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Short-term Outcomes of Weight Loss and Effects on Metabolic Disorders after Laparoscopic Sleeve Gastrectomy in Morbidly Obese Patients : A Pilot Study

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ABSTRACT

Objective : To evaluate the effects of laparoscopic sleeve gastrectomy (LSG) on weight loss and obesity-related comorbidities as an initial treatment strategy for morbid obesity at our institution.

Methods : The outcomes measured were weight loss and calculated remission rates for diabetes mellitus, hypertension, and dyslipidemia.

Results : Fourteen patients with morbid obesity underwent LSG at The Jikei University Hospital from August 2016 through November 2018. The median age was 53 years (range, 38-65 years), the preoperative body weight was 115.2 kg (interquartile range [IQR], 102.7-119.5 kg), and the body mass index was 42.2 kg/m^2 (IQR, 37.1-43.4 kg/m^2). One year after LSG the median body weight had decreased to 82.2 kg (IQR, 79.8-87.7 kg ; 11 patients) and the body mass index had decreased to 28.7 kg/m^2 (IQR, 26.9-31.4 kg/m^2). Nine patients had type 2 diabetes mellitus before LSG (64%) ; the rate of remission, including complete (6 patients) remission and partial (1 patient) remission, was 88%, and the median HbA1c 1 year after LSG was 5.7% (IQR, 5.4%-5.9%). Antihypertensive medications were discontinued after LSG by 8 patients (73%). Dyslipidemia was present in 13 of 14 patients before LSG and had a remission rate 1 year after LSG of 80%

Conclusion : For the treatment of morbid obesity, LSG performed at our institution has initial outcomes regarding weight loss and remission of metabolic disorders equivalent to those previously reported by other institutions.

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Key words : bariatric surgery, morbid obesity, sleeve gastrectomy, weight loss

INTRODUCTION

The prevalence of obesity has increased in most parts of the world over the last 20 to 30 years[1]. Obesity and related comorbidities have become widely recognized and have been strongly linked to risk factors for type 2 diabetes mellitus (T2DM), cardiovascular events, cancer, and overall mortality. The findings from large and long-term epidemiological studies suggest that being overweight or obese is associated with increased mortality[2-4].

Bariatric surgery is the most effective treatment for long-term weight loss in morbidly obese patients[5]. The Swedish Obese Subjects Study was the first long-term, prospective, controlled trial on the effects of bariatric surgery

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and provided 20 years of information. The surgery was associated with a long-term reduction in overall mortality (adjusted hazard ratio [HR] = 0.71, 95% confidence interval = 0.54-0.92 ; P = 0.01) and decreased incidences of T2DM (adjusted HR = 0.17 ; P < 0.001), myocardial infarction (adjusted HR = 0.71 ; P = 0.02), stroke (adjusted HR = 0.66 ; P = 0.008), and cancer (women : adjusted HR = 0.58 ; P = 0.0008 ; men : n.s.)[6].

According to the latest global survey by the International Federation for the Surgery of Obesity and Metabolic Disorders, 685,874 bariatric surgical procedures were performed worldwide in 2016[7]. Various types of bariatric surgery have been previously performed throughout the world. Moreover, the establishment of laparoscopic techniques for hand-sewing the gastrojejunostomy in Roux-en-Y gastric bypass greatly improved technical procedures[8]. However, trends in the types of bariatric procedures vary. In 2007, the First International Consensus Summit for Sleeve Gastrectomy confirmed the effectiveness of laparoscopic sleeve gastrectomy (LSG) alone[9] ; since then, LSG has spread from the United States and Europe and in 2016 became the type of bariatric surgery most often performed (53.6%) (rather than gastric bypass) in the world[7].

In Asia, of all bariatric surgical operations performed, 69% were LSG[7]. Especially in Japan, LSG has been reimbursed by the government health insurance system since April 2014 and has been performed each year for an increasing number of patients. At The Jikei University Hospital, we started performing LSG for weight loss in August 2016. The effects of LSG on weight loss and metabolic disorders have not been examined in our institution. Therefore, in the present study, we evaluated our initial treatment by short-term outcomes for weight loss and investigated improvement of metabolic disorders 1 year after LSG was performed for patients who were morbidly obese.

Methods

The subjects of this study were the first 14 patients who had undergone LSG with national insurance coverage to treat morbid obesity at The Jikei University Hospital from August 2016 through November 2018. The patients were followed up at our hospital through June 2019. From a database of 14 patients who had undergone LSG at our hospital, we extracted preoperative and postoperative data at 1, 3, 6, 9, 12 months after LSG regarding physical status, obesity-related comorbidities, blood examination, surgical complications, and adverse events following LSG.

Six months and 1 year after LSG, weight loss was measured with the following equations. The equation for percent of total weight loss (%TWL) was (initial weight - postoperative weight)/initial weight × 100, and that for the percent excess weight loss (%EWL) was ([initial weight] - [postoperative weight])/([initial weight] − [ideal weight]) × 100. The "ideal weight" corresponded to a body mass index (BMI) of 22 or 25 kg/m^2.

The rates of improvement and remission of 3 obesity-related comorbidities (Table 1) were also determined 6

Table 1. Criteria for remission and improvement in selected obesity-related comorbidities

Comorbidity	Complete remission	Partial remission	Improvement
Type 2 diabetes mellitus	FBG < 100 mg/dl, HbA1c < 6% without medication	FBG = 100-125 mg/dl, HbA1c = 6%-6.4% without medication	Statistically significant reduction in HbA1c and FBG not meeting criteria for remission or decrease in antidiabetic medications requirement (by discontinuing insulin or oral agent or 50% reduction in dose)
Hypertension	SBP < 120 mm Hg, DBP < 80 mm Hg without medication	SBP = 120-140 mm Hg, DBP = 80-89 mm Hg without medication	Decrease in dosage or number of antihypertensive medications or decrease in SBP or DBP with same medication
Dyslipidemia			
Low-density lipoprotein cholesterol	< 130 mg/dL without medication		Decrease in the number or dose of lipid-lowering agents with equivalent control of dyslipidemia or improved control of lipids with equivalent medication
High-density lipoprotein cholesterol	≥ 40 mg/dL without medication		
Total cholesterol	< 240 mm Hg without medication		
Triglyceride	< 150 mg/dL without medication		

Abbreviations : FBG, fasting blood glucose ; SBP, systolic blood pressure ; DBP, diastolic blood pressure months and 1 year after LSG with the diagnostic criteria of Brethauer et al.[10]. The diagnosis of T2DM was made with a fasting blood glucose ≥ 126 mg/dL and HbA1c ≥ 6.5%. Hypertension was diagnosed with a systolic blood pressure > 140 mm Hg or a diastolic blood pressure > 90 mm Hg or both. Dyslipidemia was diagnosed with a low-density lipoprotein cholesterol (LDL-C) level ≥ 140 mg/dl, a triglyceride level ≥ 150 mg/dl, or a high-density lipoprotein cholesterol (HDL-C) level ≤ 40 mg/dl.

Data were retrospectively analyzed from the database of 14 patients. Descriptive results regarding continuous variables were reported as the median value and the interquartile range (IQR). The Mann-Whitney *U* test was used to compare weight loss and data (fasting blood glucose, HbA1c) before LSG and 1 year after LSG. All tests were 2-sided, and $P < 0.05$ indicated a statistically significant difference.

Preoperative management

The inclusion criteria for laparoscopic bariatric surgery were based on insurance coverage in 2016 (medically uncontrolled obesity, age 18 to 65 years, and BMI > 35 kg/m^2 with T2DM, hypertension, or dyslipidemia). Before undergoing LSG, all patients were evaluated by a multidisciplinary team, which included a surgeon, internist, dietician, and, if necessary, a psychiatrist.

We performed upper endoscopic gastroscopy, blood tests to assess obesity-related comorbidities, and computed tomography to screen for malignancies or abnormities that required treatment. We measured the areas of visceral and subcutaneous fat at the umbilical cross section. Internal medicine physicians reviewed blood tests to exclude secondarily induced obesity and treated the comorbidities using medications. Patients who had been treated for a psychiatric disorder were evaluated by their primary care physician or the psychiatrist of our team, as necessary. Dieticians supervised balanced meals and appropriate caloric intake through nutrition counseling once per month. For patients who could not achieve their nutritional goals, surgery was postponed and nutritional counseling by the dietician was continued in the outpatient clinic.

LSG operation

Four laparoscopic trocars and a liver retractor were placed in the upper abdomen, and pneumoperitoneum was established at 15 mm Hg. The omentum along the greater curvature of the stomach was progressively freed by means of an ultrasonic energy device 4 cm from the pyloric ring to the gastroesophageal junction. Routinely obtained were complete mobilization of the fundus with exposure of the left crus and resection of the fat pad around the angle of His. A 36-Fr bougie was advanced transorally along the lesser curvature. We proceeded with dividing the stomach by means of a 60-mm endoscopic linear stapler via the bougie. The staple line was routinely reinforced with a 2-0 nonabsorbable suture to prevent bleeding from the cut line, and the remnant stomach was trimmed. Endoscopic testing was intraoperatively performed to check the integrity of the staple line for all cases.

Postoperative treatment

Sips of clear liquids were given to the patients 3 hours after LSG. A liquid diet was started the day after surgery, and detailed dietary counseling by a specialist bariatric dietician and instructions for optimal health management at home were provided. The patients were usually discharged on postoperative day 4 or 5. The patients started to consume a pureed diet after surgery, a soft diet 2 to 3 weeks later, and a normal diet after 12 to 16 weeks. Standard follow-up included visits to the outpatient clinic and receiving nutritional guidance each month. Patients underwent computed tomography examinations, blood tests regarding preoperative comorbidities, and upper endoscopic gastroscopy when weight loss reached a plateau over 1 year after LSG.

Results

The subjects were 14 patients (6 women and 8 men) with a median height of height of 1.66 m (range, 1.52-1.79 m) and a mean age of 53 years (range, 38-65 years) (Table 2). Three patients were older than 60 years. Before LSG, the median body weight was 115.2 kg, and the median preoperative BMI was 42.2 kg/m^2 (Table 3). None of the patients had super-morbid obesity, as indicated by a BMI > 50 kg/m^2. All of the operations were completed with laparoscopy and without conversion to open surgery. The median skin-to-skin operative time was 145 minutes (range, 121-196 minutes), and the median intraoperative blood loss was 10 g (range, 10-150 g). The median postoperative hospital stay was 4 days (range, 4-6 days), and surgical complica-

Table 2. Preoperative and operative characteristics of 14 patients

Characteristic	Value
Median Age (IQR, range), years	53 (46.5-58.8, 38-65)
Sex	6 women (43%) and 8 men (57%)
Median height, (IQR, range), m	1.66 (1.62-1.72, 1.52-1.79)
Body mass index > 50 kg/m^2	0
Obstructive sleep apnea syndrome	11 patients (76%)
No symptom of gastroesophageal reflux disease	8 patients (57%)
Operative time, median (IQR, range), minutes	145 (141-149, 121-196)
Intraoperative blood loss (range), g	10 (10-150)
Conversion to open surgery	0 patients

Abbreviation : IQR, interquartile range

tions did not occur in any patient.

Weight loss

Data regarding changes in body weight was collected 6 months after LSG for all 14 patients and 1 year after LSG for 11 patients. The median weight had significantly decreased after LSG ($P < 0.001$) compared with those before LSG to 83.7 kg after 6 months and to 82.2 kg after 1 year (Table 3 and Fig. 1). The median BMI also decreased to 30.3 kg/m^2 at 6 months and to 28.7 kg/m^2 at 1 year ($P < 0.001$). The median %TWL was 22.7% after 6 months and was 29.2% after 1 year. The Japan Society for the Study of Obesity set the ideal body weight (IBW) for Japanese patients as that indicated by a BMI of 22 kg/m^2 [11]. Under this definition, the median %EWL achieved was 51.7% after 6 months and 62.1% after 1 year. If the IBW is defined as that with a BMI of 25 kg/m^2 [10], the median %EWL achieved was 65.4% after 6 months and 75.1% after 1 year. The overall success rate of weight loss 1 year after LSG was 90.9% when accounted for by a %EWL > 50. Approximately 78% of total weight loss 1 year after LSG had been achieved 6 months after LSG, and body weight reached an approximate plateau 1 year after LSG.

Visceral and subcutaneous fat

Before LSG, the median area of visceral fat was 250.5 cm^2 and that of subcutaneous fat was 473 cm^2 (Table 3). Computed tomography 1 year after LSG revealed that the median area of visceral fat had decreased significantly ($P < 0.001$) to 84.2 cm^2 and that of subcutaneous fat had decreased to 206 cm^2.

OBESITY-RELATED COMORBIDITY OUTCOMES

Type 2 diabetes mellitus

Nine (64%) of 14 patients had T2DM before undergoing LSG (Table 3). While these patients were being medicinally treated the median HbA1c was 7.4%. Eight patients were followed up 1 year after LSG ; however, 1 patient had undergone LSG only 6 months before data was collected. The percentage of patients with remission, including both complete (6 patients) remission and partial (1 patients) remission, 1 year after LSG was 88% ; however, 1 patient showed no change in HbA1c. The median HbA1c among patients with a history of T2DM had decreased to 6.0% within 3 months after LSG and to 5.7% at 1 year after LSG (Fig. 2).

Hypertension

All 14 patients had hypertension before LSG and had been treated with oral antihypertensive agents. The patients temporarily discontinued this treatment within 3 months after LSG, but 3 patients restarted treatment 6 months after LSG. The remission rate of hypertension 1 year after LSG was 73% (8 of 11 patients) (Table 3).

Dyslipidemia

Dyslipidemia was present before LSG in 13 (93%) of 14 patients and was treated in 5 of them ; however, the levels of LDL-C or triglycerides had exceeded the normal limits (Table 3). The remission rate of dyslipidemia was 80% at 1 year, and 2 patients were treated with oral medications 3 months after LSG.

Table 3. Weight, improvement of comorbidities, and adverse events before and after laparoscopic sleeve gastrectomy

Characteristic	Before LSG 14 patients	6 Months after LSG 14 patients	1 Year after LSG 11 patients
Body weight, median (IQR, range), kg	115.2 (102.7-119.5, 94-145)	83.7 (81.9-88.8, 63.8-113)	82.2 (79.8-87.7, 58.3-112)**
BMI, median (IQR, range), kg/m^2	42.2 (37.1-43.4, 35.9-45.5)	30.3 (28.8-32.9, 25.6-37.0)	28.7 (26.9-31.4, 25.2-38.5)**
%TWL, median (IQR, range)	-	22.7% (17.3%-30.0%, 13.1%-32.1%)	29.2 (22.8-33.2, 10.9-38.0)
%EWL, median (IQR, range), with ideal BMI of 22 kg/m^2	-	51.7% (42.2-60.9, 29.5-82.8)	62.1 (50.4-71.4, 22.2-82.7)
%EWL, median (IQR, range), with ideal BMI of 25 kg/m^2	-	65.4% (50.1-70.3, 30.8-96.7)	75.1 (61.4-85.6, 25.9-101.3)
Visceral fat area, median (IQR, range), cm^2	250.5 (196-299, 157-391)	-	84.2 (76.4-113, 64.2-170)**
Subcutaneous fat area, median (IQR, range), cm^2	473 (432-492, 300-651)	-	206 (179-245, 154-573)**
Type 2 diabetes mellitus	9 patients (64%)	9 patients (64%)	8 patients (73%)
Fasting blood glucose, mg/dL	137 (126-154, 107-177)	103 (101-110, 88-146)	101 (94-110, 85-165)*
HbA1c, median (IQR, range), %	7.4 (6.5-7.8, 6.1-8.3)	6.0 (5.6-6.2, 5.1-7.2)	5.7 (5.4-5.9, 5.1-8.7)*
Complete remission	-	3	6
Partial remission	-	4	1
Improvement	-	2	
No change	-	0	1
Remission rate	-	78%	88%
Hypertension	14 patients (100%)	14 patients (100%)	11 patients (100%)
Systolic blood pressure, median (IQR, range), mm Hg	131 (126-140, 118-158)	120 (110-120,105-135)	120 (113-125, 110-135)
Diastolic blood pressure, median (IQR, range), mm Hg	84 (75-88, 60-95)	72 (70-80, 65-86)	77 (73-80, 70-90)
Complete remission	-	4	3
Partial remission	-	5	5
Improvement	-	5	3
No change	-	0	0
Remission rate (%)	-	64	73
Dyslipidemia	13 (93%)	13 (93%)	10 (91%)
Low-density lipoprotein cholesterol, median (IQR, range) (mg/dL)	127 (89-53, 65-162)	120 (97-134, 74-152)	100 (91-124, 70-177)
High-density lipoprotein cholesterol, median (IQR, range) (mg/dL)	48 (45-55, 37-80)	55 (53-74, 37-93)	60 (55-90, 53-102)
Total cholesterol, median (IQR, range) (mg/dL)	211 (178-232, 170-257)	195 (178-226, 161-254)	197 (189-204, 136-288)
Triglyceride, median (IQR, range) (mg/dL)	229 (215-277, 192-335)	106 (79-146, 68-212)	101 (82-141, 67-201)
Remission	-	7	8
Improvement	-	6	2
No change	-	0	0
Remission rate (%)	-	54	80
Adverse events of LSG			
Symptom of gastroesophageal reflux disease, n (%)	6 (43%)	5 (36)	4 (36)
Erosive esophagitis (Los Angeles grade M/A/B/C/D)	A = 4 ; B = 2	-	A = 1 ; B = 1 ; C = 2
Grade M (preoperative) to A (postoperative)	0	-	1 (de novo GERD)
Grade A (preoperative) to B (postoperative)	0	-	1
Grade B (preoperative) to C (postoperative)	0	-	2

**$P < 0.001$, *$P < 0.01$: Mann-Whitney U test
Abbreviations : LSG, laparoscopic sleeve gastrectomy ; BMI, body mass index ; %TWL, percent of total weight loss ; %EWL, percent excess weight loss

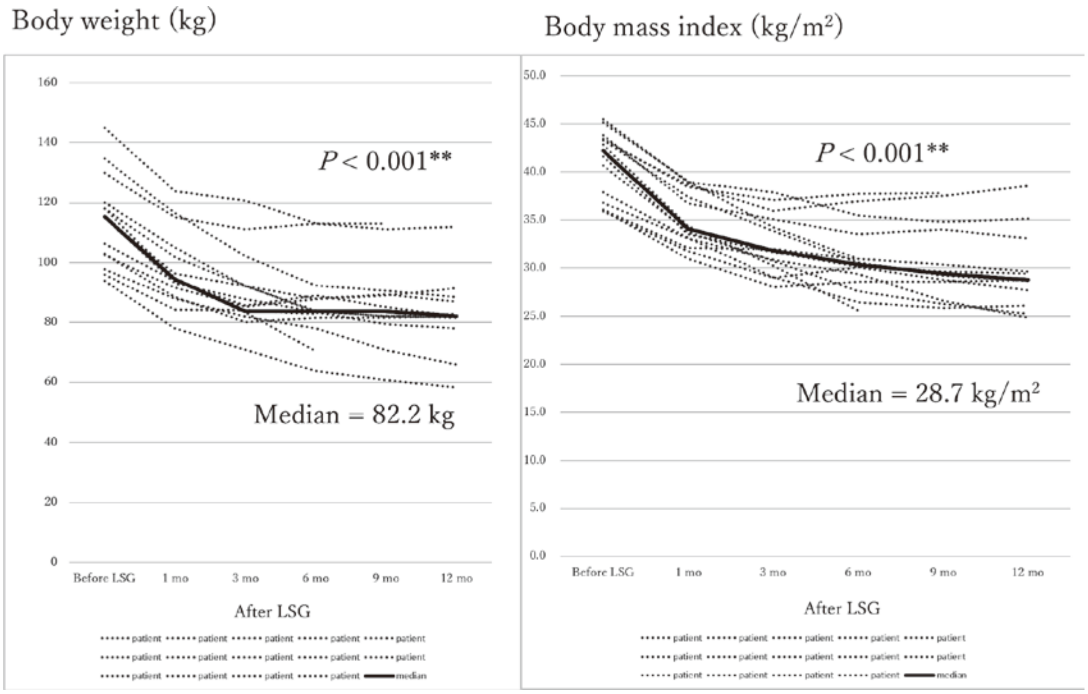

Fig. 1. Changes in body weight and body mass index. Body weight and body mass index after laparoscopic sleeve gastrectomy (LSG) significantly decreased compared with those before LSG (**Mann-Whitney U test). Dotted lines = individual patients ; solid line = median.

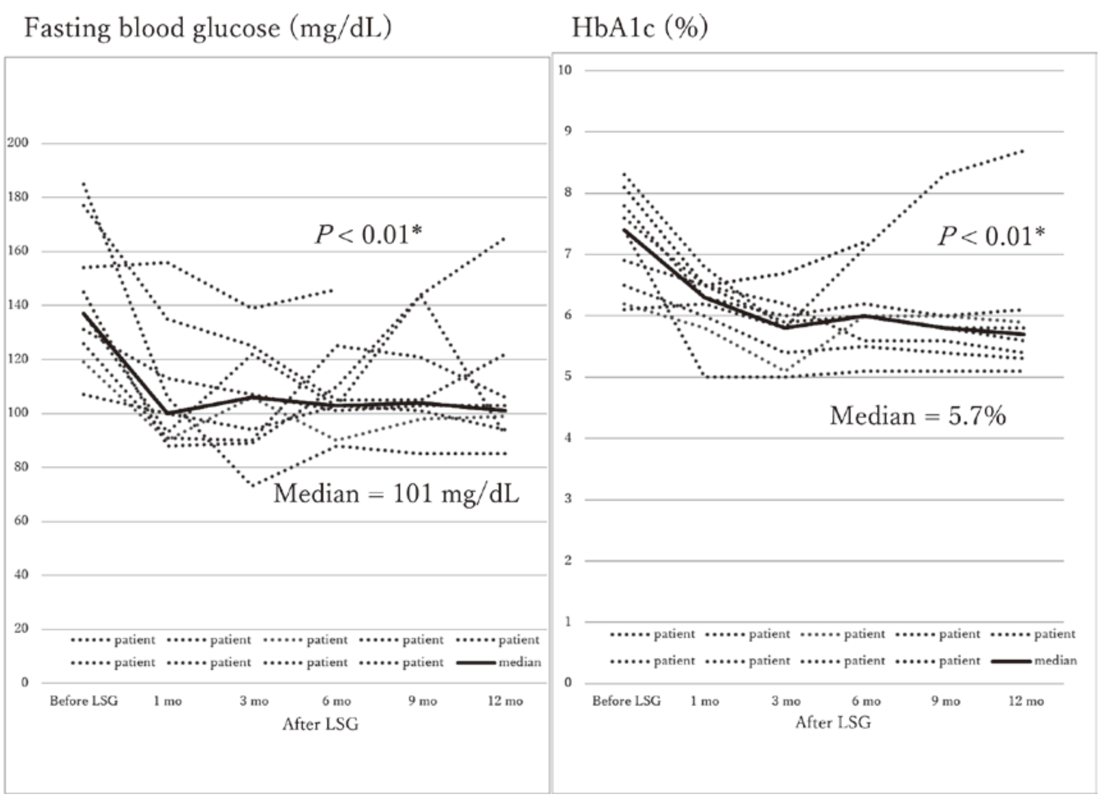

Fig. 2. Time-dependent changes of fasting blood glucose and HbA1c. Fasting blood glucose and HbA1c after laparoscopic sleeve gastrectomy (LSG) significantly decreased compared with those before LSG (*Mann-Whitney's U test). Dotted lines = individual patients ; solid line = median.

Complications

Complications of LSG did not occur in any patient.

Adverse Events after LSG

Gastroesophageal reflux disease

Endoscopic examination before LSG revealed erosive esophagitis in 6 (43%) of 14 patients (Table 3). Of the 11 patients followed up for 1 year after LSG, 4 (36%) had complained of symptoms of esophageal reflux 6 months after LSG and were treated with a proton-pump inhibitor to improve symptoms. Endoscopic findings revealed that erosive esophagitis 1 year after LSG was worse than before LSG in all patients with symptoms of gastroesophageal reflux disease (GERD).

Psychiatric disorders

Depression had been diagnosed and treated with antidepressant agents before LSG in 3 (21%) of 14 patients. Although these 3 patients were treated with antidepressant agents and were mentally stable after undergoing LSG, 2 (20%) of 10 patients were found to have an anxiety disorder 6 months after LSG and 1 (11%) of 9 patients began to be treated with an antidepressant agent 1 year after LSG, despite no psychiatric disorder having been diagnosed before LSG.

Discussion

To evaluate the effects of LSG on obesity-related comorbidities, the present study examined the first 14 patients with morbid obesity who had undergone LSG at our institution.

Regarding outcomes of weight loss and resolution of obesity-related comorbidities following LSG, data has been provided by prospective observational and retrospective studies. A study of 3003 morbidly obese patients who had undergone LSG found that the %EWL was 72% when the IBW was defined with a BMI of 25 kg/m^2 [12]. In a Japanese multi-institutional survey, 1 year after LSG the mean BMI among patients was 31 kg/m^2 and the %TWL was 27%[13]. Compared with these findings, the weight losses achieved 1 year after LSG at our institution — a median BMI of 28.2 kg/m^2 and a median %TML of 29.2% — were equivalent to those at other institutions. Nevertheless, in some of our patients the %TWL was less than 20%; therefore, we must determine whether the smaller weight loss is due to the surgical technique, the method of nutritional instruction, the psychological distress of the restriction of food intake, or other reasons. Studies in Japan have found that the weight loss after LSG is significantly lower for super-obese patients (BMI $\geq$ 50 kg/m^2) than for other morbidly obese patients[14,15]. Although the present study included no patients with a BMI $\geq$ 50 kg/m^2, the degree of weight loss decreased in 3 patients with a BMI of 44 to 46 kg/m^2 (Fig. 1). A significantly lower degree of weight loss after LSG has previously been reported in patients with a BMI > 45 kg/m^2 [16]. Therefore, for such patients we might consider including malabsorptive surgery as a treatment.

Regarding the remission of T2DM after LSG, a rate of 85% has been reported in Japanese patients[13]. In the present study the remission rate among patients 1 year after surgery was 88% (Table 3). Eight of 9 patients had been followed up after LSG without receiving medications; nevertheless, before LSG these patients had been treated with 1 to 3 oral medications. A proposed scoring system, the Diabetes Surgery Score, for predicting the success rate of treating T2DM after LSG consists of the patient's age (A), BMI (B), C-peptide level (C), and the duration of T2DM (D). The creators of this system have suggested that a remission of T2DM in patients treated with medicinal insulin is difficult to achieve with a surgical strategy of food restriction alone[17,18]. One of our patients in whom T2DM did not decrease in severity after LSG had been treated with medicinal insulin because gestational diabetes had been diagnosed. Nevertheless, this patient's insulin secretory function was as good as in the early phase of T2DM, and T2DM had been due mainly to insulin resistance. Therefore, we believe that the main reason that the severity of T2DM did not decrease was that the patient's dietary habits had not changed after LSG.

In the present study the remission rate of hypertension was 73% (Table 3) and was higher than expected. Because the median age of patients was higher in our study than in previous studies, we had believed that arteriosclerosis in our patients had already progressed. Therefore, we predicted a lower remission rate of hypertension. Nevertheless, our outcome was equivalent to those of previous studies from other institutions[13]. Of our 3 patients who continued to receive oral antihypertensive medications after LSG, each used only a single agent.

We observed a significant increase in the HDL-C level and decreases in LDL-C and triglyceride levels in almost all patients with dyslipidemia before LSG (Table 3). Among previously reported patients who had lost an adequate amount of weight, levels of HDL-C increased and levels of LDL-C, triglyceride, and non-HDL-C significantly decreased[19]. The greatest factor related to the improvement of dyslipidemia, according to the American Society for Metabolic and Bariatric Surgery, is not malabsorption but is the restoration of fat tissue function due to important and sustained weight reduction[20]. The findings of the present study suggest that the association between the decreased BMI and the enhanced lipid profile might be greater than believed, despite the relationship of BMI and lipid profile remaining unclear.

Although LSG has the positive effects of reducing weight and improving obesity-related co-morbidities, we are still concerned about the symptoms of GERD that might develop. An analysis, based on questionnaires completed by 106 bariatric surgeons in 2009, found that *de novo* GERD was present after 6.5% (range, 0%-83%) of 14,776 LSG operations[21]. In 2011, the International Sleeve Expert Panel evaluated the results of 12,799 sleeve operations and reported that the postoperative rate of GERD was 12.11% ± 8.97%[22]. The rate of postoperative GERD symptoms in the present study (36%) was higher than rates in these previous studies, and 1 patient had *de novo* GERD after LSG (Table 3). However, because improving the symptoms of severe GERD after LSG is difficult with medicinal treatment, 3 of 4 patients of the present study were treated with vonoprazan fumarate, because other proton-pump inhibitors are ineffective. In this regard, morbidly obese patients have a high prevalence of GERD because of the increased gastroesophageal pressure gradient. After bariatric surgery, weight loss has been considered to reduce the severity of GERD, mostly because of changes in the gastroesophageal pressure gradient and gastric emptying. In addition, reduced gastric acid secretion might also contribute to the reduction of reflux symptoms after LSG[23]. On the other hand, esophageal reflux can also be induced by LSG, perhaps through an adverse effect on antireflux barrier function at the gastroesophageal junction. Although a component of the antireflux barrier, the angle of His, is removed during LSG, 2 high-pressure components of the antireflux barrier, the lower esophageal sphincter and the crural diaphragm, are believed to remain functionally intact ; however, lower esophageal sphincter pressure has been reported to significantly decrease after sleeve gastrectomy, from 14.2 ± 5.8 to 11.2 ± 5.7 mm Hg[24], as shown with esophageal manometry. Furthermore, also affected by sleeve gastrectomy are the abdominal length and the total length of the high-pressure zone at the gastroesophageal junction. Therefore, the cause of GERD after LSG remains unclear. To investigate the cause of GERD after LSG, we consistently perform preoperative and postoperative high-resolution impedance esophageal manometry and 24-hour impedance pH testing.

Another concern regarding LSG is the possibility of psychiatric disorders. Many candidates for bariatric surgery already have mental health disorders, particularly depression and binge eating disorder. The subjects of the present study included 3 patients with depression, but they did not complain of a mental illness while being treated with antidepressants after LSG. Of the 2 patients in whom psychiatric disorders were diagnosed after LSG, 1 had anxiety related to work, and the other had anxiety related to parenting. Therefore, we did not believe that their disorders were direct adverse effects of LSG. Considerable evidence suggests long-term improvement in depressive symptoms after surgery[25]. Nevertheless, bariatric surgery reportedly increases the risk of suicide[26]. Therefore, we carefully follow up our patients after LSG and recommend referral to a psychiatrist during the early phase of a psychiatric disorder.

LIMITATIONS

The limitations of the present study were its small sample size and that super-obese patients (BMI > 50 kg/m^2) were not included. If more patients with BMI > 45 kg/m^2 were included, the outcomes of weight loss might have been worse. Therefore, we should prepare different treatment strategies for patients with BMI > 45 kg/m^2 who are unable to achieve their set goal weight.

CONCLUSION

The results of the first 14 patients who had undergone LSG surgery at our institution are similar to those previously reported from other institutions in terms of weight loss and the remission of obesity-related comorbidities. Nevertheless, the cause of de novo GERD remains unclear. Regarding psychiatric disorders after LSG, careful assessment of all patients and early treatment by psychiatrists are important.

Compliance with Ethical Standards

Conflict of Interest

All authors declare that they have no competing interests in this study.

Ethical Approval

All procedures performed in our study involving human participants were in accordance with the ethical standards of the institutional and/or Japanese national research committees and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

This study was approved by the Ethics Committee of The Jikei University School of Medicine for Biomedical Research 30-175 (196).

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