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Original Article

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Early Clinical Outcomes of the Morbidly Obese Patients Who Underwent Laparoscopic Sleeve Gastrectomy by Gastric Cancer Surgeons: the Analysis of Fifty Consecutive Cases

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ABSTRACT

Purpose: The number of bariatric surgeries performed at our tertiary hospital has gradually increased since the national health insurance began to cover their expenses in January of 2019. This study examined the early surgical outcomes of laparoscopic sleeve gastrectomy (LSG) performed by experienced gastric cancer surgeons.
Materials and Methods: We retrospectively reviewed and analyzed data from 50 patients who underwent LSG between November of 2018 and April of 2020 at the Asan Medical Center by 1 of 5 experienced surgeons each of whom performed approximately 100–300 cases of gastrectomy annually. The age, body mass index (BMI), weight, presence of comorbidities, operation time, hospital stay after surgery, postoperative complications, postoperative excess weight loss (EWL), and resolution of comorbidities were examined.
Results: The mean age, BMI, and weight were 37.29±9.77 years, 37.12 kg/m^2, and 102.00 kg, respectively. The mean operation time and postoperative length of hospital stay were 109.59±35.88 and 5.06±1.20 days, respectively. Two patients (4.00%) had early postoperative complications and postoperative leakage; bleeding and stenosis were not reported. The EWL after 1 and 6 months of operation was 26.55% and 60.34%, respectively. The resolution of diabetes, hypertension, and dyslipidemia after 6 months of operation was 88.89%, 54.54%, and 50.00%, respectively.
Conclusion: LSG is safe and effective when performed by an experienced gastric cancer surgeon; however, a long-term follow-up of patients is required.

Keywords: Laparoscopic surgery; Bariatric surgery; Morbid obesity; Diabetes mellitus

INTRODUCTION

Laparoscopic sleeve gastrectomy (LSG) is a procedure that induces weight loss by eliminating the greater curvature of the stomach from the antrum to the fundus. This restrictive procedure leaves behind a narrow gastric tube. LSG was first introduced in the 1990s as part of the duodenal switch operation or the first stage of the two-stage duodenal switch

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Conflict of Interest
None of the authors have any conflict of interest.

Author Contributions
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Kim BS[1], Beom Su Kim; Kim BS[2], Byung Sik Kim.

operation in patients with extreme obesity and high surgical risk [1,2]. The use of LSG has gradually increased because it is technically simple, less invasive, has fewer complications, and causes effective weight loss [3,4]. Recent multicenter randomized clinical trials have shown no difference in the 5-year follow-up when comparing laparoscopic Roux-en-y gastric bypass and LSG [5,6].

In Korea, bariatric surgery was performed in private clinics, and the number of bariatric surgeries increased until 2013 [7]. However, the death of a celebrity who underwent bariatric surgery in 2014 became a social issue, causing the number of bariatric surgeries to decline rapidly. However, when the national health insurance began to cover this procedure from January of 2019, it led to an increase in the surgeries performed in university hospitals and private clinics. In November of 2018, we performed LSG for a foreign patient, followed by 50 patients with morbid obesity and metabolic disease in our hospital. In this study, we analyzed the early surgical experiences and effectiveness of LSG for weight loss and comorbidities in this patient cohort.

MATERIALS AND METHODS

1. Patients

We retrospectively reviewed data from 50 consecutive patients who underwent LSG by 1 of 5 surgeons each of whom performed approximately 100–300 cases of gastrectomy annually between November of 2018 and April of 2020 at Asan Medical Center. All patients that enrolled in this study underwent laboratory tests, esophagogastroduodenoscopy, computed tomography (CT), and bioelectric impedance analysis. Clinical pathway was used to manage patients during their postoperative hospital stay. The patients were started on a liquid diet on postoperative day 2 and were discharged without complications on postoperative day 5. The patients were followed up regularly at 2 weeks and 3, 6, 9, 12, 18, and 24 months postoperatively.

Patient characteristics, including the age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, comorbidities, history of abdominal surgery, history of bariatric surgery, and combined operations, were examined. Clinical diagnosis and treatment by an associated physician defined each comorbidity. Reflux esophagitis was evaluated according to the Los Angeles (LA) grade. Surgical outcomes, such as operation time, time to first flatus, time to liquid diet, intra-and postoperative transfusion, postoperative pain score, intraoperative events, length of hospital stay after surgery, reoperation within 30 days of surgery, mortality within 30 days of surgery, and postoperative complications were included in the analysis. Based on whether the complications occurred within or after 30 days of surgery, the postoperative complications were classified into early and late complications, respectively. The severity of the postoperative complications was scored using the Clavien-Dindo classification (CDC) [8]. In addition, excess weight loss (EWL) and the resolution of comorbidities were examined 6 months after surgery. Resolution of comorbidities was labeled as “resolved” (no further medication was needed), “improved” (medication could be reduced), or “not responsive” (the level of medication needed remained the same) after the visit by an endocrinologist or physician.

This study was approved by the Institutional Review Board of our center (2020-0537).

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2. Surgical procedure

The operator used energy devices to divide the various branches of the gastroepiploic vessels close to the gastric wall of the greater curvature, from the antrum to the angle of His. The posterior fundus was fully mobilized, dividing the adhesions in the lesser sac and anterior to the pancreas. Next, the left crus was exposed to detect any hiatal hernia. Any fat tissue near the gastro-esophageal junction was mobilized to better examine this area so that it could be stapled appropriately. A bougie was introduced trans-orally (36 Fr) and positioned abutting the lesser curvature. Stapling began 4–6 cm proximal to the pylorus along the lateral section of the bougie. Following this, the anesthesiologist manipulated the bougie to ensure that it could freely move in and out. The last stapling was performed approximately 1 cm from the angle of His. After removal of the specimen, the staple line was reinforced to decrease bleeding and leakage.

RESULTS

Table 1 displays the clinical characteristics and comorbidities of the patients included in our study. The mean age and BMI were 37.29 years and 37.12 kg/m^2, respectively. The median weight was approximately 102.00 kg. Preoperative ASA scores of II and III were

Table 1. Patients clinical characteristics and comorbidities

Variable	Value
Age (years)	37.29±9.77
Sex	
Male	23 (46.00)
Female	27 (54.00)
BMI (kg/m^2)	37.12 (30.27–58.73)
Weight (kg)	102.00 (75.40–190.50)
ASA score	
II	41 (82.00)
III	9 (18.00)
History of abdominal surgery	
No	39 (78.00)
Yes	11 (22.00)
History of bariatric surgery	
No	50 (100.00)
Yes	0 (00.00)
Combined surgery	
No	39 (78.00)
Yes	11 (22.00)
Number of comorbidities (number, mean ± SD)	2.47±1.42
Presence of diabetes	
No	30 (60.00)
Yes	20 (40.00)
Presence of hypertension	
No	21 (42.00)
Yes	29 (58.00)
Presence of dyslipidemia	
No	27 (54.00)
Yes	23 (46.00)
Presence of depression	
No	38 (76.00)
Yes	12 (24.00)
Presence of reflux esophagitis	
No	39 (78.00)
Yes	11 (22.00)

Values are expressed as mean±standard deviation, median (interquartile range), or number (%).
BMI = body mass index, ASA = American Society of Anesthesiologists.

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seen in 41 (82.00%) and 9 (18.00%) patients, respectively. Eleven patients (22.00%) had previously undergone abdominal surgery, and eleven (22.00%) had undergone combined surgery. None of the patients had previously undergone bariatric surgery. The mean patient comorbidity rate was 2.47 ± 1.42 comorbidities. Twenty (40.00%) and twenty-nine (58.00%) patients had diabetes and hypertension, respectively. In addition, twenty-three (46.00%), twelve (24.00%), and eleven (22.00%) patients had dyslipidemia, depression, and reflux esophagitis, respectively. Furthermore, the fatty liver of approximately 60% of patients was identified by preoperative CT. One patient had coronary artery disease, and eleven patients suffered from sleep apnea. None of the patients had asthma or degenerative arthritis.

Preoperative endoscopic evaluation was performed for all patients who underwent LSG. Postoperative endoscopy was performed in 62% of patients according to the patient's symptoms or the physician's follow-up protocol. Of the 11 patients who had reflux esophagitis on preoperative evaluation, the reflux esophagitis grade of LA-M was observed in 7 patients, LA-A in 2 patients, and LA-B in the remaining patients. Among the 11 patients, 5 patients underwent endoscopy after bariatric surgery, and among them, the reflux esophagitis on endoscopy of 3 patients worsened after surgery.

Table 2 shows the early surgical outcomes of the LSG. The mean operation length was 109.59±35.88 minutes and mean hospital stay was 5.06±1.20 days after surgery. There were no

Table 2. Early surgical outcomes

Variable	Value
Operative time (minutes)	109.59±35.88
Time to first flatus (days)	2.21±0.68
Time to liquid diet (days)	2.06±0.71
Transfusion during surgery	
No	50 (100.00)
Yes	0 (0.00)
Transfusion after surgery	
No	50 (100.00)
Yes	0 (0.00)
Pick of pain score	6.33±2.26
Operation day 11 pm	3.33±1.49
POD #1 8 am	3.10±1.27
POD #3 8 am	2.17±1.23
Administration of analgesics	2.57±2.70
Hospital day after surgery (days)	5.06±1.20
Reoperation within 30 days of surgery	
No	50 (100.00)
Yes	0 (0.00)
Readmission within 30 days of surgery	
No	49 (98.00)
Yes	1 (2.00)
Mortality within 30 days of surgery	
No	50 (100.00)
Yes	0 (0.00)
Early complications	2 (4.00)
≥3 CDC complications	1 (2.00)
Wound complications	1 (2.00)
Diabetic ketoacidosis	1 (2.00)
Late complications	3 (6.00)
≥3 CDC complications	2 (4.00)
Incisional hernia	3 (6.00)

Values are expressed as mean±standard deviation or number (%).
POD = postoperative day, CDC = clavien-dindo classification.

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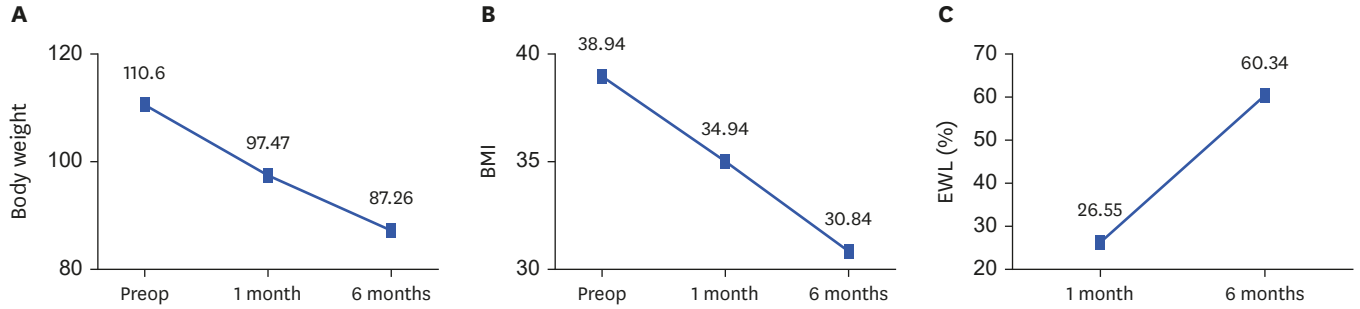

Fig. 1. Changes in body weight, BMI, and EWL after surgery. (A) Mean body weight preoperatively, 1 month, and 6 months after surgery. (B) Mean BMI preoperatively, 1 month, and 6 months after surgery. (C) Mean percent EWL at 1 and 6 months.
BMI = body mass index, EWL = excess weight loss.

intraoperative events, including conversion to laparotomy, in this patient cohort. The times to first flatus and liquid diet were 2.21±0.68 and 2.06±0.71 days, respectively. None of the patients received a transfusion during or after the surgery. The pain scores on postoperative days 0, 1, and 3 were 3.33±1.49, 3.10±1.27, and 2.17±1.23, respectively, which indicated a decrease over time. The pain score was 6.33±2.26 and the total number of administration of analgesics after surgery were 2.57±2.70. No reoperation or mortality occurred within 30 days of surgery; however, 1 patient was readmitted within 30 days of surgery.

Two patients (4.00%) reported postoperative early complications within 1 month and 1 patient (2.00%) reported ≥3 CDC complications. In addition, 3 patients (6.00%) reported late complications 1 month after surgery, 2 (4.00%) reported ≥3 CDC complications, and 3 (6.00%) reported incisional hernia. Patients with incisional hernia underwent herniorrhaphy. However, none of the patients exhibited postoperative fluid collection, bleeding, leakage, or stenosis.

Changes in the body weight, BMI, and EWL in 34 patients who had undergone LSG >6 months previously were analyzed; 27 (79.41%) and 25 (73.53%) patients completed follow-up at 1 month and 6 months, respectively. The mean body weight before surgery was 110.60 kg, which gradually decreased to 97.47 and 87.26 kg after 1 and 6 months of surgery, respectively (**Fig. 1A**). In addition, the BMI decreased over time from 38.94 preoperatively to 34.94 and 30.84 one and six months postoperatively, respectively (**Fig. 1B**). At 1 and 6 months after LSG, the median EWL was 26.55% (16.12–82.69) and 60.34% (29.75–141.44), respectively. EWL increased over time and was >60% after 6 months (**Fig. 1C**).

We measured the resolution of comorbidities in 25 patients who completed 6 months of follow-up after surgery (**Fig. 2**). Eight out of nine patients with diabetes no longer required medication, and one reported a reduction in dosage. Furthermore, six out of eleven patients no longer required hypertensive medication, and one reported a reduction in dosage. Five out of ten patients no longer required medication for dyslipidemia.

DISCUSSION

The current study demonstrated the effectiveness of LSG surgery performed by experienced gastric cancer surgeons in a tertiary hospital. We reported very few postoperative complications and favorable outcomes compared to previous studies, which have reported a range of EWL scores at 6 months after surgery (49.2–67.3%) [9-11].

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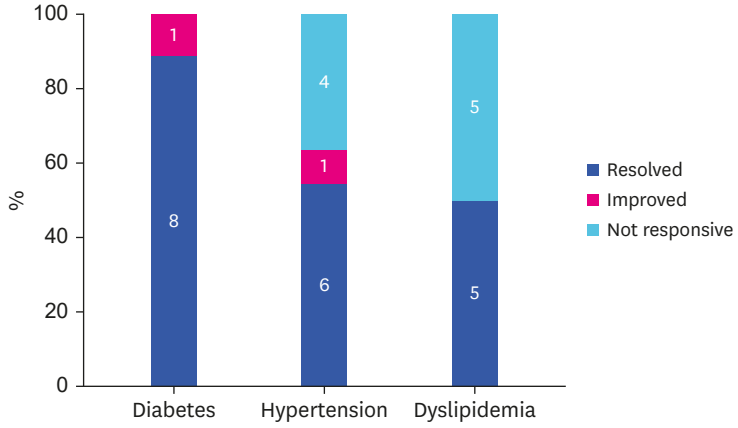

Fig. 2. Resolution of comorbidities at 6 months after surgery.

The Korean National Health Insurance Service included bariatric surgery on their list of appropriate procedures in January of 2019. This has led to many institutions regularly performing bariatric surgery, such as LSG and laparoscopic Roux-en-Y gastric bypass. Meanwhile, gastric cancer surgeons have plentiful experience with laparoscopic gastrectomy because of the relatively high incidence of gastric cancer in Korea.[12,13]. Due to the similarities between the two procedures (i.e. bariatric surgery and gastric cancer surgery), we hypothesized that bariatric surgery could be performed safely despite insufficient experience, which was verified in this study.

Several studies have reported a mean LSG surgery time of approximately 90 min, with an overall complication rate between 7% and 15% [14-16]. Major *et al.* reported that the stabilization point for the learning curve for LSG was 100 patients; the morbidity rate for the first 100 cases was approximately 13%, which decreased to 2–5% [15]. Another study proposed that >68 cases were necessary to ensure proficiency in LSG [16]. Casella et al. [14] showed no statistically significant differences in the operative data and complications between groups of young surgeons who were trained at a high-volume bariatric center for 2 years. The authors concluded that new bariatric surgeons who had long-term fellowships at a high-volume bariatric center could overcome the learning curve. However, there has been no report of the learning curve for LSG in East Asia, where laparoscopic gastric cancer surgery is widely performed. In this study, the mean surgery time was 109.59 minutes, which is longer than in previous studies; however, no intraoperative adverse events, reoperations, or mortality within 30 days of surgery were reported. Furthermore, we reported low early and ≥3 CDC complication rates, indicating that safe surgery is feasible despite early experience. This study included surgeons working in a high-volume center where 1,500 cases of gastric cancer surgery were performed annually. Furthermore, approximately 200 cases of laparoscopic gastrectomy are performed annually, which may explain the positive results of this study. Taken together, we have demonstrated that experienced gastric cancer surgeons can perform LSG safely without a learning curve; therefore, patients with morbid obesity and metabolic disease should be confident about undertaking this surgery at a high-volume center.

Patients with obesity have various underlying medical conditions that can be risk factors for complications that interfere with the postoperative recovery [17,18]. It is important to evaluate and manage these risk factors before and after surgery. In this study, preoperative cardiac ultrasound revealed dilated cardiomyopathy with an ejection fraction of 25% in

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one patient; therefore, we inserted an implantable cardioverter-defibrillator to control the accompanying arrhythmia. Pre-and postoperative management used a multidisciplinary approach, and the patient underwent surgery without any adverse events or complications. The patients were discharged after a routine recovery. In addition, one patient with end-stage renal disease who was undergoing hemodialysis and waiting for pancreas-kidney transplantation underwent LSG surgery without complications. Patients with high risk factors who undergo bariatric surgery require critical care or specialists and essential instruments for postoperative management. Therefore, treatment in tertiary referral hospitals is recommended because the staff there have treated many high-risk and severe patients. Furthermore, the medical staff have considerable experience with these cases, which is indicative of their surgical expertise.

Two cases had early post-surgical complications: one was a wound complication and one was a medical problem. The patient was discharged on postoperative day 5 without any further complications. However, on postoperative day 11, the patient was hospitalized in the intensive care unit (ICU) via the emergency room due to an altered mental status and general weakness. Following treatment with ventilator support and a continuous renal replacement therapy due to diabetic ketoacidosis, the patients were discharged. The patients undergoing bariatric surgery for type 2 diabetes in this institution were then advised to discontinue any sodium glucose co-transporter-2 inhibitor treatment to reduce the possibility of ketoacidosis. These results indicate that multidisciplinary consultations with the department of endocrinology and the ICU is significant in patients with morbid obesity and comorbidities.

The only late postoperative complication was incisional hernia, which occurred above the umbilicus in 3 patients. This may be due to surgical errors with less experience in bariatric patients. The occurrence of incisional hernia can be avoided in patients with obesity by applying different suture instruments to close their thick abdominal wall.

One important limitation of this study is the small sample size and short follow-up period. We assessed 50 patients who were followed up for less than 6 months after surgery.

CONCLUSION

Our study demonstrated favorable early surgical outcomes from LSG with few postoperative complications and no intraoperative events. Therefore, we concluded that LSG can be performed safely and effectively by experienced gastric cancer surgeons.

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