

FIG. 2. Upper GI series after LSG with omental reattachment. GI, gastrointestinal.

Postoperative care and diet regimen

Patients were encouraged to move out of bed few hours after surgery, as no anticoagulation medications were used. Administration of IV proton pump inhibitor and antiemetics were

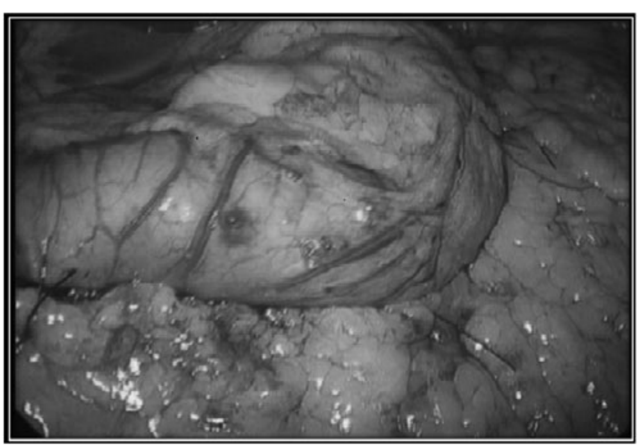

FIG. 1. The new stomach after LSG with omental reattachment. LSG, laparoscopic sleeve gastrectomy.

FIG. 3. Upper GI series after LSG without omental reattachment.

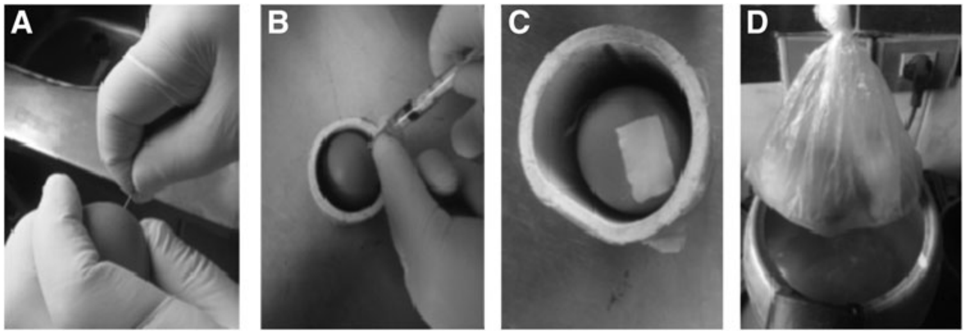

FIG. 4. Steps of labeling a raw egg with one mCi of Tc-^{99m} sulfur colloid to be ready for boiling: **(A)** gently piercing the shell of the egg with a needle, **(B)** injecting the radiotracer, **(C)** sealing the site of puncture with adhesive tape, and **(D)** boiling the labeled eggs in water.[9]

started from the first postoperative day, which is continued orally after patients begin oral feeding for the first 2 weeks only. Liquid diet was advised for 2 weeks, and then, diet progressed gradually to solids over a period of 6–8 weeks. Small frequent meals were advised with the last meal to be 2–4 h before bedtime. Regular physical exercise is encouraged for patients to attain the desired weight loss and body shape.

Two to 3 months after surgery, GE was studied radiologically. GE study for liquids and solids was performed as previously described by Kandeel *et al.*[9] We used a boiled egg as a solid food in this study to be more tolerable by patients. A modified technique was used for labeling the boiled egg with ^{99m}Tc-sulfur colloid as described by Kandeel *et al.*[9] (Fig. 4). Image acquisition was obtained at 0, 30, 60, 90, and 120 min. A time-activity curve was generated on which half GE time (T½) derived from a linear fit decay-corrected. The half emptying time is defined as the time from completion of the meal to the point at which half of the meal left the stomach. The percentage of tracer retention was measured at 30, 60, and 90 min for liquid study. An extra measurement was done after 120 min for the solid study.

The patients were interviewed 10–12 weeks postoperatively with Suter's questionnaire[10] to assess their satisfaction with food tolerance of eight different types of food, timing of eating over the day, and frequency of vomiting/regurgitation.

Sample size justification

Based on the results of a previous study,[11] we assumed that reattachment of the new greater curvature would delay GE time of solids (48.1 min) about 40% and this response was normally distributed with standard deviation 21. If the true difference in the experimental and control means is 19 min, we need to study 20 subjects in experimental and control groups to be able to reject the null hypothesis with a power of 0.8 and an alpha error of 0.05.

Table 1. Patients' Age and Preoperative Body Mass Index

	Reattachment group, n = *20*	*Non-reattachment group,* n = *20*	p
Age (years)	30.3 ± 9.4	37.0 ± 8.4	0.021
BMI (kg/m^2)	43.9 ± 5.2	49.6 ± 7.3	0.002

BMI, body mass index.

Statistical methods

Statistical analysis was done using IBM© SPSS© Statistics version 23 (IBM, Armonk, NY). The sample size was calculated using the G*Power© software (Institutfür Experimentelle Psychologie, Heinrich Heine Universität, Düsseldorf, Germany) version 3.1.9.2. Numerical data were expressed as mean and standard deviation. For quantitative data, the comparison between two groups was done using independent sample *t*-test or Mann–Whitney test. All tests were two-tailed. A *p*-value <0.05 was considered significant.

Results

Out of the 40 studied patients, 5 were males (12.5%) and 35 were females (87.5%). The mean age and BMI of the omental reattachment group was significantly lower than the non-reattachment group (Table 1). One patient in the reattachment group had diabetes and another had osteoarthritis. In the non-reattachment group, one patient had diabetes and one patient had obstructive sleep apnea.

GE of fluids was significantly faster in the non-reattachment group (Table 2). Fluid emptying T½ in the reattachment group had a mean value of 25.0 ± 6.2 min compared to 11.8 ± 3.0 min

Table 2. Gastric Emptying T ½ and Percentage of Fluids and Solids Retained in the Stomach in the Two Studied Groups

	Reattachment group, n = *20*	*Non-reattachment group,* n = *20*	p
Fluid emptying T½ (min)	25.0 ± 6.3	11.8 ± 3.0	<0.001
Percentage of fluid retention			
30 min	43.5 ± 3.5	33.9 ± 5.6	<0.001
60 min	33.0 ± 4.3	17.7 ± 2.5	<0.001
90 min	17.3 ± 2.6	7.5 ± 1.7	<0.001
Solid emptying T½ (min)	49.0 ± 13.8	28.4 ± 8.3	<0.001
Percentage of solid retention			
30 min	71.9 ± 12.3	41.9 ± 8.9	<0.001
60 min	47.3 ± 5.6	20.8 ± 4.4	<0.001
90 min	33.9 ± 4.5	10.9 ± 4.1	<0.001
120 min	21.0 ± 4.1	3.8 ± 1.3	<0.001

in the non-reattachment group ($p < 0.001$). Similarly, GE of solids was significantly faster in the non-reattachment group compared to the reattachment group ($p < 0.001$).

The percentage of excess weight loss of the non-reattachment group was 31.7% ± 5.2% compared to 32.5 ± 3.7 in the reattachment group ($p = 0.581$). Likewise, the difference between the two groups in the total score for food tolerance was nonsignificant ($p = 0.529$). The score in the non-reattachment group was 15.0 ± 4.2 compared to 14.5 ± 2.2 in the reattachment group. None of the patients in the two groups suffered from any major complication, namely hemorrhage and leak, or required hospital readmission in the 3 months of follow-up after surgery.

Discussion

In LSG, small sleeve volume leads to rapid distension and rapid GE.[12] Previous scintigraphic studies showed acceleration of the GE of solids as well as for liquids after SG.[9,13–15] A recent study, including 52 patients, demonstrated accelerated GE 3 months after LSG with increased production of GLP-1 in the distal bowel.[16] Currently, radionuclide GE scintigraphy is recognized as the standard method to evaluate GE.[17]

It has been suggested that some of LSG complications might be associated with lack of fixation of the gastric sleeve along the greater curvature. Loss of ligament fixation may result in malpositioning of the gastric sleeve with subsequent food intolerance and persistent GERD.[7,18] A retrospective study showed symptoms of gastric obstruction in 2.3% of 3634 cases after LSG. Using upper GI contrast study, axial twist was detected in 82% of these patients.[19] Lazoura *et al.*[18] identified three radiological patterns of the gastric sleeve; the tubular pattern is associated with the least reflux symptoms. In addition, cases of gastric torsion and volvulus have been described after LSG.[20]

In this study, we attempted to mimic the natural anatomy of the stomach by reattaching the greater omentum to the new greater curvature of the gastric sleeve. The ultimate goal was limiting some of the postoperative complaints of food intolerance and reverting the anatomical changes caused by SG that may affect GE. Gastric scintigraphy was used to assess GE of both liquids and solids. Our results demonstrated that reattachment of the greater omentum to the sleeve delayed GE of liquids and solids. Despite this delay, food tolerance was comparable in the two groups according to the Quality of Alimentation questionnaire.

The stomach is maintained in position by four ligaments: the gastrophrenic, gastrosplenic, gastrocolic, and gastrohepatic. The SG procedure necessitates division of the former three ligaments, in addition to the posterior gastric attachments.[21] Fixing the sleeve to the greater omentum can partially regain the anatomical position of the stomach.

In this study, GE after omentopexy was still faster compared to the normal values for liquids and solids reported in previous studies. GE T½ for liquids in healthy volunteers was reported to be 80.5 ± 22.1 min.[22] In an Asian study using a boiled egg as the test meal, similar to this study, the GE T½ was 68.7 min with 5th–95th percentile of 45.1–107.8 min.[23] Therefore, fixation of the sleeve to the greater omentum may be more physiological as it restores the anatomical position and slows stomach emptying toward normal values. This can provide better postoperative anatomical and functional conditions.

Sleeve fixation may preserve the intra-abdominal position of the stomach and prevents intrathoracic migration. Using multislice computed tomography; Bauman *et al.*[7] reported that 40% of patients with intrathoracic migration developed persistent postoperative nausea compared to 12% with the correctly positioned sleeve.

To the best of our knowledge, no former study assessed the effect of reattachment of the greater omentum to the gastric sleeve on GE using radionuclide GE scintigraphy.

Afaneh *et al.*[8] assessed the effectiveness of omentopexy during LSG to reduce postoperative food intolerance and gastrointestinal symptoms. The authors used standardized surveys in their assessment. They reported that omentopexy with three or four interrupted sutures did not improve food intolerance up to 1 year postoperatively after LSG. This technique was similar to that of this study. However, Santoro anticipated that using the greater omentum for sleeve fixation would not indorse adequate fixation, considering its natural mobility.[24] Another technique of gastric fixation in LSG implies dividing the new greater curvature into two parts. The proximal part is fixed with a continuous suture using nonabsorbable 2/0 polyester thread to the free edge of the gastrocolic ligament with invagination. The distal part is fixed to the transverse mesocolon near the lower edge of the pancreas with separate sutures.[25]

Author Disclosure Statement

No competing financial interests exist.

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