

Results of Laparoscopic Sleeve Gastrectomy (LSG) at 1 Year in Morbidly Obese Korean Patients

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Background: In Asia, the type and main cause of obesity is different than in western society. Therefore, the treatment plan should be differentiated, and the surgery for morbid obesity should be carefully chosen. The early results of laparoscopic sleeve gastrectomy (LSG) without duodenal switch that has been performed in the Korean population is reported.

Methods: We retrospectively reviewed 130 patients who underwent LSG from January 2003 to May 2004. 60 of these patients now had >1 year of regular follow-up, and are the subject of this report. LSG was performed through 4 12-mm ports and 1 15-mm port, using the Endo-GIA stapler to create a lesser curve gastric tube over a 48-Fr bougie.

Results: For the 60 patients, the postoperative EWL was $71.6 \pm 21.9\%$ at 6 months and $83.3 \pm 28.3\%$ at 12 months. At 12 months after LSG, decrease in BMI was $9.2 \pm 3.7 \text{ kg/m}^2$, and median weight loss was $24.6 \pm 10.0 \text{ kg}$. Dyslipidemia resolved in 75% of patients within 12 months. Diabetes resolved in 100% of patients within 6 months of operation. Hypertension resolved in 92.9% and improved in 100%. Joint pain resolved in 100% within 12 months. Weight loss plateaued at 12 months in the majority of patients. One patient has undergone a malabsorption procedure (duodenal switch) as a second-stage operation.

Conclusion: Additional studies and follow-up are needed to determine the best surgical treatment for morbidly obese Asian patients. However, LSG without the second-stage duodenal switch operation has been an effective weight loss operation thus far, in most of the Korean patients.

Key words: Laparoscopy, sleeve gastrectomy, morbid obesity, Korea

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Introduction

Bariatric surgery for morbidly obese persons has been applied in western countries increasingly in the past 40 years. In western medicine, obesity is accepted as a disease with awareness of its seriousness. In Korea, most people tend to perceive bariatric surgery as an esthetic procedure. Thus, complications of this surgery are observed as complications of an esthetic procedure. Also, the concept of obesity as a disease and recognition of its metabolic side-effects are not realized by many people. Yet, worldwide obesity is increasing, now to epidemic proportions.¹ With this trend, we have a distinguishably large population that are rapidly increasing. According to 2002 data, in the Korean population, BMI between 30.0 and 34.9 kg/m^2 is present in 2.92% and BMI $>35 \text{ kg/m}^2$ is present in 0.28%.²

More recent data on the rapid rise of morbid obesity in the Asian region disclosed the upsurge in rates of serious diseases such as diabetes, hypertension and coronary heart disease. Asians are more likely to be android (apple-shaped) than gynoid (pear-shaped).³ In other words, Asians are more predisposed to abdominal obesity than Europeans, and the co-morbidities of obesity seem to occur at lower BMIs in Asian people.⁴⁻⁷ Therefore, a committee established under the joint auspices of the World Health Organization and the Asia and Oceania region of IASO/IOTF proposed specific criteria to define overweight and obesity in Asians using new cut-off points for BMI and waist circumference, which reflected the increased risk of co-morbidities at lower levels of body fatness.^{5,8} In Asia, we can no longer ignore the enormous number of morbidly

obese persons. Thus, in January 2003, the first bariatric surgery in Korea was performed, and its interest is increasing. Here, we present out early results of laparoscopic sleeve gastrectomy (LSG) in two-staged bariatric surgery.

Methods

Patients

Between January 2003 and May 2004, we performed LSG on 130 patients. From January 2003 to April 2003, the operations were performed at St. Mary's Hospital of Seoul, and from May 2003 to May 2004 the surgery has been performed in the Minimally Invasive Surgery Obesity Center. From the total of 130 patients during that period, 80 have reached 1 year, and 60 of these patients were available for full follow-up. Eight men and 52 women participated in the study (gender ratio 1:6.5). Average age was 30 years (range 16-62), and average BMI was 37.2 kg/m² (range 30.0-56.1).

Preoperative Assessment

To determine whether patients were eligible for surgery, a 7-day food diary, BMI, hip and waist ratio, percent body fat, and percent abdominal fat were determined. The 7-day food diary was analyzed to determine contributing factors to obesity and to advise suitable surgery. When assessing BMI, we used the Asian Pacific standard. We measured ideal body weight and EWL by bioelectrical impedance analysis.⁹ The eligible criteria is a BMI >35 kg/m² without associated comorbid conditions or a BMI >30 kg/m² with associated co-morbidities. Laboratory tests included blood, urine, X-ray, abdominal sonogram of liver, genetic testing (β -2,3-adrenergic receptor mutations by blood sample), pulmonary function tests and cardiogram. To assess quality of life, the patients filled out health and lifestyle questionnaires, which include previous diet programs, changes in food consumption and eating behaviors. All patients received nutritional counseling on postoperative diets and postoperative care was emphasized in outpatient visits before surgery. Also, we explained the purpose of our study, and received the consent form.

Operative Method

Our principle method is a two-staged operation. The first procedure is restrictive – a laparoscopic sleeve gastrectomy (LSG) which is a precondition to receive the second operation which is malabsorptive – a duodenal switch. After 1 year following LSG, it is determined whether the malabsorption procedure is needed as the second stage. For the LSG, four 12-mm ports and one 15-mm port are used, and the Endo-GIA stapler (Ethicon Endo-Surgery, Cincinnati, OH, USA) beside a 48-Fr bougie was used for the resection, leaving a 50-60 cc stomach. In the fundic portion, the gastric tube was made close to the esophago-gastric junction; then, methylene blue was used to test for leakage. In order to check the remaining portion of the stomach, saline was instilled via a nasogastric tube.

Postoperative Care

Patients were discharged home on the second postoperative day. On the first postoperative day, the patient received a clear liquid diet, which was progressed to a full liquid diet for 1 week (stage I diet). After 1 week, the patient was progressed to a soft diet (stage II diet), which was followed for 3 weeks, and then advanced to a regular diet (stage III) on the 5th week. Follow-up visits were scheduled for every 3 months, when changes in EWL and abdominal fat were measured.

To assess effectiveness of surgery, we surveyed three domains of the patient's quality of life, which included subjective view on appetite, amount of food consumption, and level of satisfaction with the operation. To assess appetite, preoperative appetite was used as a baseline of 100%, so that if the patient indicated postoperative appetite as 50%, the appetite had decreased 50%. On satisfaction with surgery, if the patient indicated as 200%, the patient's satisfaction had doubled.

Results

Preoperative Eating Habits

Seven-day food diary was assessed preoperatively in 130 patients; the average proportion of macronutrients (carbohydrate: fat: protein) was 58%: 26%: 16% (Can Pro 2.0, Korean Dietetic Association). Total fat

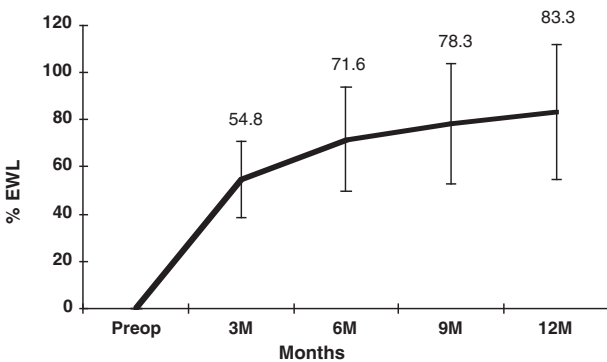
intake and saturated fat intake were lower than the maximum range in the Recommendations for Healthy Americans.¹⁰ Polyunsaturated fat intake was >10%, saturated fat intake was <10%. Breakfast was skipped in 41% of patients. Fast food consumption per week occurred in 0.8 patients. High fat meats were consumed an average of 1.5 times per week, and night snacking averaged 2 times per week.

Weight Loss

At 3 months after LSG, the patients' EWL was $54.8 \pm 15.9\%$, at 6 months $71.6 \pm 21.9\%$, at 9 months $78.3 \pm 25.4\%$, and at 1 year $83.3 \pm 28.3\%$ (Figure 1). The preoperative BMI was 37.2 (30.0-56.1), and post-operative BMI decreased to 31.3 ± 4.8 at 3 months, 29.4 ± 4.9 at 6 months, 28.6 ± 4.9 at 9 months and 28.0 ± 5.1 at 1 year (Figure 2). According to the Reinhold classification,¹¹ in the total 60 patients, 37 patients (61.7%) had >75% EWL, 14 patients (23.3%) had 50-75% EWL, 8 patients (13.3%) had 25-50% EWL, and 1 patient (1.7%) had <25% EWL. We categorized the 60 patients by severity of BMI and compared each group depending on EWL (Table 1).

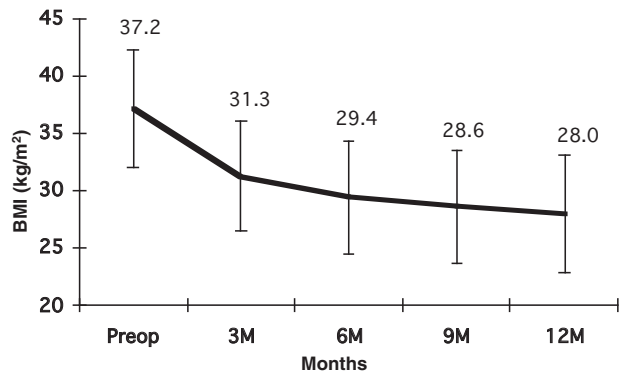
Improvements on Co-morbidities

Changes in co-morbid diseases are given in Table 2. In the total 60 patients, 50 had at least one co-morbid disease, and the co-morbidities totaled 127. These disorders were significantly improved within 6 months after LSG.



All 60 patients had follow-up at each time-point of the study.

Figure 1. Percentage of excess weight loss (%EWL) after laparoscopic sleeve gastrectomy without duodenal switch in the 60 patients who have passed 1 year of follow-up.



All 60 patients had follow-up at each time-point of the study.

Figure 2. Course of body mass index after laparoscopic sleeve gastrectomy without duodenal switch in the 60 patients who have passed 1 year of follow-up.

Postoperative Complications

Early complications (within 1 month postoperatively) are shown in Table 3. From the total of 130 patients who underwent LSG, 5 had operative complications. Two patients had major complications: 1 leakage (0.7%) and 1 delayed bleeding (0.7%). In the case of the delayed bleeding, the patient underwent laparoscopic re-operation for irrigation and drainage. There were 2 minor complications (1.5%): 1 patient developed atelectasis, and the other patient experienced nausea and vomiting for 21 days after surgery. In the latter patient, abdominal sonogram, upper GI series, 24-hr pH monitoring of the lower esophageal sphincter and manometry were normal. The patient received total parenteral nutrition, and the symptoms disappeared at 21 days. One death occurred 3 weeks after surgery (0.7%); according to the autopsy, no leakage or strangulation was found, but primary peritonitis was diagnosed. One patient (0.7%) was converted to laparotomy due to short gastric artery bleeding.

The average operative time for the LSG operation was 70 minutes (45-100). The estimated blood loss was <50 cc, except in the one patient who had short gastric artery bleeding during operation.

Subjective Postoperative Assessment

Changes in appetite (Figure 3) increased minimally after the surgery, but at 12 months, the appetite level increased to 54.6% of the preoperative. Changes in the amount of food consumed (Figure 4) stayed at

Table 1. Percentage of excess weight loss (%EWL) of 60 patients who have reached 1 year following laparoscopic sleeve gastrectomy, grouped according to preoperative BMI categories

Preoperative BMI (kg/m ²)	No.of patients	% EWL			
		3 months	6 months	9 months	12 months
30-34.9	23	60.6±15.9	76.9±20.3	83.1±23.4	87.6±27.9
35-39.9	21	54.9±12.9	73.6±17.5	80.7±21.8	86.1±23.7
40-49.9	15	48.6±14.5	64.4±24.7	71.4±28.9	77.0±31.7
≥50	1	13.3	16.7	19.7	21.3

*One patient who had an initial BMI ≥50 underwent a malabsorptive procedure as a second-stage operation.

Table 2. Outcome of co-morbidities in the 60 patients who had passed 1 year after laparoscopic sleeve gastrectomy

Co-morbidity (no.)	6 months		12 months	
	Resolved (%)	Improved (%)	Resolved (%)	Improved (%)
Fatty liver (40)	100			
Arthritis/joint pain (21)	76	23.8	100	
Dyslipidemia (20)	45	30	65	10
Hypertension (14)	93	7	93	7
Sleep apnea (14)	100			
Diabetes mellitus (8)	100			
Reflux esophagitis (5)	80	20	100	
Amenorrhea (4)	75	25	100	
Asthma (1)	100			

40.6%. Level of satisfaction (Figure 5) showed 105.7 to 112.3%, which was higher than expected.

Failure Rate of Weight Loss following LSG

To determine the success of LSG, we applied the Reinhold classification. From the total 60 patients, one (0.7%) failed to achieve satisfactory weight loss by LSG alone at 1 year (21.3% EWL at 1 year after LSG, and BMI fell from 56.1 to 50.5). This patient under-

went Roux-en-Y gastric bypass as a second stage.

Further follow-up of the 60 patients beyond 1 year has indentified 4 more patients who will likely need the second-stage duodenal switch. Most of them had an initial BMI ≥50.

Table 3. Postoperative complications in the total 130 patients who have undergone LSG

Complications	N (%)
Leakage	1 (0.7)
Delayed bleeding	1 (0.7)
Atelectasis	2 (1.5)
Prolonged vomiting	1 (0.7)

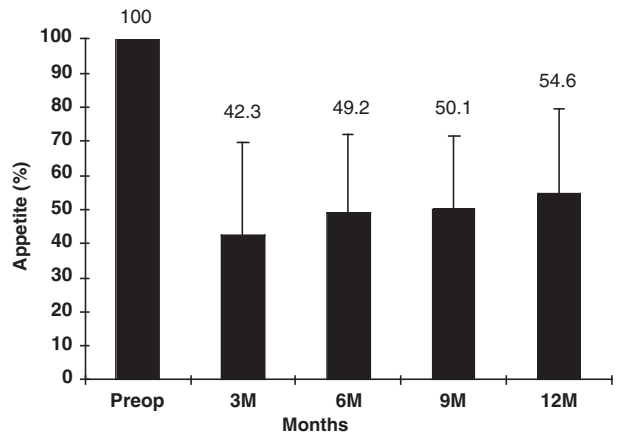


Figure 3. Appetite change after operation in percentage in the 60 patients who have reached 1 year of follow-up.

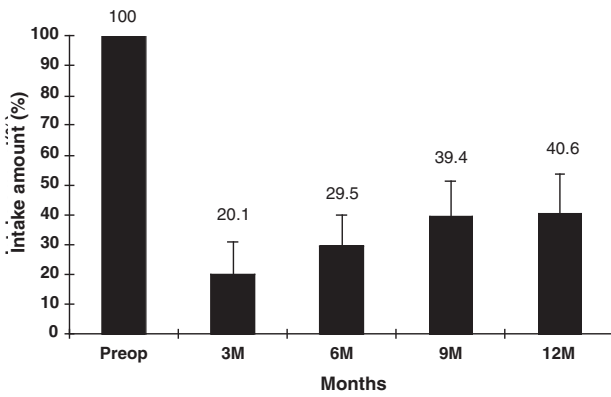


Figure 4. Changes in amount of intake in percentage in the 60 patients who have reached 1 year after LSG.

Discussion

Two types of bariatric operations exist – restrictive and malabsorptive. To optimize the results of surgery, surgeons should consider the patient's degree of weight, dietary habits, personality patterns, possible psychiatric illness, metabolic diseases and esophageal motility. In Korea, patients and their families often perceive a bariatric operation as an esthetic procedure rather than treatment for the disease of obesity. Thus, surgical complications are regarded as esthetic complications. The conceptualized understanding of the surgery is weak. Also, acceptance and handling of medico-legal issues are immature. Therefore, surgeons prefer to choose safer and simpler procedures to minimize the reported risks.¹²⁻¹⁵

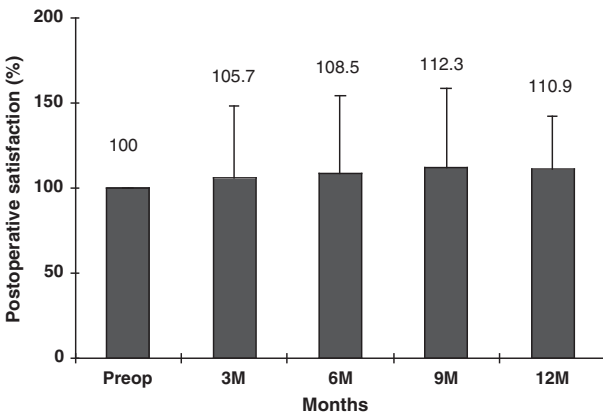


Figure 5. Postoperative satisfaction in percentage in the 60 patients who have passed 1 year after LSG.

Our morbidly obese patients diet composition differs from American morbidly obese patients. First, Koreans consume mainly carbohydrates and less protein and fat, do not exceed a BMI of 60, and have a higher incidence of central obesity. Fat intake is higher than in our normal weight individuals, but still lower than the recommendations for healthy Americans.^{10,16} Second, we tend to dine under pressure due to Confucianism, which leads to fast eating. Third, the meal (appetizer, main course, drinks) is served at once on one table, not in courses. Fourth, due to a low economic status in the past, the “clean plate syndrome” exists. Dietary habits must be considered when selecting the type of procedure. When defining the success of surgery in Korea, the patient's postoperative dietary habits and long-term follow-up visits play important roles in weight loss,¹⁴ continuous education and check-ups are especially needed. Our bariatric surgery is a staged operation; our success-rate with the first stage in the short-term (up to 1 year) has been 99.3%. Regan et al¹⁴ performed sleeve gastrectomy as a staged operation in patients with BMI ≥ 60 , and had decreased complications and mortality rate if a second-stage operation was needed. Therefore, the method that we are pursuing is safe, not only for Asians.

Because of the presence of obesity-related diseases at a lower BMI in Asians,^{1,4,6,7} and because EWL is based on Metropolitan Life studies in a North American population, there are no standards for Asians. According to the Reinhold classification¹¹ in our 60 patients, weight loss from sleeve gastrectomy was 71.6% at 6 months and 83.3% at 1 year, classified as excellent. One patient had EWL of 21.3% and thus underwent a 2nd stage operation.

Almogly et al¹² performed a sleeve gastrectomy in 21 patients, and 19 patients had an EWL of 45.1% at 1 year. In the latter group, the average preoperative BMI was 56, while in our patient, preoperative BMI was 37.2. Because of the large difference in BMI, it is difficult to compare the two groups in the same way, but our data represent an excellent result for Asian morbidly obese persons.

Gastric banding is widely used as a restrictive procedure, because it requires simple technique and a short operating time. Belachew et al¹⁷ reported 50-60% EWL after 5 years. However, Martikainen et al¹⁸ found only 36% EWL loss, which would be a low success-rate compared to our patients.

Co-morbidities in our patients improved with weight loss, especially diabetes which improved in 100%. Kim et al¹⁹ found improvement in diabetes with biliopancreatic diversion (BPD) with duodenal switch in 71% of patients. Scopinaro found improvement in diabetes in ~100%.²⁰ The reduced food intake after surgery and other mechanisms decrease insulin resistance.²¹⁻²⁴

Hypertension resolved in 13 of our 14 patients (92.9%). With sleeve gastrectomy, Almogy et al¹² reported that 62% of patients were hypertensive and 38.1% improved after the surgery. Dixon and O'Brien²³ reported improvement in 86% after gastric banding.

With hyperlipidemia, Scopinaro et al²⁰ found 100% improvement with BPD. However, after gastric banding, high density lipoprotein levels have increased, triglycerides levels decreased, and low density lipoprotein (LDL) levels have had no change.²⁵ In our patient material, LDL levels improved in 77% of patients, but in 23% showed either a decrease or increase. The difference might be related to our resection of the fundic portion of the stomach, because gastric banding involves no resection.²⁶ More research is needed to support this concept.

Three major surgical complications were seen in 3 patients (2.3%). The first complication was bleeding (0.7%), converted to an open gastrectomy. The second was atelectasis. The third complication was delayed bleeding (0.7%), and was re-operated for control. Almogy et al¹² found no complications with laparoscopic sleeve gastrectomy. Complications of laparoscopic gastric banding have been reported in 1.5%-12.3%;^{27,28} O'Brien and Dixon reported that 25.3% underwent re-operation.²⁷ Martikainen et al¹⁸ reported that 52% of gastric banding patients had complications, of which band erosion was a major problem which appeared within 3 years after surgery. Obstruction due to band slippage and pouch dilatation occurred in 5-8%.

After laparoscopic gastric bypass, Higa et al²⁹ reported an incidence of complications of 0.9% and DeMaria et al³⁰ of 5.1%. Anastomotic leakage after Roux-en-Y was cited as 4% by Anthone et al.³¹ Our data show leakage in only 0.7%, and we suggest the sleeve gastrectomy reduces major complications like leakage.

Gastric cancer is the most prevalent cancer in Asia. It should be considered for Asian morbidly obese patients who are planning to receive gastric bypass as their bariatric surgery. Khitin et al³² have reported cancer after gastric bypass. The early development of this

disease is difficult to diagnose in the bypassed stomach. Thus, gastric exclusion may be avoided when selecting the type of bariatric operation for Asians.

Weight loss improves quality of life. The Bariatric Analysis and Reporting Outcome System (BAROS) has been used widely to assess changes in EWL, obesity-related co-morbidities and quality of life based on patients' answers.³³ BAROS facilitates assessment of patient satisfaction. In patients who underwent gastric banding, Zinzindohoue et al³⁴ classified 500 patients into 4 categories: 6% failure, 18% fair, 49% good, 27% excellent; however, Martikainen et al¹⁸ reported 50% as unsuccessful and only 10% as success. These low scores on BAROS may be due to the complications of gastric banding. Our own quality of life questionnaires indicated that the satisfaction level was higher than expected. When rating patient satisfaction, a well-defined system like BAROS should be implemented to enable comparison with other studies.

The amount of dietary intake gradually increased during the first 6 months, but between 6 to 12 months, it stayed at about 40% of the original intake. The appetite level was at 54.6% at 12 months, which was a 50% reduction. Longer follow-up will indicate whether the sleeved stomach will enlarge significantly over time.

In summary, for the lower levels of morbid obesity and different dietary pattern which exist in Koreans, the sleeve gastrectomy has shown favorable results. However, the second-stage operation (malabsorptive duodenal switch)³⁵ may be needed especially for the rare Korean super-obese patient (BMI ≥ 50).

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