Metabolic outcomes in the first year after laparoscopic sleeve gastrectomy: a high-volume single-center experience

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Abstract. – OBJECTIVE: Laparoscopic sleeve gastrectomy (LSG) is the most preferred bariatric surgical procedure worldwide. LSG, a restrictive surgical method, has also proven to be a good metabolic surgery option. In this study, we examined weight loss and changes in metabolic parameters in our patients in the first year after LSG.

PATIENTS AND METHODS: In this retrospective cohort study, preoperative and postoperative first-year body mass index (BMI) changes, biochemical and hormonal analysis results, and excess weight loss (EWL) rates of 1,137 patients who underwent LSG were evaluated.

RESULTS: The median age of patients undergoing LSG was 39 years, and 943 (82.9%) of the patients were female while 194 (17.1%) were male. Preoperative BMI was 45.91 kg/m² and postoperative first-year BMI was 28.98 kg/m² (*p*<0.01). Fasting blood glucose, alanine aminotransferase, aspartate aminotransferase, total cholesterol, triglycerides, insulin, free thyroxine, thyroid-stimulating hormone, and HbA1c percentage levels were significantly low in the postoperative first year (*p*<0.001). EWL was 81.0% (68.4-97.9%) and sufficient weight loss (SWL; ≥50% of EWL) was 92.2% in the postoperative first year. Median age, the prevalence of type 2 diabetes mellitus, preoperative fasting plasma glucose levels, and preoperative triglyceride levels were higher in the SWL group than they were in the group with insufficient weight loss (EWL of <50%). Factors such as male sex, body weight, and triglyceride levels were positively correlated with adequate weight loss, while BMI and total cholesterol levels were negatively correlated with adequate weight loss. Patients with BMI of >46.87 kg/m² had a higher rate of adequate weight loss.

CONCLUSIONS: LSG is a bariatric surgical procedure providing satisfactory weight loss and metabolic outcomes in the short term. Weight loss success in the first year after LSG was higher among patients with a baseline BMI of 46 kg/m².

Key Words:
Laparoscopic sleeve gastrectomy, Metabolic outcomes, Surgical success.

Introduction

Obesity and related comorbidities incidence have been rapidly increasing in recent years and they impose serious burdens on health systems in many ways. Obesity is a serious health hazard, and it is recognized as a risk factor for type 2 diabetes mellitus (T2DM), hypertension, dyslipidemia, heart failure, and many other diseases. Therefore, obesity prevention and treatment have become popular areas of research. The results of several large studies[1-3] have shown that bariatric surgery is the most effective treatment for morbid obesity and its associated comorbidities. Bariatric surgery is also referred to as metabolic surgery because it shows its effects not only through weight loss but also by affecting a number of endocrinological and metabolic pathways.

Laparoscopic sleeve gastrectomy (LSG) is a type of bariatric surgery that quickly became the most preferred surgical procedure of its kind worldwide. LSG, which is a restrictive surgical method, has proven[4] to be a good metabolic surgical option, as the removal of the gastric fundus decreases the level of ghrelin, an orexigenic hormone produced in the fundus, and also accelerates gastrointestinal transit and strongly induces the effects of incretin.

A large proportion of obese patients are from younger age groups; therefore, the long-term effects of LSG are very important. While the first months after the operation are characterized by rapid weight loss and metabolic changes, it has been said that

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data[5] from the early period after LSG can predict results in the longer term. In this study, we investigate the weight loss and changes in metabolic values in our patients in the first year after LSG.

Patients and Methods

This study included 1,332 patients aged 18-65 years who underwent LSG performed by a single experienced surgeon between 02.01.2015 and 15.11.2021. This cohort study involved retrospective analysis of prospectively collected data. Age, sex, height, weight, body mass index (BMI), and laboratory data of the patients preoperatively (3 months before surgery) and at the end of the first year postoperatively were analyzed using obesity follow-up forms. Biochemical and hormonal results including fasting blood glucose (FBG; mg/dL), creatinine (mg/dL), alanine aminotransferase (ALT; mg/dL) (Beckman Coulter, Hormone Analyzer, Brea, CA, USA), aspartate aminotransferase (AST; mg/dL) (Beckman Coulter, Hormone Analyzer, Brea, CA, USA), total cholesterol (mg/dL), triglycerides (mg/dL), HbA1c (mmol/IU) (Allied Fully Automated H9 HbA1c Analyzer, Mumbai, India), fasting insulin (mIU/L) (Beckman Coulter, Hormone Analyzer, Brea, CA, USA), free triiodothyronine (fT3; pg/dL) (Abbott Alinity, IL, USA), free thyroxin (fT4; ng/dL) (Abbott Alinity, IL, USA), and thyroid-stimulating hormone (TSH; mIU/L) (Abbott Alinity, IL, USA), levels were recorded. Homeostasis model assessment of insulin resistance (HOMA-IR) values were calculated preoperatively and postoperatively, and patients with T2DM were identified[6]. Patients with a preoperative diagnosis of T2DM who had postoperative FBG of <126 mg/dL, HbA1c level of <6.5%, and no medical treatment for diabetes in at least the last 3 months were considered to be in T2DM remission. Patients whose data could not be accessed from obesity follow-up forms, whose file data were incomplete, who could not be followed regularly postoperatively, who were diagnosed with any detectable malignancy in the postoperative period, who were pregnant in the postoperative period, or who underwent revision bariatric surgery within the first year postoperatively were not included in the study.

All patients included in the study had undergone LSG according to the recommendations of the American Society for Metabolic and Bariatric Surgery (BMI of ≥40 kg/m^2 or BMI of ≥35 kg/m^2 with one or more additional comorbidity and approval for the surgery due to an inability to lose weight with diet and physical activity)[7].

BMI was calculated by dividing weight in kilograms by height in meters squared (kg/m^2). The percentage of excess weight loss (%EWL) was calculated by assuming a normalized body weight at a BMI of 25, dividing the postoperative weight loss by the preoperative excess weight, and multiplying the result by 100 [EWL = (Preoperative weight – postoperative weight)/(preoperative weight – ideal body weight) × 100][8].

Statistical Analysis

Data were analyzed with SPSS 25.0 (IBM Corp., Armonk, NY, USA). Kolmogorov-Smirnov and Shapiro-Wilk tests were used for normality analysis. Categorical data were expressed as numbers and percentages (%). Numerical variables with normal distribution were shown as means and standard deviations, and non-normally distributed numerical variables were shown as medians and interquartile ranges (IQR 25-75%). The Chi-square test was used to compare categorical variables between two groups. The Mann-Whitney U test was used to compare numerical variables between groups that did not comply with normal distribution. Spearman correlation analysis was performed to identify variables that correlated with insufficient and sufficient weight loss. Binary logistic regression analysis was applied for the variables affecting adequate weight loss. Receiver operating characteristic (ROC) curve analysis was used for BMI to determine the cut-off value of sufficient weight loss. The statistical significance level for all the test was set as $p<0.05$.

Results

This study was conducted with 1,137 patients. Some patients were excluded for the following reasons: 2 patients due to pregnancy in the postoperative period, 7 patients due to a lack of obesity follow-up forms, 1 patient due to having been diagnosed with lymphoma in the postoperative period, and 185 patients due to incomplete data in obesity follow-up forms. In the early postoperative period (<30 days), a staple line leak was observed in 1 patient, anastomosis leakage in 1 patient, and deep vein thrombosis in 2 patients. In the late postoperative period (>30 days), dumping syndrome was observed in 7 patients, hypoglycemic attacks in 2 patients, and incisional hernia complications in 23 patients.

The median age of patients undergoing LSG was 39 years, and 943 (82.9%) were female while 194 (17.1%) were male. BMI was 45.91 kg/m^2 preoperatively and 28.98 kg/m^2 in the first postoperative year (p<0.01). Creatinine, AST, and fT3 levels were significantly high while FBG, ALT, total cholesterol, triglycerides, insulin, fT4, TSH, and HbA1c percentage levels were significantly low in the first postoperative year (p<0.001). The percentage of excess weight loss (%EWL) was 81.0% (68.4-97.9%). Sufficient weight loss (SWL; >50% of EWL) was achieved by 92.2% (1,048/1,137) of the patients (Figure 1; Table I).

The number of patients with BMI of 35-40 kg/m^2 before surgery was 26 (2.3%), while 887 (77.8%) had BMI of 40-50 kg/m^2, and 226 (19.9%) had BMI of >50 kg/m^2. The categorization of patients according to BMI after the first postoperative year was as follows: BMI of 20-25 kg/m^2 in 220 cases (19.3%), 25-30 kg/m^2 in 418 cases (36.8%), 30-35 kg/m^2 in 383 cases (33.7%), 35-40 kg/m^2 in 77 (6.8%) cases, and >40 kg/m^2 in 39 cases (3.4%).

When the patients were divided into two subgroups, (those with preoperative BMI values below and those above 50 kg/m^2), the EWL value of the group with BMI of ≥50 kg/m^2 was 94.2% and the EWL value of the group with BMI of <50 kg/m^2 was 84.1% (p<0.001).

The patients who underwent LSG were also divided into two groups: having adequate weight loss (EWL of ≥50%) and inadequate weight loss (EWL of <50%) in the first postoperative year. While there was no difference between the adequate and inadequate weight loss groups in terms of sex, median age, prevalence of T2DM, preoperative FBG levels, and preoperative triglyceride levels were higher in the adequate weight loss group as preoperative BMI and preoperative total cholesterol levels were higher in the inadequate weight loss group (Table II).

While triglyceride levels were positively correlated with SWL (r=0.126, p<0.001), age, BMI, and FBG levels were negatively correlated with SWL (respectively r=-0.075, p<0.011; r=-0.127, p<0.001; r=-0.087, p<0.01).

Logistic regression analysis was performed to determine the factors associated with adequate weight loss. Male sex, body weight, and triglyceride levels were positively correlated with adequate weight loss, while BMI and total cholesterol levels were negatively correlated with adequate weight loss (p<0.05) (Table III).

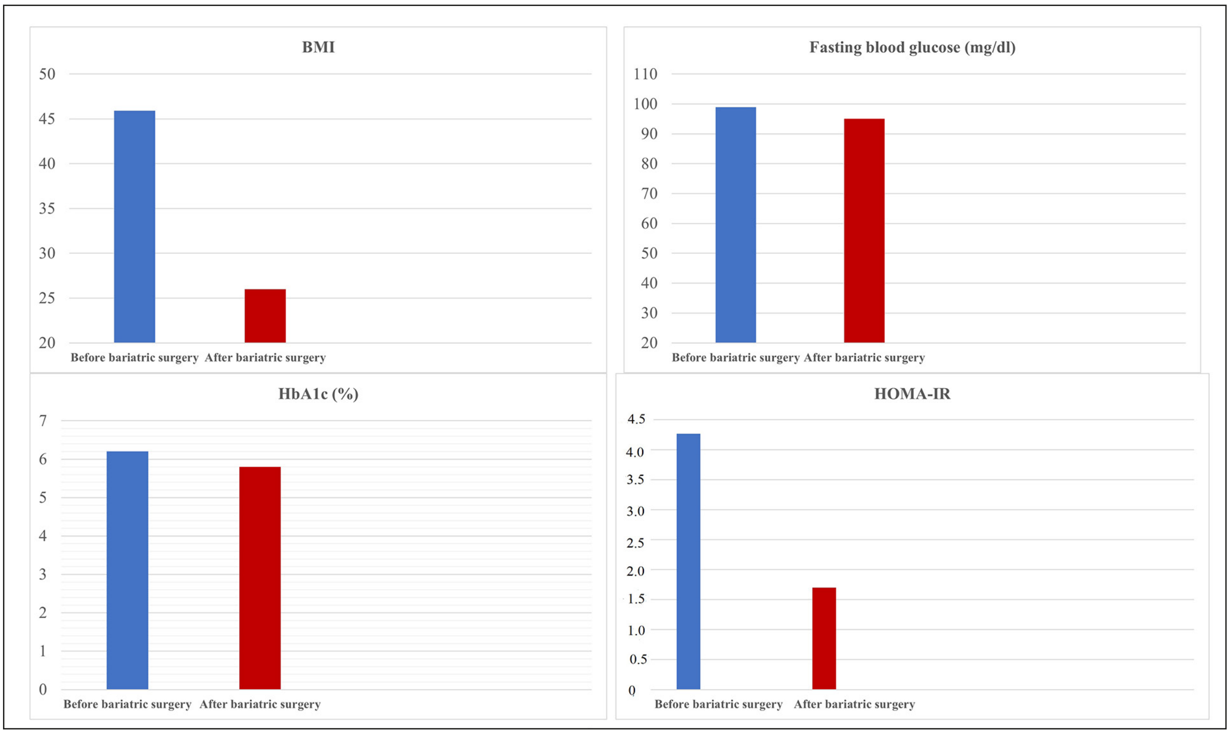

Figure 1. BMI, FBG, HbA1c, and HOMA-IR values of patients before and after surgery; data are presented as median values. BMI: Body mass index, FBG: Fasting blood glucose, HbA1c: Glycated hemoglobin, HOMA-IR: Homeostasis model assessment-insulin resistance.

Table I. Demographic characteristics and laboratory findings of patients before and in the first year after laparoscopic sleeve gastrectomy.

	Before surgery	After surgery Median (IQR: 25-75%)	*p**
Age (years)		39.0 (30.0-47.0)	
Sex, n (%)			
Female	943 (82.9)		
Male	194 (17.1)		
BMI (kg/m²)	45.91 (42.21-48.45)	28.98 (25.39-31.47)	**<0.01**
FBG (mg/dL)	99.0 (89.0-113.0)	95.0 (85.0-99.0)	**<0.01**
Creatinine (mg/dL)	0.72 (0.66-0.76)	0.75 (0.67-0.90)	**<0.01**
ALT (mg/dL)	30.9 (21.0-31.0)	29.0 (20.0-31.0)	**<0.01**
AST (mg/dL)	23.6 (19.0-23.6)	29 (20.0-31.5)	**<0.01**
Total cholesterol (mg/dL)	227.0 (192.0-232.8)	188.1 (178.1-198.1)	**<0.01**
Triglyceride (mg/dL)	182.6 (128.0-182.6)	138.4 (128.3-148.4)	**<0.01**
HbA1c (%)	6.2 (5.7-6.2)	5.8 (5.7-5.8)	**<0.01**
Insulin (mIU/L)	18.8 (13.0-18.9)	7.6 (6.5-7.6)	**<0.01**
T2DM diagnosis, n (%)	151 (13.3)	137 (10.8)	**0.258α**
HOMA-IR	4.27 (3.25-5.68)	1.70 (1.43-1.83)	**<0.001**
fT3 (pg/dL)	3.25 (2.90-3.25)	3.4 (2.7-3.7)	**<0.01**
fT4 (ng/dL)	1.15 (1.00-1.40)	1.11 (1.03-1.11)	**<0.01**
TSH (mIU/L)	2.24 (1.54-2.30)	1.55 (0.90-1.55)	**<0.01**
Total weight loss (%)	—	36.00 (30.00-43.57)	—
Percentage of excess weight loss (%EWL)	—	81.0 (68.4-97.9)	
Sufficient weight loss (≥50% of EWL)			
Yes		1048 (92.2)	
No		89 (7.8)	

*Wilcoxon signed rank test, αMcNemar test, IQR: Interquartile range, ALT: Alanine aminotransferase, AST: Aspartate aminotransferase, BMI: Body mass index, FBG: Fasting blood glucose, fT3: Free triiodothyronine, fT4: Free thyroxine, TSH: Thyroid-stimulating hormone, T2DM: Type 2 Diabetes mellitus, HOMA-IR: Homeostasis model assessment-insulin resistance, HbA1c: Glycated hemoglobin.

Table II. Demographic and laboratory parameters of patients with sufficient and insufficient weight loss.

	Sufficient weight loss (EWL ≥50%)	Insufficient weight loss (EWL <50%)	*p**
	Median (IQR: 25-75%)		
Age (years)	38.0 (30.0-47.0)	43.0 (36.0-47.0)	**0.011**
Sex, n (%)			
Female	869 (82.9)	74 (83.1)	0.957β
Male	179 (17.1)	15 (16.9)	
Baseline body weight (kg)	120.0 (110.0-130.0)	146.5 (120.0-160.0)	0.126
BMI (kg/m²)	45.8 (42.2-48.1)	48.0 (44.0-55.6)	**<0.001**
T2DM diagnosis, n (%)	139 (13.3)	12 (13.5)	0.953β
Before surgery - FBG (mg/dL)	113.0 (98.0-151.0)	110.7 (104.0-170.0)	**<0.01**
Before surgery - HbA1c (%)	6.2 (5.7-6.2)	6.2 (5.6-6.2)	0.841
Before surgery - insulin (mIU/L)	18.8 (13.1-18.9)	18.8 (12.6-18.8)	0.195
Before surgery - total cholesterol (mg/dL)	232.8 (227.0-243.2)	181.1 (181.-203.0)	0.259
Before surgery - triglyceride (mg/dL)	182.6 (132.0-192.6)	138.4 (112.0-138.4)	**<0.001**
After surgery -BMI (kg/m²)	28.6 (25.6-30.8)	38.9 (36.0-43.0)	**<0.001**
After surgery - FBG (mg/dL)	95.0 (85.0-99.0)	95.0 (87.0-98.5)	0.071
After surgery - HbA1c (%)	5.8 (5.7-5.8)	5.8 (5.7-5.8)	0.723
After surgery - insulin (mIU/L)	7.6 (6.6-7.6)	7.6 (6.1-7.6)	0.225
After surgery - total cholesterol (mg/dL)	181.1 (178.1-198.1)	178.1 (178.0-203.0)	**0.011**
After surgery - triglyceride (mg/dL)	138.4 (128.4-138.4)	138.4 (112.0-138.4)	0.139

*Mann-Whitney U test, βChi-square test, IQR: Interquartile range, BMI: Body mass index, FBG: Fasting blood glucose, T2DM: Type 2 Diabetes Mellitus, HbA1c: Glycated hemoglobin.

Table III. Logistic regression analysis of variables for sufficient weight loss.

	B	SE	Wald	df	*p*	OR	95% CI (upper-lower)
Age	-0.003	0.012	0.000	1	0.836	0.997	0.974-1.022
Sex	0.691	0.346	3.984	1	**0.046**	1.996	1.013-3935
Body weight	0.037	0.035	8.718	1	**0.003**	1.038	1.012-1.063
BMI (kg/m^2)	-0.178	0.035	26.327	1	**<0.001**	0.837	0.782-0.896
T2DM diagnosis	0.838	0.573	2.135	1	0.144	2.311	0.751-7.106
FBG (mg/dL)	-0.004	0.003	2.129	1	0.145	0.996	0.990-1.002
Total cholesterol (mg/dL)	-0.008	0.004	4.942	1	**0.026**	0.992	0.984-0.999
Triglyceride (mg/dL)	0.011	0.003	17.291	1	**<0.001**	1.011	1.006-1.016
HbA1c (%)	-0.190	0.117	2.646	1	0.104	0.827	0.658-1.040
Insulin (mIU/L)	0.004	0.015	0.060	1	0.806	1.004	0.975-1.033
TSH (mIU/L)	0.228	0.136	2.820	1	0.093	1.256	0.963-1.638
fT3 (pg/dL)	-0.095	0.045	4.359	1	**0.037**	0.910	0.833-0.894
fT4 (ng/dL)	0.003	0.220	0.000	1	0.998	1.003	0.6511-1.545

BMI: Body mass index, T2DM: Type 2 Diabetes Mellitus, FBG: Fasting blood glucose, HbA1c: Glycosylated hemoglobin, fT3: Free triiodothyronine, fT4: Free thyroxine, TSH: Thyroid-stimulating hormone.

According to whether sufficient weight loss was achieved or not as a categorical variable, ROC analysis was carried out for the relationship between SWL and BMI. The BMI cut-off was calculated as 46.87 kg/m^2 with area under the curve of 0.964, sensitivity of 0.364, and specificity of 0.427 ($p<0.001$) (Figure 2; Table IV).

Discussion

In response to the rapidly increasing rates of obesity around the world, lifestyle changes, medical treatments, and bariatric surgical methods are being used. It is estimated that by the year 2030, at least half of the population of many European countries and the United States will consist of obese individuals[9]. In patients undergoing medical treatment for obesity, weight loss is considered to be very good if it is about 10-15% and excellent if it is above 15%. However, the methods used for medical treatment today generally achieve less than 10% weight loss. Since the most effective treatment for high rates of weight loss is bariatric surgery, its application rates have been increasing rapidly both in Turkey and around the world[10,11].

The biggest challenges in obtaining successful outcomes by LSG are the maintenance of weight loss and minimizing weight regain in the long term. Literature data show that weight loss is greatest in the first months and the first year after bariatric surgical procedures. However, a certain amount of weight is regained in the following years. According to the Swedish Obese Subjects (SOS) study[12], patients had regained approximately 20-25% of the weight lost within 10 years after their surgery. The main reason for this appears to be related to lifestyle modifications, but there are other various reasons for weight gain after bariatric surgery, such as changes in the entero-hypothalamic axis by gastrointestinal hormones including glucagon-like peptide 1 (GLP-1), ghrelin,

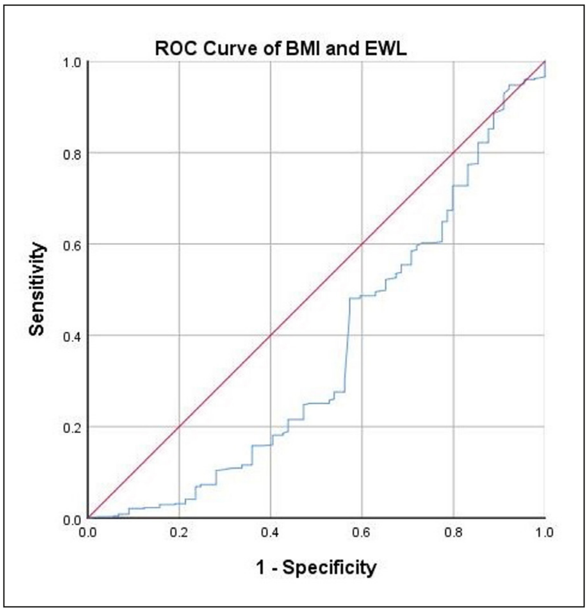

Figure 2. ROC analysis of body mass index and sufficient weight loss.

Table IV. ROC analysis of body mass index and sufficient weight loss.

	AUC (95% CI)	Cut-off value according to Youden's index	*p*	Sensitivity	Specificity
BMI	0.364	46.87	<0.001	0.454	0.427

AUC: Area under the curve, CI: Confidence interval, BMI: Body mass index.

glucose-dependent insulinotropic polypeptide (GIP), and the adipokine leptin, as well as very high preoperative BMI, low physical activity levels, eating behavior disorders, and neglect of postoperative follow-up examinations by patients[5,8,13].

The most significant outcome in case of bariatric surgery is postoperative weight loss, with success being defined as EWL of ≥50% after LSG. This effect of LSG seems to be related to a restrictive procedure and plasma ghrelin levels decrease and GLP-1 and peptide YY levels increase after surgery[14]. In the study conducted by Zachariah et al[15] with 228 participants, postoperative first-year EWL was 72.3% and fifth-year EWL was 71.9%. However, they had 129 patients with 1-year follow-up data, 33 patients with 3-year follow-up data, and only 6 patients with 5-year follow-up data. Golomb et al[8] reported postoperative data of 443 patients who underwent LSG, including data for 54% at year 1, 49% at year 3, and 69% at year 5, and they found that postoperative EWL at year 1 was 76.8%, at year 3 was 69.7%, and at year 5 was 56.1%. Our EWL result (81%) reflects a higher success rate of bariatric surgery than was previously reported[8]. Moreover, we were able to achieve adequate weight loss in a very large proportion of cases (92.2%). We believe that this outcome is related to the procedure followed in the study. For example, we analyzed data from patients who had been monitored endocrinologically for obesity for at least six months during the preoperative period. Also, we psychologically prepared the patients to ensure high levels of motivation for the postoperative period by conducting frequent patient information meetings regarding the expected dietary and lifestyle changes in the postoperative period, and that patients were closely followed by the Endocrinology Department postoperatively. However, it should be noted that EWL values in the first year after LSG do not guarantee long-term permanent weight loss. A second battle against obesity begins in the postoperative period to preserve the high EWL values obtained in the early postoperative period or to ensure a slight decrease in follow-up. Meta-analyses[11,16,17] have reported regression in EWL after the second or third postoperative year. Since our findings include data from only the first postoperative year, we cannot comment on this issue prospectively. The data should be reanalyzed after long-term follow-up of the patients is completed.

In our analysis, we found that patients with BMI values of >46.87 kg/m^2 lost sufficient weight at a higher rate after LSG. Perathoner et al[14] reported the same result for a BMI cut-off value of 45 kg/m^2, similar to our findings. As the similar results were obtained in these studies, it can be concluded that patients with severe BMI levels benefit more from LSG in the early period. Furthermore, the EWL value of the group with preoperative BMI of ≥50 kg/m^2 was 94.2%, indicating a very high rate of surgical success among super-obese patients (i.e., those with BMI of ≥50 kg/m^2). Ozturk and Celik[18] also calculated the 2-year EWL of 138 super-obese patients as 92% after LSG. Although Thereaux et al[19] stated that laparoscopic Roux-en-Y gastric bypass is more effective than LSG for super-obese patients, and LSG seems to stand out as a more effective and safe method for this population.

Although the success of bariatric surgical methods is defined according to weight loss, evaluations of metabolic recovery parameters are also important. Romano et al[20] examined T2DM effects on post LSG weight loss and they concluded that the changes over time of the BMI were affected by the presence of T2DM. Similarly, Ozturk et al[21] found that the 6-month postoperative weight and BMI values were higher in T2DM group of patients. Golomb et al[8] found complete remission of T2DM in 50.7% of their patients at 1 year, 38.2% at 3 years, and 20% at 5 years. Changes in total cholesterol were not found to be statistically significant, and no correlation was determined between hypertriglyceridemia and EWL at 3 years and 5 years of follow-up. In another study[14], 85% regression in T2DM and 50% regression in dyslipidemia were observed in the first year. In our series, a significant decrease was observed in FBG, insulin, HOMA-IR, HbA1c, triglyceride, and total cholesterol levels in the first year. However, we did not observe a statistically significant decrease in the number of patients with T2DM in the first postoperative year.

We think that this is due to the fact that our criteria for T2DM remission were strict. We also found that advanced age, high BMI levels, and high FBG levels were associated with inadequate weight loss, whereas triglyceride levels were positively associated with adequate weight loss. Considering that the high triglyceride levels in prediabetic and diabetic individuals are associated with glucotoxicity, it can be concluded that the application of LSG before patients reach diabetic levels is associated with higher weight loss success.

Although obesity rates are equal for men and women, the majority of patients undergoing bariatric surgery are female[22]. In our patient population, 83% of the patients were female. Literature data show that male patients lose more weight after bariatric surgery than female patients. It has been suggested[5,23] that this difference is the result of higher percentages of fat mass loss and increased lean muscle mass in male patients. Although we found that male gender was positively associated with adequate weight loss, surprisingly, no significant sex difference was found in terms of weight loss in our study. This may be due to the predominance of women in our patient population. It is noteworthy that the rate of weight loss after bariatric surgery is lower in women while the rate of weight regain is higher. According to Meguid et al[24], this can be attributed to the inability to maintain high plasma peptide YY concentrations and failure to adapt to changes in eating habits and diet among women. In addition, it is noteworthy that postoperative complications, rehospitalization, and revision surgery rates are higher among women than men[25,26].

Another result of our study was the observation of prominent changes ion thyroid functions. We observed that TSH and fT4 levels increased and fT3 levels decreased. It is known that TSH levels are higher in obese patients than in normal-weight individuals and they decrease after LSG. However, there is no consensus in the literature regarding changes in fT3 and fT4 levels. These differences are thought[27-30] to be due to various reasons, such as leptin hormone-related mechanisms or, iodine absorption problems caused by accelerated gastrointestinal passage after bariatric surgery.

Limitations

The main limitations of our study include the fact that we evaluated data from only the first postoperative year, that some metabolic syndrome parameters such as blood pressure and high-density lipoprotein (HDL) cholesterol could not be evaluated, and that other medical treatments of the patients were not included in the evaluations. On the other hand, our large number of patients and preoperative and postoperative comparisons of metabolic parameters and thyroid function are the strengths of our study.

Conclusions

The advantages of LSG can be listed as satisfactory weight loss results and the relative simplicity and safety of the technique. There is a tendency for significant improvement in metabolic parameters in the first year after LSG. Surgical success increases as BMI values increase. Although results after LSG are satisfactory in the short to medium term, long-term regular follow-up is essential.

Ethics Approval

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethics Committee approval was obtained from the Clinical Research Ethics Committee of the Health Sciences University Ankara Atatürk Sanatoryum Education and Research Hospital (Project No.: 2012-KAEK-15/2588).

Informed Consent

Not applicable due to the retrospective nature of the study.

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Authors' Contributions

Conception and design: Koca AO; Acquisition of data: Bulus H; Analysis and interpretation of data: Koca AO, Bulus H; Drafting the article: Koca AO; Supervision: Bulus H; Validation and final approval: Koca AO, Bulus.

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Conflicts of Interest

The authors declare no conflicts of interest.

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article.

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