Association of Radiographic Morphology with Early Gastroesophageal Reflux Disease and Satiety Control after Sleeve Gastrectomy

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BACKGROUND: Variable gastric morphology has been identified on routine upper gastrointestinal series after laparoscopic sleeve gastrectomy. This test might give us useful information beyond the presence of leak and obstruction. The aim of this study is to standardize a morphologic classification of gastric sleeve based on water-soluble contrast upper gastrointestinal series, and to determine possible clinical implications.

STUDY DESIGN: One hundred morbidly obese patients underwent laparoscopic sleeve gastrectomy and had routine upper gastrointestinal on postoperative day 1 or 2. Images were reviewed by 4 radiologists who were blinded to outcomes, and sleeve shape was classified as upper pouch, lower pouch, tubular, or dumbbell. Inter-observer agreement was calculated. Clinical outcomes including weight loss, satiety control, and reflux symptoms were recorded. Comparisons were determined by 1-way ANOVA and *t*-test.

RESULTS: Mean age was 46 ± 12 years and mean BMI was 45.1 ± 6 kg/m^2. Overall inter-observer agreement level for the sleeve shape classification was 76.3%. Sleeve shapes were tubular in 37%, dumbbell in 32%, lower pouch in 22%, and upper pouch in 8%. Mean excess body weight loss at 1, 3, and 6 months was 16.8%, 29.9%, and 39.1%, respectively. Excess body weight loss was not associated with sleeve shape. Mean hunger score was 213 ± 97, and patients with dumbbell shape had higher hunger scores ($p = 0.003$). Mean reflux score was 5.7 ± 8. Upper pouch shape was associated with greater severity of reflux symptoms ($p = 0.02$).

CONCLUSIONS: This study suggests a standardized radiographic classification of gastric sleeve morphology. Although sleeve shape is not correlated with weight loss, gastric sleeves with retained fundus result in lower satiety control and higher severity of reflux symptoms. An adequate resection of the gastric fundus might avoid this potential complication. (J Am Coll Surg 2014;219:430–438. © 2014 by the American College of Surgeons)

Obesity has become an extremely common disease, with recent studies showing an overall prevalence of 35.7% in the United States.[1] In addition, obesity is associated with comorbidities including hypertension, diabetes, dyslipidemia, and sleep apnea, leading to decreased life expectancy.[2] Bariatric surgery is currently the most effective method to achieve sustainable weight loss and resolution of comorbidities.[3]

Diverse surgical procedures have been developed through the history of bariatric surgery and these have gained more popularity in the last 2 decades due to the availability of laparoscopic techniques. Currently, the most commonly performed procedures are Roux-en-Y gastric bypass, laparoscopic adjustable gastric band, laparoscopic sleeve gastrectomy (LSG), and biliopancreatic diversion with or without duodenal switch.[4] However, LSG is one of the more attractive options in the bariatric armamentarium because of the absence of anastomosis, the avoidance of foreign body use, and minimal

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Abbreviations and Acronyms
EBWL = excess body weight loss
HRQL = Health-Related Quality of Life
LSG = laparoscopic sleeve gastrectomy
POD = postoperative day
UGI = upper gastrointestinal series

morbidity and mortality. Although previously considered the first step of biliopancreatic diversion with or without duodenal switch, LSG has shown rapid growth as a primary procedure, with reported mean excess body weight loss (EBWL) of around 60%, and improvement rates of >90% for diabetes and sleep apnea and >70% for hypertension and dyslipidemia.[5]

As LSG is being increasingly performed, it is imperative that surgeons and radiologists understand the surgical technique, the normal postoperative anatomy, and the imaging findings of potential complications.[6,7] The rationale of the operation is to perform a vertical gastrectomy resulting in a narrow and tubular stomach. This is usually performed laparoscopically through 4 to 5 trocars in the upper part of the abdomen. The resulting effect is primarily restriction of oral intake, although some metabolic and hormonal effects have been described, such as ghrelin-level reduction due primarily to resection of the gastric fundus, where the majority of the ghrelin-producing cells are located.[8] Although it is a low morbidity procedure, potentially disastrous complications, such as leaks, can occur.

In many centers, a water-soluble contrast upper gastrointestinal series (UGI) is usually performed in the first 24 to 48 hours after the procedure. For some bariatric surgeons, this is a routine test included in the perioperative management protocol before restarting oral intake; others use it only in selected cases when there is clinical suspicion of leak or obstruction.[9,10] As the frequency of these complications is low, and most leaks occur after postoperative day 5, many surgeons have stopped performing UGI studies routinely on these patients.[11] Unnecessary radiation exposure and increased cost are 2 additional disadvantages. However, some reports highlight the potential advantages of performing this test, such as the assessment of contrast flow that can indicate the oral fluid tolerance[12] and the documentation of normal postoperative anatomy, which is especially important for the performance evaluation of surgeons in training.[11]

Although routine UGI to evaluate for leak might not be justified, it might be that the routine UGI series could provide useful information about sleeve shape. In fact, previous reports have identified different gastric sleeve shapes on UGI series[13] and have tried to determine the correlation between these shapes and the clinical outcomes of the procedure.[14] The aims of this study were to standardize a morphologic classification of gastric sleeve based on UGI series and determine the possible implications of the radiographic sleeve shape in terms of weight loss, satiety control, and GERD symptoms.

METHODS

Patient population

We included 100 consecutive morbidly obese patients who underwent LSG between December 2011 and October 2013 in our group. Most (83%) of the patients were female and 17% were male. Mean age, preoperative weight, and preoperative BMI were 46 ± 12 years (range 20 to 71 years), 124 ± 23 kg (range 85 to 188 kg), and 45.1 ± 6 kg/m^2 (range 33.6 to 67.8 kg/m^2), respectively. All but 1 patient had at least 1 comorbidity. The main comorbidities, in decreasing order, were hypertension (75%), GERD (49%), joint disease (43%), diabetes (37%), obstructive sleep apnea (36%), hyperlipidemia (19%), psychiatric disorders (19%), and hypothyroidism (17%). Other perioperative clinical variables were collected from the electronic medical records. This study was approved by the Institutional Review Board of Emory University (IRB No. 45910).

Surgical technique

The same surgical technique and instruments were used in all patients. All cases were either laparoscopic or robot-assisted procedures and performed by 2 surgeons. We used a 4-trocar approach (two 12-mm and two 5-mm) and an epigastric 5-mm incision for the liver retractor. After trocar placement, the dissection begins 4 cm proximal to the pylorus toward the gastroesophageal junction, detaching the major omentum from the greater gastric curve. Special attention is paid to coagulate and divide the short gastric vessels when the fundus is fully mobilized. All the attachments between the gastric fundus and the left crus are released and the gastroesophageal junction is identified.

Next, a diagnostic gastroscope (approximately 32F in diameter) is passed through the stomach into the first portion of duodenum and is used as a calibration bougie. The first stapler firing is performed at the antrum, ensuring not to place the stapler too close to the incisura angularis to avoid any narrowing. Subsequent stapler firings are carried out proximally for the rest of the stomach. All staple loads are reinforced with bioabsorbable buttress material. The last firing is performed 1 cm lateral to the gastroesophageal junction to avoid any accidental stapling of the distal esophagus and potential leaks.

The staple line is then closely examined. We performed an intraoperative endoscopy for checking hemostasis and ruling out leaks. Next, a round Blake drain is placed