

Initial Experience with Laparoscopic Mini-gastric Bypass in Korean Obese Patients

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Purpose: To report our initial experience with laparoscopic mini-gastric bypass (LMGB) in Korean obese patients. **Materials and Methods:** From July 2016 to February 2018, 14 male patients underwent LMGB for morbid obesity at a single institution. Five trocars were placed in a U-shape formation and 1 trocar was placed at the epigastrium as a liver retractor; a window was created between the vagal nerve and lesser curvature at the gastric angle for entering the lesser sac; a narrow gastric tube (~100-120 ml volume) was made; a linear-stapled gastrojejunostomy was created after bypassing the jejunum 200 cm from the Treitz' ligament; and the Petersen defect was closed to prevent internal hernia. Patient demographics, operative time, estimated blood loss, postoperative hospital stay, complications, weight loss, and resolution of comorbidities were evaluated during 1 year of follow-up. **Results:** All procedures were successful by laparoscopy. The average age was 29 (19-49) years; weight, 164.9 (127-250) kg; and body mass index, 51.0 (42.4-81.6) kg/m². In 1 case, nephrectomy was simultaneously performed for early renal cell carcinoma. The mean operative time was 148.8 (120-175) min. The mean postoperative hospital stay was 1.9 (1-4) days. The percentage excess weight loss at 1, 3, 6, 9, and 12 months was 16.6%, 31.0%, 41.4%, 45.4%, and 50.4%, respectively. The resolution rate of type 2 diabetes mellitus, hypertension, and dyslipidemia was 75%, 40%, and 66.7%, respectively. There was no major complication including mortality during the follow-up. **Conclusion:** LMGB is a technically simple, safe, and effective procedure in Korean obese patients.

Key Words: Mini-gastric Bypass, Bariatric surgery, Metabolic Surgery, Morbid Obesity

INTRODUCTION

Obesity is one of the most important health issues worldwide. Recently, bariatric surgery has become the best treatment option for morbid obesity and related comorbidities, as it has been shown to be more effective than medical therapy or lifestyle modification [1-3]. To date, laparoscopic Roux-en-Y gastric bypass (LRYGB) is the gold standard procedure for morbid obesity among

various types of surgical procedures [4]. However, LRYGB remains technically challenging and ranks as one of the most difficult laparoscopic surgeries, especially for inexperienced surgeons [4,5]. It has a highly steep learning curve and is associated with longer operating times and higher perioperative complication rates in the upward portion of the curve [6].

Laparoscopic mini-gastric bypass (LMGB) was first proposed by Rutledge in 2001 [7]. The procedure consists

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of a long lesser-curvature gastric tube with gastrojejunostomy performed 200 cm distal to the Treitz' ligament. This procedure, similar to LRYGB, causes weight loss through both restrictive and hypoabsorptive mechanisms. There are several apparent advantages of LMGB over LRYGB. LMGB has a shorter learning curve because the side-to-side loop gastrojejunostomy in LMGB is technically easier to perform than the Roux-en-Y-fashioned anastomosis in LRYGB. In addition, LMGB has a lower potential risk of internal herniation than LRYGB because the internal defect after LMGB is less than that after LRYGB. Moreover, LMGB is easier to revise or reverse than LRYGB because of the simplicity of the technique. However, despite the several benefits of LMGB along with its equivalent effects to those of LRYGB in terms of weight loss and resolution of comorbidities, concerns related to symptomatic alkaline reflux and the risk of gastric/esophageal cancer have prevented its adoption [8].

During the last 20 years, a number of surgeons from different countries have been able to replicate these results and >16,000 published cases now exist in the surgical literature [9]. We believe that there is now sufficient evidence supporting the adoption of this procedure as another surgical treatment option. However, to date, published studies on LMGB in Korean obese patients are scarce [10]. Therefore, we aimed to describe our initial experience with LMGB in Korean obese patients.

MATERIALS AND METHODS

1. Patients

We retrospectively reviewed the prospectively collected medical records of Korean obese patients who underwent LMGB for the treatment of morbid obesity from July 2016 to February 2018 at a single institution. The patients' demographics, operative time, estimated blood loss, postoperative hospital stay, early and late complications, weight loss, and resolution of comorbidities were evaluated during 1 year of follow-up after surgery.

2. Definitions of ideal body weight, remission of comorbidities, and complications

Ideal body weight was defined as the weight corre-

sponding to a body mass index (BMI) of 23 kg/m^2 , and excess weight loss was defined as the difference between a patient's real weight at baseline and the ideal body weight. The percentage excess weight loss (%EWL) and the change in mean BMI were used to evaluate weight loss. The outcomes of comorbidities and complications were based on the standardized outcome reporting in metabolic and bariatric surgery published by Brethauer et al. [11] in 2015. Remission of comorbidities, such as type 2 diabetes mellitus (T2DM), hypertension, or dyslipidemia, means normalized values of the clinical parameters of each comorbid condition without the need for any medication, and improvement means the decrease in the values of the clinical parameters with the same medications or a decrease in the dosage or number of medications. Complications were reported according to 2 different methods: based on the time frame (early [<30 days] vs. late [>30 days]) and based on the complication itself (major vs. minor).

3. Surgical techniques

Each patient was placed in the reverse Trendelenburg supine position. The surgeon and camera operator stood on the right side of the patient, and an assistant stood on the left side of the patient. The main monitor was at the head of the operating table to the left side of the patient,

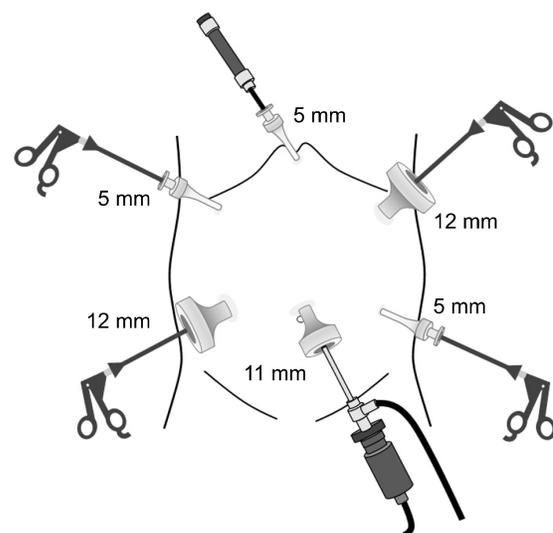


Fig. 1. Position of the trocars in laparoscopic mini-gastric bypass.

and the secondary monitor was at the right side of the patient. First, by using a 0° optic scope, a 12-mm trocar was placed on the left hypochondrium and a pneumo-peritoneum was made. After changing to a 30° optic scope, the second trocar (11 mm) was placed on the umbilicus for the camera. The third trocar (12 mm) was placed on the right side of the same horizontal level of the camera port at the mid-clavicular line. The fourth trocar (5 mm) was placed on the right hypochondrium, and the fifth trocar (5 mm) was placed on the left side of the same horizontal level of the camera port at the mid-clavicular line. The 5 trocars were placed in a U-shape formation. Finally, a 5-mm trocar for retracting the liver was placed just below the xiphoid process (Fig. 1). A window was created between the vagal nerve and the lesser curvature at the gastric angle for entering the lesser sac. Through the created window, a linear stapler loaded with a 45-mm purple cartridge (Endo-GIA™; Medtronic, USA) was passed and applied horizontally. Thereafter, linear staplers with a 60-mm purple cartridge were passed vertically to the axis of the stomach and fired upward to the angle of His, creating a narrow gastric tube of approximately 100-120 ml volume. The jejunum was mobilized upward, placing it without tension after bypassing 200 cm from the Treitz' ligament. Division of the omentum was sometimes required in obese patients with bulky omental fat. Gastrotomy and enterotomy were performed using a monopolar energy device for the entry of the linear stapler, and a 2-cm gastrojejunal anastomosis was created using a linear stapler loaded with

a 45-mm purple cartridge in an antecolic fashion. The entry hole for the linear stapler was closed with extramucosal continuous sutures using braided absorbable 3-0 suture (Polysorb™, Medtronic). Thereafter, the Petersen defect was sewn with braided non-absorbable suture 2-0 (Ethibond Excel®; Ethicon, USA). Lastly, a leakage test with methylene blue dye was performed to confirm the anastomotic integrity. No closed drain was placed. Fig. 2 shows the schematic diagram of LMGB. Upper gastrointestinal series were performed on the first postoperative day to check for leakage and passage.

RESULTS

All procedures were successful by laparoscopy. All patients were men with average age of 28.9 years (range 19-49 years). The mean operative time was 148.8 (120-175) min; the mean estimated blood loss was 50.7 (0-100) ml; and the average length of postoperative hospital stay was 1.9 (1-4) days. In 1 case, nephrectomy was simultaneously performed for early renal cell carcinoma. The follow-up rate at postoperative 1 year was 78.6% (11/14 patients).

The mean body weight at the time of operation was 164.9 (127-250) kg, and the mean BMI was 51.0 (42.4-81.6) kg/m². The BMIs at postoperative 1, 3, 6, 9, and 12 months were 46.8 (36.1-79.0), 43.0 (33.0-75.4), 40.4 (30.0-68.6), 40.4 (28.7-66.3), and 38.7 (26.9-64.7) kg/m², respectively (Fig. 3). The %EWL at postoperative 1, 3, 6, 9,

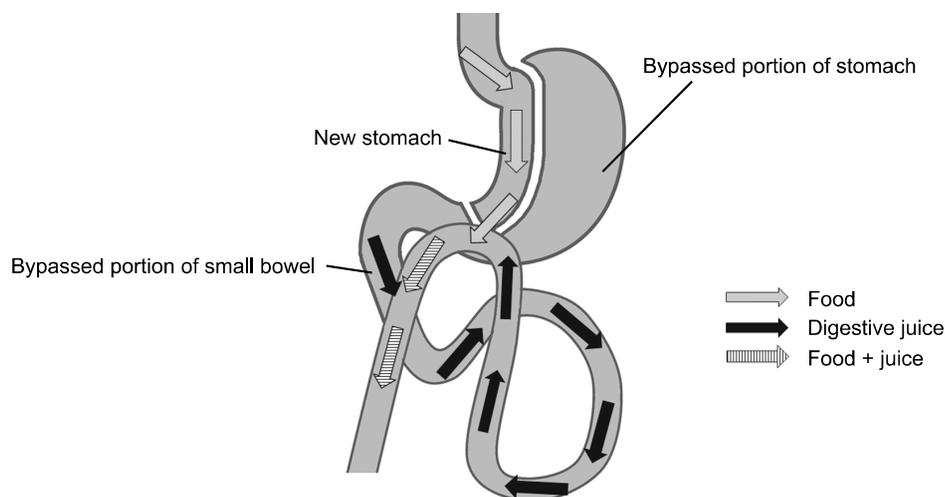


Fig. 2. Schematic diagram of the laparoscopic mini-gastric bypass procedure.

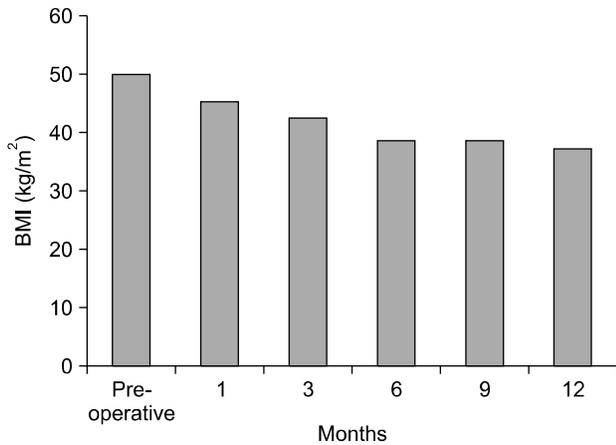


Fig. 3. Longitudinal changes of body mass index (BMI) in the study population (%).

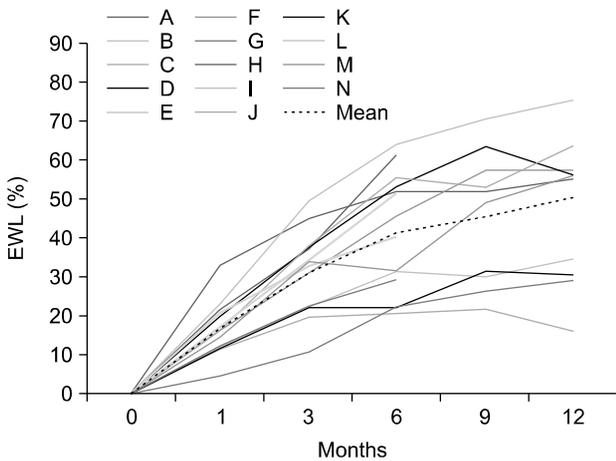


Fig. 4. Individual's percentage excess weight loss (%EWL) after laparoscopic mini-gastric bypass.

and 12 months were 16.6% (4.5-32.8%), 31.0% (10.6-49.2%), 41.4% (22.3-63.9%), 45.4% (26.2-70.5%), and 50.4% (29.0-80.9%), respectively (Fig. 4).

Four (28.6%) patients had T2DM before surgery, and 3 of them had been prescribed with oral anti-diabetic agents. Three of the 4 patients (75%) experienced resolution of T2DM at 1 year follow-up after surgery, and 1 patient achieved improvement of T2DM (Table 1). The level of glycated hemoglobin decreased from 9.3% (6.6-10.8%) at baseline to 5.2 (4.7-5.7%) at 1 year after surgery (Fig. 5). Two of 5 patients (40%) with hypertension achieved resolution. On the other hand, 2 of 3 patients (66.7%) with dyslipidemia achieved resolution, and the remaining 1 patient experienced improvement of dyslipidemia after

Table 1. Resolution rate of obesity-related comorbidities after laparoscopic mini-gastric bypass

Problems	Resolution rate (%)
Type 2 diabetes mellitus	75
Hypertension	40
Dyslipidemia	66.7

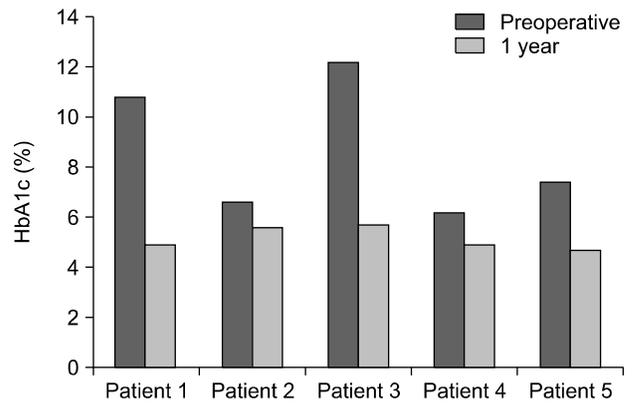


Fig. 5. Glycated hemoglobin (HbA1c) level after laparoscopic mini-gastric bypass (%).

surgery (Table 1).

There was no early complication or mortality after surgery in all patients. There was 1 case of late major complication involving marginal ulcer bleeding with melena requiring endoscopic intervention and transfusion of 2 pints of packed red blood cells at 3 months after surgery. Four (28.6%) patients had reflux gastroesophagitis requiring a proton pump inhibitor (PPI). Four patients (28.6%) developed marginal ulcers, and all were managed with PPI. Dumping syndromes were noted in 2 patients (14.3%), and anemia requiring supplementation of iron and vitamin B12 was noted in 1 patient (7.1%) (Table 2).

DISCUSSION

Our study demonstrated that LMGB has good short-term outcomes in terms of weight loss and resolution of comorbidities such as T2DM, hypertension, and dyslipidemia in Korean obese patients. To our knowledge, only 1 previous study has reported the outcome of LMGB in Korean patients [10]. Although this study included non-obese patients with T2DM, it nevertheless showed that

Table 2. Complications of laparoscopic mini-gastric bypass

Complications	Class	Patients (%)	Management
Marginal ulcer bleeding with melena	Late major	1 (7.1)	Blood transfusion and PPIs
Reflux gastroesophagitis	Late minor	4 (28.6)	PPIs ^a
Marginal ulcer	Late minor	4 (28.6)	PPIs
Dumping syndrome	Late minor	2 (14.3)	Dietary education
Anemia	Late minor	1 (7.1)	Iron and vitamin B12 supplement

^aPPIs = proton pump inhibitors.

LMGB has good effects on weight loss and the control of T2DM. Our study is meaningful in that it is the first study on obese patients in Korea and might serve as a basis for considering LMGB as another option in bariatric surgery in Korean obese patients.

In terms of the impact of LMGB on weight loss, our study showed %EWL of 50.4% (29.0-80.9%) at 1 year follow-up after LMGB, which is relatively low compared with the mean %EWL at 1 year reported in other studies, including randomized controlled trials and meta-analyses [9,12-15]. These other studies demonstrated that a %EWL of >65% was achieved at 1 year follow-up after LMGB. We speculated that less weight loss was observed in our study than in other studies because the BMI of our patients (51.0 [42.4-81.6] kg/m²) was much higher than that in other studies (25.3-49.5 kg/m²). This is consistent with previous findings showing that the %EWL was greater in the lower BMI group for each baseline BMI grouping [16,17]. Compared with other studies in patients with super obesity (BMI ≥50 kg/m²), the %EWL after LMGB in the present study is higher than that after laparoscopic sleeve gastrectomy (mean 40.2%, 49.5%, and 35.6%), whereas the weight loss effect is similar to or slightly less than that of LRYGB (mean 55.0%, 55.8%, and 51.0%) [18-20].

In terms of the impact of LMGB on comorbidities, our study showed that 3 of 4 (75%) patients had remission of T2DM, 1 (25%) patient had improvement of T2DM, 2 of 5 (40%) patients had remission of hypertension, and 2 of 3 (66.7%) patients had remission of dyslipidemia after LMGB. According to a systematic review published by Quan et al. [15] in 2015, 7 of 9 studies that reported the T2DM status demonstrated diabetes remission or an improvement rate of >80%, whereas Wang et al. [21] reported a 2-year remission rate of 100% in 79 patients with T2DM,

demonstrating the effect of LMGB on diabetes control. Moreover, a recently published meta-analysis comparing LMGB and LRYGB reported that LMGB resulted in a significantly higher rate of remission of T2DM than LRYGB and had a similar rate of remission of hypertension to that of LRYGB [14].

In terms of the feasibility of LMGB, the mean operative time in this study was 148.8 (120-175) min, which was longer than the operative time of LMGB (mean 92.9-147.7 min) and similar to that of LRYGB (mean 129.5-205 min) in comparative studies between LMGB and LRYGB [15]. The possible reasons for this result are as follows: 1) the operator was not familiar with LMGB despite being an experienced surgeon who had performed >1,000 bariatric surgeries; 2) all patients were men; and 3) the mean BMI was >50 kg/m². It is expected that the operation time will be shorter as the number of cases increases [21]. The estimated blood loss was 50.7 (0-100) ml, similar to that in another study (mean 39.8 ml) [22]. The postoperative hospital stay was 1.9 (1-4) days, which seems shorter than that in other studies (about 2-7.1 days) [14]. In several studies, the simplified surgical processes of LMGB resulted in a shorter operative time, less blood loss, and shorter hospitalization than LRYGB [22-24].

In terms of safety, there were no early major complications, such as bleeding or leakage, after LMGB. Only 1 case needed further treatments including endoscopic interventions and blood transfusion because of the development of marginal ulcer at postoperative 3 months. LMGB has one less anastomosis than LRYGB, and this would certainly reduce the possibility of anastomotic leakage and bleeding; however, the longer staple line on the gastric pouch and remnant stomach than LRYGB might increase such possibility [8]. The main criticism against

LMGB has been the potential for bile reflux and its consequences such as intestinal metaplasia, Barrett's esophagus, and gastric/esophageal cancer [25,26]. Reflux gastroesophagitis or esophagitis was the most frequent complication in our study, although it was successfully treated with medication. Thus far, the causal relationship between bile reflux and the risk of gastric cancer is debated. However, it should be considered that there was a report of 1 case of gastric stump cancer that occurred 26 years after the "loop gastric bypass" technique, the ancestor of LMGB [27]. It suggests that more follow-up is needed as gastric stump cancer can take more than 20 years to appear after surgery to confirm or disprove the role of LMGB in the genesis of gastric/esophageal cancer. Therefore, in 2018, the International Federation for the Surgery of Obesity Task Force recommended that patients should be encouraged to remain in long-term multidisciplinary care because bile reflux remains a theoretical risk even if it is either underreported or does not seem to be a major issue [9]. In addition, it should be considered that cancer in the bypassed stomach can be occurred. To date, 3 cases of cancer in the bypassed stomach has been reported after the loop gastric bypass surgery and 1 case of gastric cancer has been reported after LMGB [28,29]. Three of these 4 cases were diagnosed advanced gastric cancer including 1 case of peritoneal seeding. Since the delay in diagnosis affects the survival rate of patients, it is necessary to take a cautious approach when performing LMGB in countries such as Korea, Japan and China, where has a high incidence of gastric cancer.

This study has several limitations. First, the number of cases (n=14) was small. Second, the follow-up period was too short to evaluate for bile reflux as a long-term complication. Third, as all surgeries were performed by only 1 expert, the result may be somewhat different for beginners although LMGB is clearly one of the easiest operation for beginners to practice.

CONCLUSION

LMGB is a technically simple, safe, and effective procedure in Korean obese patients. It seems to result in favorable weight loss and has a high resolution rate of metabolic

comorbidities in the short term; however, information about long-term weight loss, durability, and safety profile in this population will require studies with a greater number of patients and a longer follow-up period.

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