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A Prospective Randomized Study Comparing Two Different Techniques for Laparoscopic Sleeve Gastrectomy

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Background: Laparoscopic sleeve gastrectomy (LSG) represents a relatively new restrictive operation for obesity. We report a prospective randomized study comparing two different techniques of performing this procedure.

Methods: Between January and August 2006, 20 patients (group A) and 20 patients (group B) were prospectively and randomly submitted to LSG. The characteristics of the patients in the two groups were similar for age and sex. The median preoperative weight was of 120 kg (95-180) (A) and 133 kg (83-175) (B) (NS). The median preoperative BMI was of 42.5 kg/m^2 (35-58) (A) and 47 kg/m^2 (37-58) (B) (NS). The two techniques differ in that in A, stapling is performed after full devascularization and mobilization of the gastric curve, whereas in B stapling is performed as soon as the lesser sac is entered and the greater curve is devascularized after full completion of the sleeve. The staple-line is reinforced at the end of stapling in both techniques.

Results: Median operative time was 34 min (12-54) (A) and 25 min (9-51) (B) (*P*=0.06). Median peroperative bleeding was 5 mL (0-450) (A) and 5 mL (0-100) (B) (*P*=0.37). Median number of staple cartridges used was 6 (5-7) (A) and 6 (4-7) (B) (*P*=0.63). Peroperative complications were a small hiatal hernia requiring repair and a bleeding in two patients of A. Postoperative leak occurred in 1 patient of A, and minor early complications affected 2 patients of A and 1 patient of B. Peroperative and postoperative mortality was 0. Median hospital stay was 3 days (1-10) (A) and 3 days (2-7) (B) (*P*=0.59). One stenosis as a late complication appeared in a patient of B. %EWL at 6 months and 1 year was respectively 43.4% (A), 42.2% (B) and 48.3% (A) 49.5% (B) (*P*=0.82).

Conclusion: LSG can be performed by two different techniques. The technique B (section of the stomach followed by its mobilization) appears familiar to surgeons usually performing laparoscopic RYGBP. No observed differences are significant, but the technique B when looking at observed distributions, seems to be better than the technique A (mobilization of the stomach followed by its section) in terms of operative time, peroperative bleeding and hospital stay.

Key words: Morbid obesity, bariatric surgery, sleeve gastrectomy, laparoscopy, duodenal switch, gastric leak, endoscopic stent, weight loss

Introduction

Laparoscopic sleeve gastrectomy (LSG) is considered as a restrictive operation for bariatric surgery. It was described in 1988 as the restrictive part of duodenal switch (DS) by Hess[1] and Marceau,[2] and in 1993 as an isolated form by Johnston.[3]

LSG is currently less popular than laparoscopic adjustable gastric banding (LAGB) in Europe and than laparoscopic Roux-en-Y gastric bypass (LRYGBP) and LAGB in the United States.[4] In the literature, more reports described the LSG as the first-step of other bariatric procedures such as DS[5-9] or RYGBP,[7,10-13] offering the possibility to reduce the operative risks and postoperative morbidity and mortality.

Percentage of excess weight loss (%EWL) after LSG is

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reported to be 35-61% at 6 months,[4,7,14-17] 46-83% at 1 year,[8,10,15,18,19] 56-83% at 2 years,[9,20] and 66% at 3 years.[16]

The technique of performing LSG has been described generally in the same fashion,[4,5-7,9,17,19] but the most demanding step in this procedure is the dissection of the angle of His, that must consider the risks of esophageal injury, redundant stomach after the last firing of the stapler, and bleeding in the deep splenic region. We hereby compare in a prospective randomized study two different techniques to perform the LSG. The two techniques differ in that in one (group A) stapling is performed after full devascularization and mobilization of the gastric greater curve, whereas in the other (group B) stapling is performed as soon as the lesser sac is entered and the greater curve is devascularized after full completion of the sleeve.

Materials and Methods

Between January 1st and August 31st 2006, 40 patients were consecutively and randomly assigned to LSG as the technique A (20) or the technique B (20). Surgical technique was randomly decided by opening sealed envelopes before laparoscopy. One patient of group B was converted to an LRYGBP because a giant hiatal hernia was discovered peroperatively (despite normal preoperative gastroscopy); the latter was excluded from the study after randomization and this exclusion was not related to the surgical procedure. LSG was performed as the sole operation in 14 patients of A and 8 patients of B, as the first step of a DS in 1 patient of A and 5 patients of B, and during a laparoscopic DS in 5 patients of A and 6 patients of B.

The characteristics of the patients were similar for the two groups: 10 males and 10 females (A) versus 8 males and 11 females (B) (NS), a median age of 43.5 years (29-62) (A) and 48 years (19-64) (B) (NS), a median preoperative weight of 120 kg (95-180) (A) and 133 kg (83-175) (B) (NS), and a median preoperative BMI of 42.5 kg/m^2 (35-58) (A) and 47 kg/m^2 (37-58) (B) (NS). Eleven patients (55%) of A and 9 patients (45%) of B suffered preoperatively from one or more morbidity related to the obesity.

The following variables were chosen as outcome measures considered as continuous: operative time, peroperative bleeding, number of staple cartridges used, hospital stay, weight loss and the following categorical variables: peroperative complications, early and late postoperative complications, and peroperative and postoperative mortality. The distributions of the continuous variables were compared using non-parametric Mann-Whitney tests and the distributions of categorical variables were compared using Fisher's exact tests (two-tailed tests). A statistical difference was considered significant for $P<0.05$. The patients were followed-up in the office at 10 days, 1, 3, 6 months and 1 year.

Surgical Technique

Technique A and B

The patient is positioned in dorsal decubitus, with the legs apart and in reversed Trendelenburg position with a 10° tilt, carefully strapped to the operating table, with the arms placed in abduction. Shoulder supports are placed and extreme care is taken to pad the pressure points and joints with foam cushions. The surgeon stands between the patient's legs, the assistant to the patient's left and the cameraman to the patient's right.

Abdominal insufflation is set at 15 mmHg. Trocars are placed as fellows: a 10-mm trocar (T1) 20 cm below the xyphoid process for the 30° optical system, a 5-mm trocar (T2) on the left anterior axillary line, a 12-mm trocar (T3) on the left mid-clavicular line just between the 1st and the 2nd trocars, a 12-mm trocar (T4) on the right mid-clavicular line and a 5-mm trocar (T5) below the xyphoid process (Figure 1).

After identification of the Crow's foot, a straight line is marked with the coagulating hook up to the greater curve, delimiting the spared antrum (Figure 2). The lesser sac is accessed through a window made in the greater omentum 3 cm laterally from the marking, close to the greater curve and within the epiploic arch.

Technique A

The dissection proceeds cranially in order to completely dissect the omentum off the greater curve using the coagulating hook. The dissection reaches the left diaphragmatic crus which is entirely freed as well as the base of the right diaphragmatic crus (Figure 3). It is completed caudally in the direction of the pylorus, reaching the previously marked proximal border of the antrum. All retrogastric adhesions must be divided, respecting the left gastric vessels. A first firing of the linear stapler blue or green load (EndoGIA 60-mm), inserted in the abdomen through T4, divides the greater curve in the direction of the Crow's foot, aiming towards

the endings of the small gastric vessels on the lesser curve (Figure 4). Other firings of the linear stapler blue or green load (EndoGIA 60-mm), inserted through T3, transect the stomach parallel to the lesser curve, from the antrum to the angle of His. Before the third firing of the stapler, the anesthesiologist passes down a gastric tube of 34 French, in order to guide the gastric section. During section, the assistant grasper, inserted through T2, takes laterally the greater curve in the direction of the spleen. A running suture, using absorbable material (e.g. PDS 1) reinforces the staple-line, starting from the area of the angle of His until the marking (Figure 5).

Technique B

The window in the greater omentum is opened, close to the greater curve, from 3 cm laterally until the marked stomach. It is made just sufficiently large enough to permit the introduction of the first firing of the linear stapler, blue or green load (EndoGIA 60-mm) through T4. The stapler arrives in contact with the endings of the small gastric vessels on the lesser curve and is fired (Figure 4). Further firings of linear stapler, inserted through T3, should be parallel to the lesser curve. Posterior gastric adhesions are divided. Before the third firing of the stapler, the anesthesiologist passes down the 34 French gastric tube in order to guide the gastric section in the direction of the angle of His. Before the last firing of the stapler the angle of His is freed from top to bottom and vice versa (Figure 6); the stomach is transected without tension, staying distant from the gastroesophageal junction (Figure 7). The staple-line is reinforced by a running suture using absorbable material (e.g. PDS 1) starting from the last firing of the stapler until the marking. The greater omentum is now dissected off the stomach along the greater curve by a coagulating hook, reaching the left diaphragmatic crus.

Technique A and B

The resected part of the stomach is extracted through T3. The patient is positioned in Trendelenburg position and the operative field is immersed in saline solution. Compressed air insufflated through the gastric tube by the anesthesiologist tests the integrity and symmetry of the sleeve. A drain is placed along the sleeve until the upper pole of the spleen and the T3 is closed in layers. The gastric tube is extracted at the end of the operation.

Results

The median operative time was 34 minutes (12-54) (A) and 25 minutes (9-51) (B) (P=0.06). The median peroperative bleeding was 5 mL (0-450) (A) and 5 mL (0-100) (B) (P=0.37). The median number of staple cartridges used was 6 (5-7) (A) and 6 (4-7) (B) (P=0.63).

Peroperative complications were registered in group A. Diaphragmatic crura repair was performed in a patient for a small hiatal hernia evidenced peroperatively and a significant peroperative bleeding (450 mL) during the dissection of the greater omentum occurred in another patient of this group.

Postoperative major complication occurred in one patient of group A, who presented a leak at the site of the angle of His, treated by placement of an endoscopic stent (Ultraflex/Polyflex, Boston Scientific, Natick, MA). The enterocutaneous fistula was successfully healed on the 65th postoperative day.

Postoperative minor complications for A were a bronchospasm with tachycardia and a pneumonia in another patient, both treated medically; for B an abdominal wall cellulitis at the extraction site, treated medically.

The median hospital stay was 3 days (1-10) (A) and 3 days (2-7) (B) (P=0.59). There was no peroperative and postoperative mortality in either group. Postoperative late complication occurred in one patient of group B, who presented a stenosis of the sleeve on the 41st postoperative day, treated by a single endoscopic dilation.

Average weight loss for group A at 10 days, 1, 3, 6 months and 1 year, for the isolated sleeve and as a first step, was respectively of 4, 11, 30, 35, 40 kg for A, and for group B, 3, 12, 29, 33, 42 kg for B (P=0.82). %EWL (using the Metropolitan tables) at 1, 3, 6 months and 1 year for A was 16.2%, 38.3%, 43.4%, 48.3%, and for B was 16.8%, 37.7%, 42.2%, 49.5%, respectively (P=0.82).

Discussion

LSG as an isolated operation has become increasingly popular in Europe, because it represents a relatively simple restrictive procedure for obesity. After having performed >350 isolated LSG using

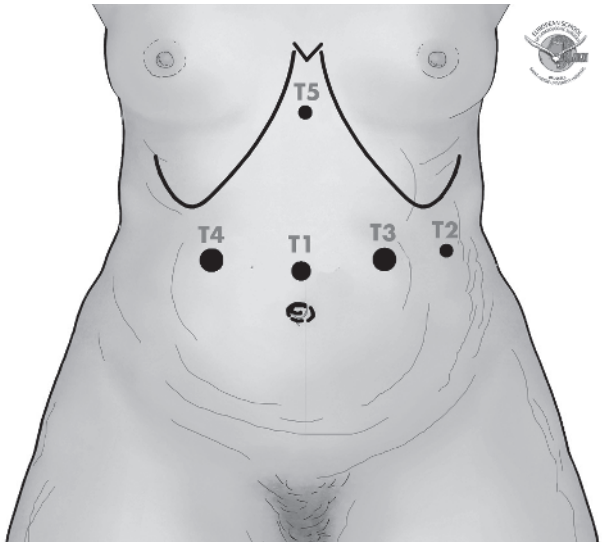

Figure 1. Laparoscopic sleeve gastrectomy: position of the 5 abdominal trocars.

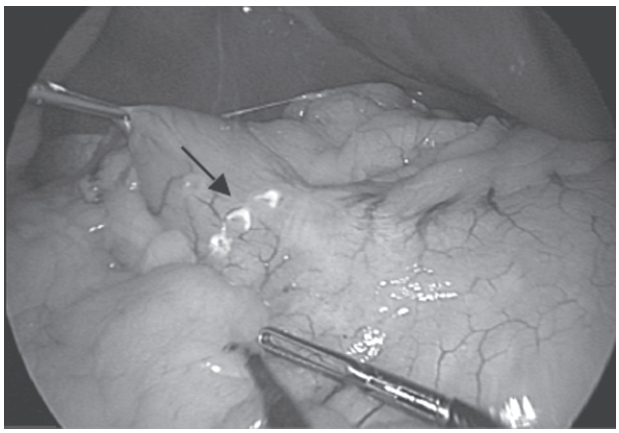

Figure 2. Technique A and B (first step): arrow points the limit of the spared antrum indicated by marking.

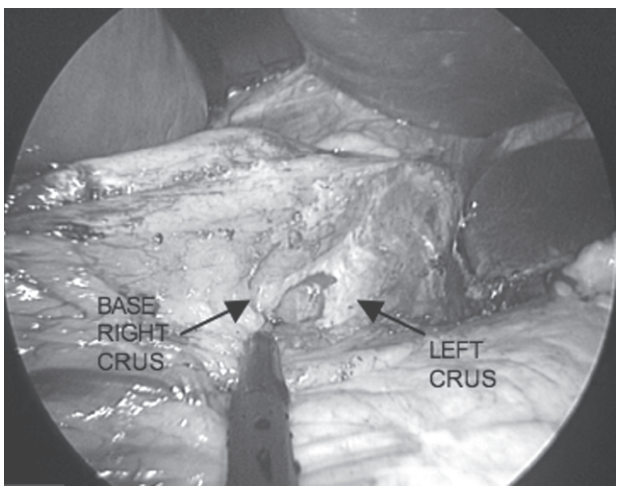

Figure 3. Technique A: arrows point to the left crus and base of right crus freed.

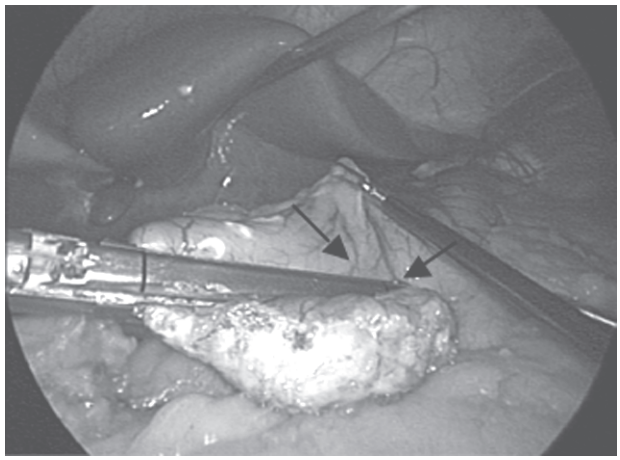

Figure 4. Technique A and B: first firing of linear stapler. Arrows point to the endings of the small gastric vessels on the lesser curve.

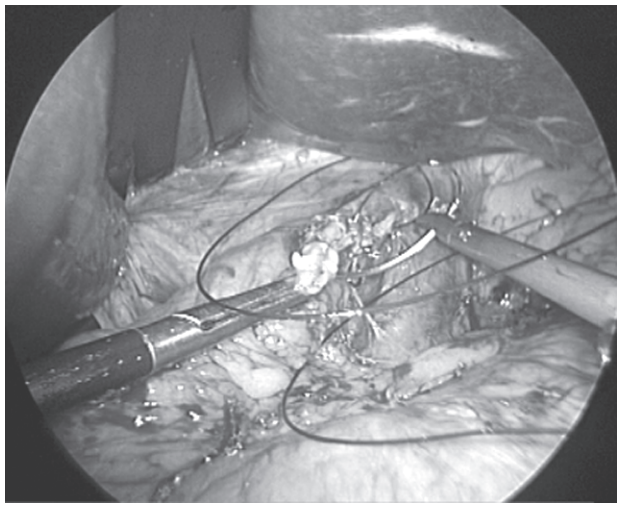

Figure 5. Technique A: start of the running suture oversewing the staple-line.

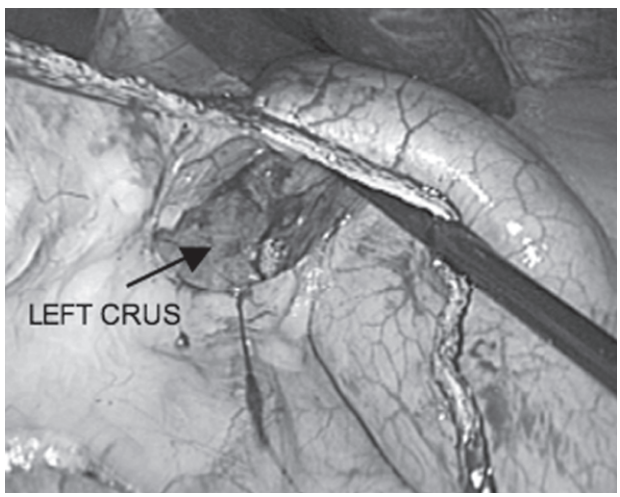

Figure 6. Technique B: angle of His freed from bottom to top. Arrow points to the left crus.

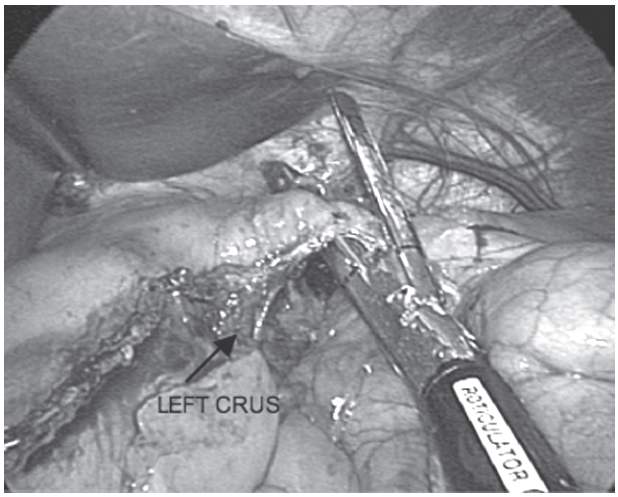

Figure 7. Technique B: last firing of linear stapler placed so as to stay distant from the gastroesophageal junction. Arrow points to the limit of the left crus.

the technique A, one of the authors (JH) had the idea to perform a new technique (B).

Two essential technical aspects must be considered during the LSG: the complete liberation of the gastric fundus, and the final firing of the linear stapler near the angle of His, avoiding encroachment on the esophagus. These two aspects are very important in order to obtain a narrow gastric tube without any redundant part and to avoid a postoperative leak at the site of the angle of His.

The technique B, regarding the division of the stomach performed at the end of the procedure, appears to be easier than A, because the last firing of the stapler is given in the same condition as the gastric pouch construction during LRYGBP. This is probably due to the learning curve obtained with LRYGBP, because this manoeuvre can thus appear familiar to the surgeon. Before firing of the last stapler, the angle of His is freed from top to bottom and vice versa, and this permits the introduction of the stapler and the successive section without any undue tension of the tissue. With this method, the stomach can be sectioned without tension because the greater curve is not taken laterally in the direction of the spleen, unlike with technique A. Postoperative leaks can probably be avoided because of the absence of tissue tension during the last division of the stomach. Moreover, during the posterior dissection, conditions are very similar to LRYGBP.

Analysis of the results does not show statistically significant differences in terms of operative time, peroperative bleeding, number of cartridges used, hospital stay and weight loss. Operative time seems to be lower after the technique B than A. This result is probably related to the dissection of the greater curve of the stomach. In technique B, this step appears to be easier and faster, because the most difficult part of devascularization of the stomach is performed without endangering the angle of His.

The risk of peroperative bleeding during LSG always exists at the moment of the dissection of the gastrosplenic ligament, as appeared in one of our patients of group A. Dissection of the greater omentum was performed by the coagulating hook for cost reasons. However, it is preferable to be performed using the Ultracision device (Ethicon EndoSurgery, Cincinatti, OH) or the Ligasure device, in order to control any possible bleeding from the small gastric vessels of the greater curve.

Absence of hiatal hernia or gastroesophageal reflux is one of the factors to be considered for the selection of the patients for LSG or DS, because this procedure actually worsens this condition, unlike after LRYGBP.[21,22] In the case of hiatal hernia discovered peroperatively in an asymptomatic patient, a plasty of the diaphragmatic crura must be performed, as was done for a patient of group A. On the contrary, when a giant hiatal hernia is discovered, as appeared in one patient of group B, we believe empirically that LSG must be replaced by LRYGBP.

Postoperative leak after LSG is reported with an incidence of 0-1.4%[23] up to 5.3%.[19] Management of gastric leak after LSG is usually difficult to treat. Clinical status of the patient, volume of the leak and position of the drain must be considered. The site of the leak after LSG is usually the angle of His, as presented in a patient of group A, and this is probably related to the tissue-tension maintained by the assistant grasper during section of the stomach, which causes transsection to occur too close to the esophageal wall. Our management of postoperative leak after LSG is as follows: if the patient is hemodynamically stable (patient without dyspnea, tachycardia or fever) and the drain appears to be properly placed, the patient is treated conservatively with parenteral nutrition and antibiotics, as is well reported in bariatric surgery.[24-28] If the patient is not hemodynamically stable or the drain is not well positioned resulting in a source of local peritonitis, a relaparoscopy is mandatory. Laparoscopy with toilette

of the cavity, placement of the drain near the leak, and a feeding jejunostomy is our first choice of treatment, because suture-control does not achieve permanent closure. Unfortunately, an enterocutaneous fistula after LSG does not heal in a few days; hence, collaboration with a gastroenterologist is mandatory, as has already been reported after other bariatric procedures.[29] We then consider placement of a stent by endoscopy,[30] if the treatment is unsuccessful and the gastric leak is again present after 3 weeks. The treatment by endoscopic stent is usually performed in two steps: firstly a metallic stent (Ultraflex, Boston Scientific, Natick, MA) is placed for 4 or 6 weeks followed by the placement of one or more plastic stents (Polyflex, Boston Scientific, Natick, MA) for another 4 weeks. With the healing of the leak, the plastic stent is removed. Cottam and colleagues[10] reported 5 cases of strictures in a series of 126 LSG, probably due to oversewing of the staple-line, as appeared in one of our patients of group B. The latter was successfully treated by a single endoscopic dilation, but seromyotomy performed by laparoscopy remains another valuable option (Figure 8).

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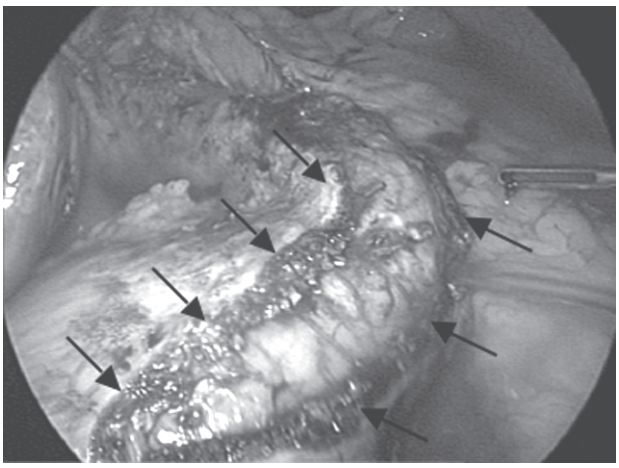

Figure 8. Final view of laparoscopic seromyotomy of the sleeve. Arrows point to both edges of seromyotomy.

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