The Laparo-endoscopic Rendezvous: An Evolving Technique in Sleeve Gastrectomy

Ayman M. A. Osman[1], Mohamed D. Sarhan[1], Doaa A. Mansour[1], Mohamed H. A. Fahmy[1], Mohamed S. Abdel-Bary[2], Mostafa Abdelaziz[1].
[1]Department of General Surgery, Faculty of Medicine, Cairo University, Egypt.
[2]Department of Tropical Medicine, Faculty of Medicine, Cairo University, Egypt

ABSTRACT

Objective: *Laparoscopic sleeve gastrectomy (LSG) is a relatively new bariatric surgical procedure that is commonly performed nowadays. Here, we conducted a prospective study in order to evaluate the potential benefits and drawbacks of the use of intra-operative endoscopy (IOE) in conjunction with LSG, which we called the "Laparo-endoscopic Rendezvous" technique.* ***Methodology:*** *Fifteen morbidly obese patients underwent LSG using the "Laparo-endoscopic Rendezvous" technique. The potential benefits of this technique, difficulties encountered, as well as operative time and postoperative complications were observed.* ***Results:*** *Three intra-operative problems were encountered in our study group [intra-luminal bleeding (n=1), twisting of the gastric sleeve (n=1), kinking of the gastric sleeve (n=1)]. The operative time ranged from 100 to 180 minutes (mean, 134.3 ± 21.86 SD). No postoperative complications were reported and the gastric leak rate was 0%.* ***Conclusion:*** *Inspite of the logistical and technical difficulties encountered, and the relatively long operative time, the "Laparo-endoscopic Rendezvous" is a safe and promising technique with several potential benefits. It allows for assessment of the staple-line integrity by different methods and for intra-operative detection and management of some potential LSG problems, thereby preventing postoperative morbidity.*

Keywords: *Intraoperative endoscopy; Laparo-endoscopic; Rendezvous technique; Laparoscopic sleeve gastrectomy; Morbid obesity.*

INTRODUCTION

Bariatric surgical procedures are becoming increasingly common worldwide because of their efficacy in weight reduction and improved management of obesity-related co-morbidities e.g. diabetes, hypertension. Obese patients who undergo bariatric surgery have lower long-term mortality rates compared to matched controls who do not undergo bariatric surgery [1]. In a survey from the *International Federation for the Surgery of Obesity and Metabolic Disorders* [2], it has been shown that approximately 340,770 bariatric procedures were performed worldwide in 2011. The most frequently performed procedure in this survey was sleeve gastrectomy.

Laparoscopic sleeve gastrectomy (LSG), also known as longitudinal or vertical gastrectomy, is a relatively new and effective surgical option for the management of morbid obesity in which resection of much of the gastric body leaves a narrow tube of stomach as an alimentary conduit [3,4]. Complications of LSG include reoperation (4.5%), gastric leak (0.9-5%), stricture (0.7%), bleeding (1-6%), pulmonary embolism (0.3%), delayed gastric emptying (0.3%), abscess (0.1%), wound infection (0.1%), splenic injury (0.1%), and trocar site hernia (0.1%), with an overall mortality rate of 0.6% [5]. One of the most serious and dreaded complications of LSG is gastric leak (staple-line leak). Several classifications of gastric leak exist, based on radiologic findings [Type 1 (subclinical) and Type 2 (clinical) leaks] and time of diagnosis [Early and late (delayed) leaks] [6-9].

Due to the large volume of patients undergoing bariatric surgery, improving the safety of these operations has become a major priority, leading to the development of strict criteria for center accreditation, guidelines for safe and effective bariatric surgery, as well as careful monitoring of surgical outcomes [10]. Here, we conducted a prospective study in order to evaluate the potential benefits and drawbacks of the use of intra-operative endoscopy (IOE) in conjunction with laparoscopic sleeve gastrectomy (LSG), as well as the role of this evolving technique, which we called the *"Laparo-endoscopic Rendezvous"*,

in intra-operative identification and prevention of staple line leak.

PATIENTS METHODS

Fifteen morbidly obese patients underwent laparoscopic sleeve gastrectomy using the *"Laparo-endoscopic Rendezvous"* technique, in Kasr Al-Aini Hospital, Cairo University between August 2014 and April 201٥ after failure of conservative measures for management of their morbid obesity. Informed consent was obtained from all patients prior to their inclusion in the study. The study has been approved by the institutional Ethical Committee and has therefore been performed in accordance with the ethical standards laid down in an appropriate version of the Declaration of Helsinki/Declaration of Istanbul.

Patient enrollment into the study was based on strict inclusion and exclusion criteria **(Table 1)**. All patients were subjected to full preoperative evaluation aiming at assessment of the degree of obesity, as well as detection and evaluation of different co-morbidities e.g. hypertension, diabetes mellitus, sleep apnea, etc. Preoperative investigations included routine laboratory tests, hormonal assay to exclude any endocrinal causes of obesity, chest X-ray, pulmonary function testing, cardiological assessment, abdominal ultrasonography and upper gastrointestinal (UGI) endoscopy.

Table 1: Inclusion and exclusion criteria used for patient selection in our study group.

Inclusion criteria	*Exclusion criteria*
▪ BMI ≥ 40 or BMI ≥ 35 with a significant obesity-related co-morbidity. ▪ Age between 14 and 60 years. ▪ No endocrinal causes for obesity. ▪ Previously successfully instituted and supervised but failed adequate conservative program (diet, exercise and/or medication) for at least 6 months. ▪ Psychological stability. ▪ Motivation & acceptance of surgical risks.	▪ Patients with large ventral hernias. ▪ Active alcohol or substance abuse. ▪ Active gastric ulcer disease. ▪ GERD with a large hiatal hernia. ▪ Pregnancy or lactation. ▪ Previous upper abdominal / bariatric surgery or other contraindication for laparoscopic surgery. ▪ Sweet eaters. ▪ Significant longstanding heart/lung disease or other severe systemic disease. ▪ Mental illness, dementia or other severe psychiatric illness.

BMI = Body Mass Index; GERD = Gastro-esophageal Reflux Disease

In all cases, the patient was placed on the operating table in the supine position with the operating surgeon standing between the patient's legs. A CO2 pneumoperitoneum was established (to a pressure of 15 mmHg) using veress needle. Direct optical entry to the abdominal cavity was carried out under vision using a 0º laparoscope. This was then changed to a 30º or 45º scope. Four 12-mm trocars were introduced into the abdominal cavity including right and left upper quadrant trocars, an epigastric trocar and a supra-umbilical trocar just to the left of the midline. A fifth 5-mm trocar was inserted at the left anterior axillary line. Following port placement, the patient was placed in anti-Trendelenburg position. A window was created at the junction of the greater curvature of the stomach and the greater omentum, around 10 cm from the pylorus. The greater omentum was then dissected from the greater curvature, from a point 4 cm proximal to the pyloric ring up to the angle of His, using the ultracision Harmonic scalpel. Once the dissection part was completed, a flexible fiberoptic upper gastrointestinal endoscope (30-Fr) was introduced orally by the endoscopist through the oesophagus into the stomach. The endoscopist then guided it along the lesser curvature into the pyloric channel and duodenal bulb. The endoscope was maintained in this position until completion of the gastric transaction in order to size the gastric sleeve *(serving the same function of a bougie)*, as well as to avoid stapling across a displaced endoscope.

Gastric transection was started 3-4 cm proximal to the pylorus. An Endo-GIA linear stapler was used to construct the gastric sleeve

over the 30-Fr endoscope, leaving a distance of about 1 cm between the endoscope and the stapler with each firing. The stapler was first placed through the left upper quadrant port, across the antrum and fired **(Figure 1 A and B)**. It was then placed, through the right upper quadrant port, across the stomach approximately 1-2 cm from the border of the lesser curvature in the direction of the gastroesophageal junction, and again fired. Sequential firings of the stapler along the border of the endoscope on the lesser curvature were used to transect the stomach until the angle of His. For the first stapler firing, a 60-mm green or gold cartridge was used, whereas blue cartridges were used for sequential firings.

After completing the gastric transection, the entire staple-line was inspected carefully (from the intraluminal side through the endoscope by the endoscopist and from the extraluminal side through the laparoscope by the surgeon) to make sure that the staples were properly placed especially at the antrum where the stomach is thickest **(Figure 1C)**. The transected stomach was then removed through one of the 12-mm port sites. The integrity of the staple line was tested for water-tightness by a methylene blue test. About 50-100 ml of methylene blue dye was injected into the stomach (via the endoscope by the endoscopist), while the pylorus was compressed by a grasper (by the surgeon) **(Figure 1D)**. The staple-line was carefully inspected (from the extraluminal side by the surgeon) in order to exclude macroscopic staple-line leaks. The dye was then endoscopically aspirated from the stomach. An air leak test was also performed by insufflating the gastric sleeve tube with air (via the endoscope by the endoscopist) then placing the patient in Trendelenburg position while immersing the staple-line in saline **(Figure 2)**. Air bubbles, seen by the surgeon escaping from the staple-line, indicated a leak. A 20-24 Fr nelaton drain was inserted along the staple-line. All trocar sites were closed.

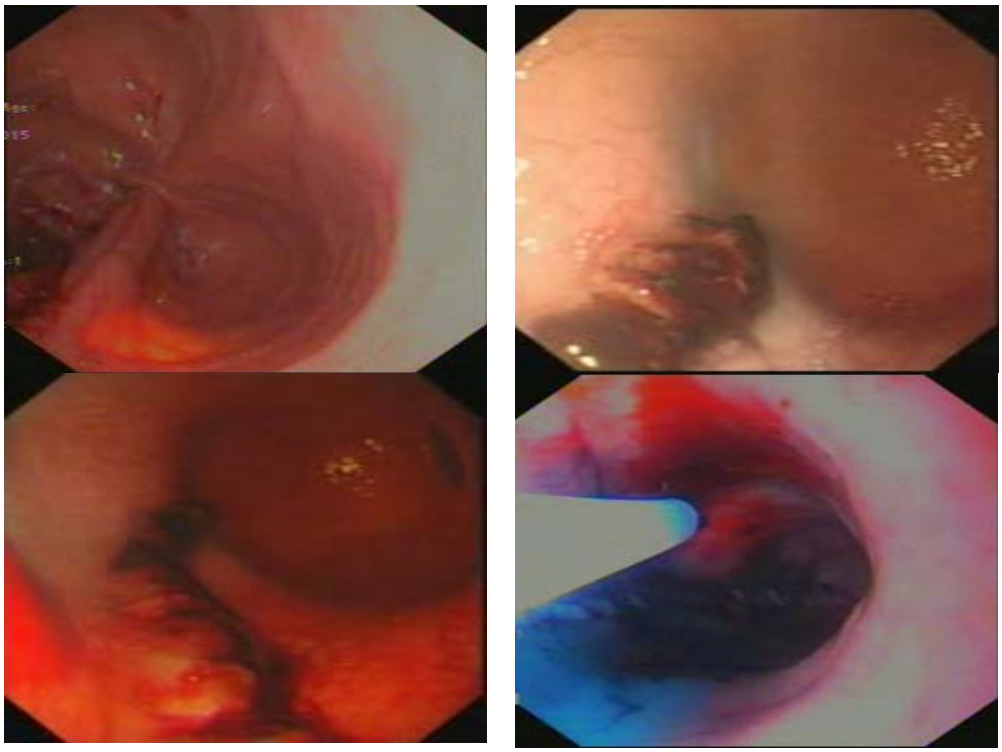

Fig. 1 (A-D): A and B; Endoscopic views showing the first line of staples beginning 3-4 cm proximal to the pylorus. **C;** Endoscopic view showing the staple-line after multiple firings. **D;** Endoscopic view showing methylene blue dye injection into the stomach along the staple-line.

Fig. 2: Laparoscopic view showing a negative air leak test after immersing the staple-line in saline and insufflating the gastric sleeve tube with air.

In all patients, a Gastrographin meal was performed on postoperative day (POD)1. Oral fluids were started, if tolerated, after confirming that there was no gastric leak on the contrast study. On POD3, the abdominal drain was removed and the patient was discharged home as long as there were no complications. All patients returned for their first outpatient-clinic appointment 12 days postoperatively. During the first month, patients were placed on a liquid-only diet. This was advanced to a semi-solid diet for two weeks, then mashed food for another two weeks. After that, a regular healthy diet was started.

The potential benefits of the *"Laparo-endoscopic Rendezvous"* technique, difficulties encountered, as well as operative time and postoperative complications were all observed in the study group **(Table 2)**. Values in our study were expressed as means and standard deviations (mean ± SD) or as numbers (%). A descriptive data analysis was then conducted, however, in view of the small number of patients enrolled in our study, statistical evaluation of the results was not feasible.

Table 2: Items observed in all cases of our study group.

Potential benefits	▪ Intra-operative identification of staple-line leak through assessment of air tightness and water tightness of the staple-line as well as direct visualization of the staple-line. ▪ Intra-operative identification of staple-line bleeding (either from the intraluminal side of the staple line through the endoscope or from the extraluminal side through the laparoscope). ▪ Intra-operative assessment of the staple-line position to detect any mal-alignment or deviation of the staple line whether anteriorly or posteriorly, which may result in twisting of the gastric sleeve. ▪ Intra-operative identification of any anatomical abnormalities of the gastric sleeve tube after gastric transection e.g. stenosis, kinking. ▪ Advantages of the UGI endoscope over the bougie.
Difficulties encountered	▪ Logistical difficulties encountered during the process of arrangement for the procedure. ▪ Technical difficulties encountered during the procedure itself.
Operative time	
Postoperative complications	e.g. staple-line leak, bleeding, stenosis.

UGI = Upper Gastrointestinal

RESULTS

Patients ranged in age from 14 to 36 years (mean, 26.2 years ± 5.821 SD) and included 14 adults and one 14-year old adolescent. The male-to-female ratio was 5:10. Preoperative BMI ranged from 42.3 to 54.5 Kg/m^2 (mean, 49.113 Kg/m^2 ± 3.596 SD) **(Figure 3)**. Preoperative obesity-related co-morbidities included hyperlipidemia in 3 patients (20%), hypertension in 2 patients (13%) and lumbar disc prolapse in 1 patient (7%).

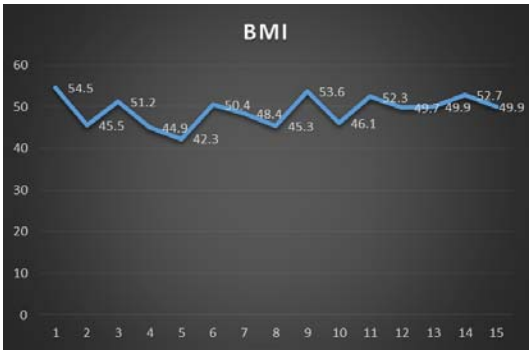

Fig. 3: Line chart of preoperative body mass index (BMI) distribution in the study group *(BMI = Body Mass Index).*

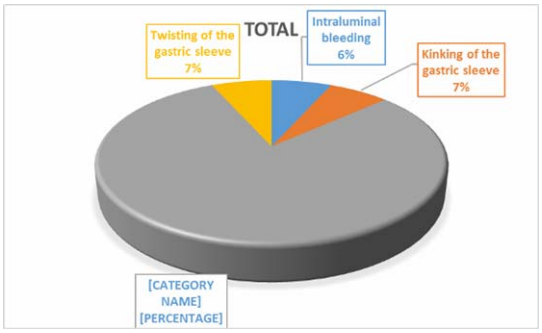

Fig. 4: Pie chart of intra-operative problems encountered in the study group *(Intra-op. = Intra-operative).*

In all our study cases, the intra-operative staple-line leak tests were negative. However, three intra-operative problems were encountered in our study group **(Figure 4)**. In one case, intra-luminal bleeding from the staple line was detected by the endoscopist but this was minor bleeding that stopped spontaneously. In another case, a twist of the gastric sleeve tube was observed endoscopically after firing of the first 2 staplers. This was attributed to asymmetrical transection of the anterior and posterior walls of the stomach. Subsequent firings were then carefully carried out with symmetrical gastric transaction in order to overcome the gastric sleeve twist. In a third case, the endoscopist faced some difficulty while attempting to re-introduce the endoscope through the stoma of the gastric sleeve tube, after firing of the first stapler. We thought that the stomach was stapled across till the lesser curvature and that we would need to convert to a gastric bypass. However, we observed that there were some retro-gastric adhesions (between the stomach and the pancreas) causing some kinking of the gastric sleeve. Following laparoscopic lysis of those adhesions, the endoscope was allowed to pass smoothly through the gastric sleeve till the duodenum. A stenosis of the gastric sleeve tube was thus ruled out.

The operative time using this evolving technique ranged from 100 to 180 minutes (mean, 134.3 min ± 21.86 SD) **(Figure 5)**. No postoperative complications (e.g. gastric leakage, bleeding, stenosis) were reported in the study group. However, only some mild, self-limited, postoperative symptoms / signs were observed. Postoperative vomiting occurred in 4 cases (27%). This improved with proton pump inhibitors and anti-spasmodics (to decrease the intra-gastric pressure) in the 4 cases. Postoperative pyrexia was observed in 2 cases (13%), ranging from 37.5 to 38.1 ºC. This resolved in both cases, with the use of antipyretics, within the first 48 hours postoperatively. The overall gastric leak rate was 0% in the study group.

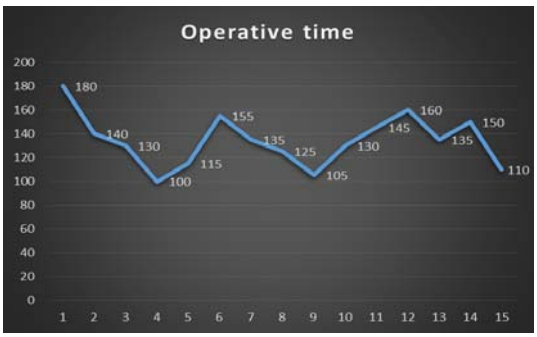

Fig. 5: Line chart of operative time in the study group.

DISCUSSION

Laparoscopic sleeve gastrectomy has been recently gaining popularity over other bariatric procedures[11-13]. Advantages of LSG include low complication (3-24%) and mortality (0.39%) rates, ease of performing the procedure, preservation of the pylorus, maintenance of physiological food passage and avoidance of foreign material [14-17].

Anastomotic/staple-line leak remains the most dreaded technical complication of bariatric surgery[18]. Many different intra-operative techniques have been used to decrease the incidence of leaks. Over-sewing staple lines, buttressing materials for the staple-line, and fibrin glue have been used, but there is no evidence that these methods reliably decrease the leak rates after bariatric surgery [19]. In laparoscopic Roux-en-Y gastric bypass (LRYGB), several techniques have been utilized to identify potential anastomotic leaks. One of those involves the injection of methylene blue dye near the gastrojejunal anastomosis via a nasogastric tube. In the case of an inadequate anastomosis, methylene blue dye will leak out of the anastomosis, and can be easily identified by the surgeon. However, after repair of the anastomotic leak, the surgeon will not be able to use methylene blue again as the field becomes contaminated with blue dye. Consequently, the use of intra-operative UGI endoscopy in identifying potential anastomotic leaks in LRYGB has been evolving. Intra-operative endoscopy allows for visualization of the upper gastrointestinal tract and assessment of the gastrojejunal anastomosis by immersing it in saline and clamping the Roux limb, then insufflation with air. Bubbles escaping from the anastomosis indicate a leak [20-22]. Additionally, endoscopy has the added benefit of allowing multiple leak checks and direct visualization of the anastomosis [23].

In a retrospective review of a series of primary and revisional RYGB and LSG [444 cases (299 RYGB and 145 LSG)], IOE was performed in 100% of the cases to check for leak, bleeding or stenosis at the end of the operation using a 32-Fr endoscope [24]. The intra-operative leak test was positive in 6/299 RYGB cases (2%), compared to 0/145 LSG cases (0%). There were 3/299 (1%) clinical leaks after RYGB, but no leaks after LSG. In addition, IOE with LSG detected 3 cases where the gastric sleeve was too tight, and sutures were removed to correct the size or configuraton of the gastric sleeve. Postoperatively, no cases of gastric sleeve stenosis or twist were reported in the LSG group. Thus, IOE has allowed the study group to immediately deal with intra-operatively encountered problems during RYGB and LSG, leading to low leak and stenosis rates.

In our study, in view of the descriptive data analysis, the *"Laparo-endoscopic Rendezvous"* technique allowed for assessment of the integrity of the staple-line by methylene blue test, air leak test, as well as direct visualization of the staple-line. Additionally, endoscopy had the added benefit of allowing multiple leak checks. The intra-operative staple-line leak tests were negative in all of our study cases, and no subsequent staple-line leaks were identified postoperatively. The *"Laparo-endoscopic Rendezvous"* technique has also proved helpful for intra-operative detection of some potential LSG complications. This, in turn, has allowed us to immediately deal with such problems intra-operatively. Three intra-operative problems were encountered in our study group [Intra-luminal bleeding (n=1), twisting of the gastric sleeve (n=1) and kinking of the gastric sleeve (n=1)]. The event of intra-luminal bleeding has alerted us to the fact that bleeding might arise from the entire thickness of the staple-line, thus might occur into the lumen of the stomach without necessarily causing extra-luminal bleeding. Although the bleeding in our case was minor and stopped spontaneously, we believe that, if significant intra-luminal staple-line bleeding was encountered during LSG, intra-operative endoscopic control of bleeding in such case could be one of the potential advantages of the *"Laparo-endoscopic Rendezvous"* technique. In the second case, observing a twist of the gastric sleeve intra-operatively after firing of the first 2 staplers has alerted us to carefully carry out subsequent firings while ensuring symmetrical gastric transection in order to overcome the gastric sleeve twist. The endoscopic view of the staple line position has thus proved to be an additional useful indicator -beside the laparoscopic view- for the symmetry of gastric transection. In the third case, facing some difficulty while attempting to re-introduce the endoscope through the stoma of the gastric sleeve

tube, after firing of the first stapler, gave us an initial false impression of gastric sleeve stenosis. This endoscopic finding has forced us to stop the gastric transection and re-explore the operative field, thus observing some retro-gastric adhesions, causing kinking of the gastric sleeve. Laparoscopic adhesiolysis eventually solved the problem, and a stenosis of the gastric sleeve tube was ruled out. Therefore, the *"Laparo-endoscopic Rendezvous"* technique can serve as a useful guide for immediate intra-operative management of some potential LSG problems, either by the surgeon or by the endoscopist, thereby preventing postoperative morbidity. This is nearly consistent with the findings of Al Hadad et al in their recent series [24].

It has been clearly shown in our series that the UGI endoscope can be safely used to size and configure the gastric sleeve, thus serving the same function of the bougie. It can be introduced either at the beginning of the gastric transection or after firing of the first stapler on the bougie. The endoscope seemed to be even superior to the bougie in terms of the relative ease of introduction through the stomach and rapid advancement into the duodenal bulb.

On the other hand, performing LSG in our study using the*"Laparo-endoscopic Rendezvous"* technique was not free of difficulties. Generally speaking, the process of arrangement for the procedure was somehow logistically cumbersome. Arranging for a surgical procedure, in an operating room, with an endoscope, an endoscopist and a surgeon, all available at the same time, was not always easy. The main difficulty was usually related to the availability of the endoscope as we had to transfer it from the endoscopy unit to the operating room each time. In addition, the availability of an experienced endoscopist was crucial in order to avoid the potential hazards of IOE during LSG –resulting from distortion of the anatomy of the stomach during and after gastric transaction-, as well as to avoid damage of the endoscope during stapler firing.

In our study, the operative time was relatively long, ranging from 100 to 180 minutes (mean, 134.3 minutes ± 21.86). No doubt, performing a combined laparo-endoscopic procedure was more technically demanding than performing the purely-laparoscopic LSG procedure. In every case, we had to decrease the intensity of the light source of the laparoscope during IOE because the light of the laparoscope interfered with the quality of the endoscopic image. In addition, during introduction of the endoscope, the endoscopist had to insufflate the stomach to inspect it from within. This interfered with laparoscopic manipulation of the stomach and stapler application by the surgeon. The endoscopist also had to deflate the stomach before applying each stapler, a process which took some time. So, in some cases, we used to introduce the endoscope after firing of the first stapler in order to save some time.

Finally, we can conclude that, inspite of the logistical and technical difficulties that might be encountered with the use of IOE in conjunction with LSG, and the relatively long operative time, the *"Laparo-endoscopic Rendezvous"* is a safe and promising technique with several potential benefits. It allows for assessment of the staple-line integrity by methylene blue test, air leak test and direct visualization of the staple-line, besides the added benefit of allowing multiple leak checks. This can contribute to low gastric leak rates after LSG. In addition, it is a valuable tool for intra-operative detection and management of some potential LSG problems (e.g. intraluminal bleeding, twisting of the gastric sleeve, kinking of the gastic sleeve), either by the surgeon or by the endoscopist, thereby preventing postoperative morbidity. Our conclusion is nearly consistent with Diamantis et al [25] who suggested, in a 25-patients study series, that LSG with intra-operative endoscopic guidance is a safe and efficient alternative method to treat morbid obesity and a viable option for surgical units familiar with endoscopic techniques. However, a study with a larger sample size is still required in order to adequately evaluate this evolving technique and its potential role in improving LSG outcomes.

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