The Egyptian Journal of Hospital Medicine (October 2022) Vol. 89, Page 5350- 5355

Advantages of Laparoscopic Sleeve Gastrectomy with Intraoperative Endoscopic Guidance

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ABSTRAC
Background: For optimal safety following Laparoscopic Sleeve Gastrectomy (LSG), regular intraoperative endoscopy is recommended to prevent postoperative stenosis and gastric leak.
Objective: The aim of the present study is to assess the advantage of using intraoperative endoscopic guidance during sleeve gastrectomy and its efficiency to decrease various complications.
Patients and methods: A follow up case series study was conducted at Laparoscopic Gastrointestinal Surgery Unit, General Surgery Department of Zagazig University Hospitals. The study included 18 cases planned for laparoscopic sleeve gastrectomy.
Results: Operative time ranged from 2 to 3 hours with mean of 2.19 hours. Concerning intraoperative complications, no patient had bleeding. One patient had leak which was corrected by reinforcement suture. Another patient had twisting which was corrected. Postoperatively, all patients did not develop leak, bleeding or obstructive symptoms. Two (11.1%) patients had postoperative vomiting which was corrected by prescribing antiemetics. There were no statistically significant associations between incidence of intra/postoperative complications and either age, weight, body mass index, operative time or comorbidities.
Conclusion: Important complications after LSG, such as bleeding or even deadly ones like gastric leak, can be avoided with the help of an endoscope, which is used during the calibration of the gastric sleeve.
Keywords: Laparoscopic Sleeve Gastrectomy, Intraoperative Endoscopic Guidance, Leak, Bleeding.

INTRODUCTION

The development and success of bariatric surgery can be directly attributed to the increasing prevalence of obesity and the large number of people who fail to lose weight while participating in medically supervised weight loss programs. Bariatric surgery has progressed from its original focus on weight loss to include health benefits [(1)].

Hess and Marceau were the first to provide a description of the laparoscopic sleeve gastrectomy (LSG) [(2)], during the procedure of biliopancreatic division and duodenal switch. LSG is the most common bariatric procedure performed today. A large amount of weight can be lost in a relatively short time with this easy, low-cost technique, and the risks involved are minimal [(3)].

There are immediate, intermediate, and long-term risks associated with LSG. Gastric leak, bleeding, blockage, abscess formation, and infection are all considered to be early problems. Fistula formation, stenosis, weight regain, dietary inadequacies, and gastroesophageal reflux disease (GERD) are all examples of difficulties that can arise in the later stages of treatment [(4)].

Asymptomatic benign disorders (such as peptic ulcers or hiatus hernias) or premalignant (such as Barrett's oesophagus) or malignant (like gastric or esophageal cancer) lesions can be detected with routine preoperative endoscopic screening [(5)].

Because of the intraoperative endoscope's bright illumination, we can see how close we are to the lesser curvature, which improves our ability to precisely position the instrument. In addition to the stomach, the endoscope can be fixed in the early section of the duodenum, and after a brief retraction, it will remain in this position for the duration of the treatment [(6)].

Easily check the stomach tube for leaks or bleeding at the end of the procedure by looking at the inner surface of the steady line. The perigastric region and the leftover stomach can be carefully insufflated to look for leak spots in the steady line. Leak testing prior to dye injection into the stomach residual is preferred [(7)].

For the prevention of postoperative stenosis and gastric leak, two significant problems following LSG, **Nimeri and colleagues** [(8)] advocated for the routine use of intraoperative endoscopy. Endoscopy is carried out after the transection of the stomach to check for leak, hemorrhage, or stenosis, and a 32-Fr endoscope is utilized as a bougie at the outset of the process. As a result, normal intraoperative endoscopy can be incorporated into surgical operations without significantly increasing the duration or expense of the surgery [(9)].

The aim of the present study was to assess the advantage of using intraoperative endoscopic guidance during sleeve gastrectomy and its efficiency to decrease various complications.

PATIENTS AND METHODS

A follow up case series study was conducted at Laparoscopic Gastrointestinal Surgery Unit, General Surgery Department of Zagazig University Hospitals. The study included 18 cases planned for laparoscopic sleeve gastrectomy.

Received: 13/06/2022
Accepted: 21/08/2022

Inclusion criteria: Between the ages of 18 and 60, both sexes, and BMI 40kg/m2 or 35kg/m2 with comorbidity.

Exclusion criteria: Persons younger than 18 or older than 60, Obese patients with major cardiac, respiratory, renal, or hepatic comorbidities interfering with anesthesia or laparoscopy, Patients with previous upper gastrointestinal tract surgeries, and Patient not fitted for bariatric surgery.

All patients were subjected to:

A. History taking: Full clinical history taking was obtained from each patient with special emphasis on the presenting symptoms.

B. Clinical Examination: Both general and local examinations were performed to every patient. Patients diagnosed with stricture by clinical verified by upper gastrointestinal endoscopy (UGI endoscopy) symptoms include food aversion, dysphagia, and vomiting. Patients diagnosed with GERD by clinical symptoms include heartburn and regurgitation and confirmed by endoscopy.

C. Laboratory and interventional investigations: Blood Group, Complete Blood Count, Random Blood Sugar, Renal Function Test, Serum Electrolyte, Liver Function Test, coagulation profile, thyroid function test, cortisol level and virology.

D. Pelvic and abdominal ultrasound.

E. Chest X ray.

F. Pulmonary Function Tests if indicated (history of bronchial asthma or breathing difficulty) recommending from anesthesia or chest consultation.

Operative steps:

- Antiembolic precautions (as low molecular weight heparin and elastic stocking) are taken, and appropriate preoperative antibiotics are administered.
- Gastroscope (Pentax company) done to detect any cause postpone or against sleeve, if endoscopy of the patient is fit procedure continued.
- Using direct visualization, a 12mm Frist trocar (optical trocar) is inserted 15 cm below the xiphoid and 3 cm to the left of midline.
- After inserting the first trocar, a second trocar of the same size (12 mm) is positioned in a straight line with the first at the right midclavicular point.
- The third trocar, a 12 mm instrument, is inserted along the left costal margin, at the level of the midclavicular line.
- When the liver needs to be raised, a trocar of 5 mm is inserted in the epigastric region.
- A final 5mm trocar is inserted in the left anterior axillary line at the costal border.

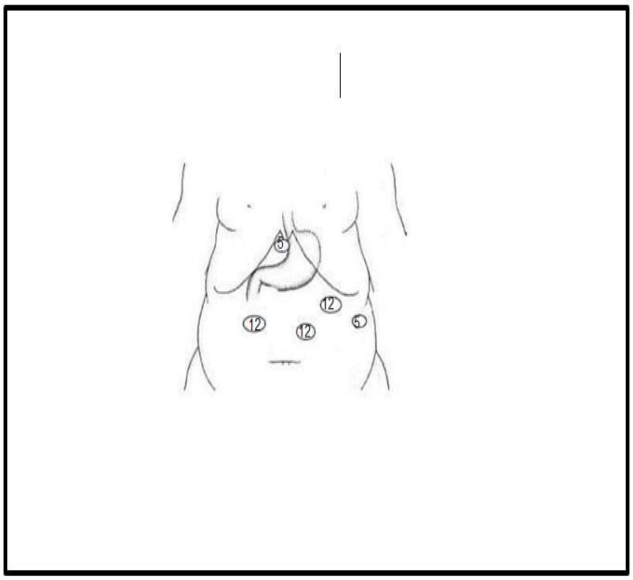

Figure (1): Trocar placement for the laparoscopic sleeve gastrectomy.

Because the liver is at a higher level, the entire stomach may be seen clearly during the gastrectomy. The stomach's pylorus was then located, and the stomach's bigger curve was brought to a higher position.

- After cutting through the greater omentum to access the greater sac, an ultrasonic scalpel (Laparoscopic Tissue Sealer G2, Ethicon Endo-Surgery firm) was utilized. The laparoscopic ultrasonic scalpel was then used to dissect the stomach's larger curvature free of the omentum and the short gastric blood veins.
- Dissection began 5 cm from the pylorus and continues to the Angle of Hwas. After that, a 10 mm gastroscope (32 Fr bougie) was inserted down the esophagus, across the stomach, and into the first part of the duodenum via direct invasion. With the gastroscope positioned along the stomach's lower curvature as a guide, a vertical sleeve gastrectomy was performed, starting 5 cm proximal to the pylorus and continuing all the way to the Angle of Hwas.
- A linear endoscopic cutting stapler was utilized to transect the stomach in a series of staples while staying to the endoscope's left and side. Using the endoscope, the gastrectomy was visualized in real-time. Left flank port incision was used to completely liberate the transected stomach, including the larger curvature, from the peritoneum.
- The gastroscope was used to check for leaks in the staple line through the remaining tubularized stomach by insufflating the stomach from the outside.
- In parallel, the staple line was checked for bleeding, thrombosis, and stenosis both intraperitoneally with the laparoscope and intraluminal with the gastroscope.
- Following sleeve gastrectomy, a 20-French Blake

drain was placed in the upper left abdominal area, next to the staple line. In order to prevent bowel herniation, we close the fascia at the left flank port site using a transabdominal suture passer and absorbable suture.

Postoperative steps:

(a) Careful observation of the patient to early detection of any complications (bleeding, leakage, stenosis or twisting) with postoperative instructions (appropriate oral intake, oral proton pump inhibitors and vitamin supplementations).
(b) Routine bariatric labs for nutrient deficiencies (vitamin B1, B2, B3, B5, B6, B7, B12, vitamin D, ascorbic acid, iron, folic acid, calcium, magnesium, and zinc) were evaluated.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 20 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro-Walk test. Qualitative data were represented as frequencies and relative percentages. Pearson Chi-Square and Chi-Square for Linear Trend (X^2) were done to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed in the form of the mean, median, standard deviation, and confidence intervals. Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P-value <0.05 was considered significant.

RESULTS

Eighteen patients who had LSG under intraoperative endoscopic guidance were included in this study. All of them were females with age range from 28 to 58 years with mean age 41.22 years (**Table 1**).

Table (1): Demographic data of patients who had Laparoscopic Sleeve Gastrectomy.

Variable	N=18	%
Gender: Female	18	100%
Age (year): Mean ± SD Range	41.22 ± 8.24 28 – 58	

Patients' weights ranged from 102 to 125 kg with mean weight 112.94 kg. Body mass index ranged from 40 to 43.5 kg/m2 with mean age 41.51 kg/m2 (Table 2).

Table (2): Anthropometric data of patients who had Laparoscopic Sleeve Gastrectomy.

Variable	Mean ± SD	Range
Weight (kg)	112.94 ± 6.76	102 – 125
Height (cm)	165.28 ± 5.29	153 – 173
BMI (kg/m2)	41.51 ± 1.14	40 – 43.5

Table 3 summarizes the comorbidities of the participants.

Table (3): Comorbidities of patients who had Laparoscopic Sleeve Gastrectomy.

Variable	N=18	%
Comorbidities:		
Absent	12	66.6%
Diabetes	2	11.1%
Hypertension	1	5.6%
Diabetes and hypertension	2	11.1%
Osteoarthritis	1	5.6%

Operative time ranged from 1.5 to 2.5 hours with mean 1.75 hours. Concerning intraoperative complications, no patient had bleeding. One patient had leak which was corrected by reinforcement suture. Another patient had twisting which was corrected by fixation to retroperitoneum.

Table (4): Distribution of the studied patients according to intraoperative data.

Variable	N=18	%	Additional procedure
Leak: Absent Present	 17 1	 94.4% 5.6%	 Reinforced by suture
Bleeding Absent	 18	 100%	 ----------
Twisting: Absent Present	 17 1	 94.4% 5.6%	 Fixed to retroperitoneum
Operating time (hour) Mean ± SD Range	1.75 ± 0.35 1.5 – 2.5		

Patients were followed up for post-operative complications. All patients did not develop leak, bleeding or obstructive symptoms. Two (11.1%)

patients had postoperative vomiting which was corrected by prescribing antiemetics (**Table 5**).

Table (5): Distribution of the studied patients according to postoperative data.

Variable	N=18	%
Leak: Absent	18	100%
Bleeding Absent	18	100%
Obstructive symptoms: Absent	18	100%
Vomiting: Absent	16	88.9%
Present **(antiemetic)**	2	11.1%

There were no statistically significant associations between incidence of intra/postoperative complications and either age, weight, body mass index, operative time or comorbidities

Table (6): Relation between incidence of complications and baseline data of the studied patients.

Variable	Complicated (n=4)	Non-complicated (n=14)	P-value
	Mean ± SD	**Mean ± SD**	
Age (year)	39.0 ± 10.89	41.86 ± 7.72	0.557§
Weight (kg)	109.0 ± 4.08	114.07 ± 7.05	0.194§
BMI (kg/m^2)	41.54 ± 0.998	41.54 ± 1.21	0.804§
Operative time (hours)	1.88 ± 0.48	1.71 ± 0.32	0.439§
Comorbidities			
Absent	3 (75%)	9 (64.3%)	
Diabetes	0 (0%)	2 (14.3%)	
Hypertension	0 (0%)	1 (7.1%)	>0.999¥
Diabetes and hypertension	1 (25%)	1 (7.1%)	
Osteoarthritis	0 (0%)	1 (7.1%)	

DISCUSSION

In order to prevent postoperative stenosis and gastric leak, two primary consequences of LSG, **Nimeri and colleagues [10]** advocated for the routine use of intraoperative endoscopy. Endoscopy is carried out after the transection of the stomach to check for leak, hemorrhage, or stenosis, and a 32-Fr endoscope is utilized as a bougie at the outset of the process.

In conclusion, routine intraoperative endoscopy can be incorporated into surgical operations without significantly increasing either the duration or cost of the surgery **[11].**

Eighteen individuals who had LSG under intraoperative endoscopic guidance were included in this study. All of them were females with age range from 28 to 58 years with mean age 41.22 years.

Andreas *et al.* [12] had a study on 100 morbidly obese patients have had LSG with intra-operative endoscopy at our clinic. Among the patients, 21 were males and 79 were females.

In line with our results regarding age, **Diamantis *et al.* [13]** had a study on 7 (28%) men and 18 (72%) women were among the 25 patients who underwent LSG with the aid of intra-operative endoscopy. They averaged 40.2-2.35 years old (ranging from 20 to 59).

The current study reported that weight of the studied patients ranged from 102 to 125 kg with mean weight 112.94 kg. Body mass index ranged from 40 to 43.5 kg/m^2 with mean of 41.51 kg/m^2.

Our results were in agreement with **Minhem *et al.* [14]** who showed that mean age of cases with endoscoped LSG was 45.8 kg/m^2.

Concerning comorbidities in our study, 12 (6.7%) patients had no comorbidities, 11.1% had comorbid diabetes, 5.6% had comorbid hypertension, and 11.1% had comorbid diabetes and hypertension.

In the same line with the current study, **Diamantis *et al.* [13]** reported in their cases series, 8% had comorbid diabetes, and 24% had comorbid hypertension.

Our results showed that operative time ranged from 2 to 3 hours with mean 2.19 hours. Concerning intraoperative complications, no patient had bleeding. One patient had leak which was corrected by reinforcement by suture. Another patient had twisting which was corrected by fixation to retroperitoneum.

Andreas *et al.* [12] revealed the absence of any religious conversions. There were no deaths or complications during surgery. Average operative time was 114 minutes. Only one patient required an ICU overnight stay. Regarding the operation time, their study showed less operation time than ours, this could be as they used both minimally invasive sleeve gastrectomy laparoscopically and robotically

In agreement with the present study **Hassan *et al.* [11]** found that 2 cases had showed intraoperative leak that was managed successfully intraoperatively by over suturing and omental patch. One case had mild twisting at the incisura angularies that was managed by fixing the twisted angle to the retroperitoneum. Two cases had marked internal bleeding from the staple line which necessitated endoscopic clip insertion for one case and epinephrine injection for the other.

The current findings revealed that patients were followed up for post-operative complications. All patients did not develop leak, bleeding or obstructive symptoms. Two (11.1%) patients had postoperative vomiting which was corrected by prescribing antiemetics.

On the other hand, **Yuval *et al.*** [15] we looked at 32 different LSG series and found that bougie sizes ranged from 28Fr to 60Fr, with the bigger sizes being linked to less post-operative leak from the staple line and no difference in weight loss.

In contrast to the present study **Moszkowicz *et al.*** [16] showed that common postoperative symptoms associated with gastric leak include epigastric discomfort, fever >37.5 °C, tachycardia >120 bpm, leukocytosis >10,000/mm3, and CRP >10 mg/L. The percentages for those who migrated early are as follows: 23% for those who experienced early migration, 3% for those who had intolerance with pain and vomiting, and 2% for those who experienced success.

Minhem *et al.* [14] showed endoscoped LSG patients had lower sepsis rate 0.21%, prolonged hospital stay 14.0%, unplanned reoperation 0.38%, and composite complications 1.17%.

When using smaller bougies, there is a real danger of staple line leakage, although we did not experience this. Leakage from the staple line after surgery and the size of the gastric remnant are not directly related to the diameter of the stent used to measure the stomach. Tension or ischemia to the stomach wall along the staple line, was caused by factors like how tightly the surgeon applies the stapler along the stent or the application of reinforcing sutures that further narrow the gastric remnant, can be crucial in determining whether or not a leak occurs.

The increased incidence of GERD during the first post-op year, including worsening of pre-existing symptoms and the emergence of new ones, has been cited as a drawback of LSG [17].

Intraoperative endoscopy has been shown to reduce the likelihood of postoperative complications following laparoscopic sleeve gastrectomy, including infections, unexpected reoperations, prolonged hospital stay, and composite problems [14].

The endoscopic light shines through the stomach wall and may help guide the stapling instruments to the correct location. Few problems, like as iatrogenic damage and lacerations, have been observed despite the use of IOE in bariatric surgery [18].

Our findings showed that there was statistically non-significant relation between incidence of intra/postoperative complications and either age, weight, body mass index, operative time or comorbidities.

Patel *et al.* [19] anastomotic leak, which occurred in 13.2% (n=20/151) of patients in a recent series of bariatric re-interventions, was found to be the primary cause of the increased morbidity.

In conclusion, important complications after LSG, such as bleeding or even potentially deadly issues like gastric leak, can be avoided with the help of an endoscope, making its usage essential not just for the calibration of the gastric sleeve. When used routinely, intraoperative endoscopy is a useful tool that can be included into surgical procedures without significantly increasing operating times.

Conflict of interest: The authors declare no conflict of interest.
Sources of funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
Author contribution: Authors contributed equally in the study.

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