

An analysis of weight loss failure and weight regain in patients undergoing laparoscopic sleeve gastrectomy

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ABSTRACT

Introduction: The present study evaluates the weight regain (WR) and weight loss failure at the end of 4 years in patients undergoing laparoscopic sleeve gastrectomy (LSG).

Materials and Methods: The data of patients who underwent a LSG in a single center for the treatment of morbid obesity were reviewed and analyzed retrospectively. Body mass index (BMI) was measured before surgery in all patients. The patients underwent a control examination and BMI measurement at 1, 2, 3, and 4 years. The data were analyzed using the Statistical Package for the Social Sciences.

Results: A total of 179 patients were included in the study. The proportion of male patients was significantly higher in the group of patients who re-gained weight than in those who did not re-gain weight at the end of 4 years. The rate of smokers was lower in the group of patients who re-gained weight than those who did not re-gain weight at the end of 4 years ($p < 0.05$).

Conclusion: The short- and long-term results of the present study suggest that LSG is an effective bariatric surgery procedure. WR was at the lowest levels in the first 3 years after LSG, but showed a progressive increase at the end of 4 years.

Keywords: Laparoscopic sleeve gastrectomy, obesity, weight loss failure, weight regain

Introduction

Bariatric surgery is an effective means of therapy in the fight against obesity-related diseases in the face of the increasing incidence of obesity.^[1] That said, more than 15% of patients undergoing bariatric surgery will fail to lose more than 50% of the excess weight.^[2,3] Weight regain (WR) may harm the patient due to the recurrence of obesity-related comorbidities.^[4]

Sleeve gastrectomy (SG) was proposed as the first stage of a staggered duodenal switch procedure and afterward

became a restrictive bariatric surgical procedure of its own.^[5] The procedure has gained popularity among both bariatric surgeons and patients. It is preferred due to the relatively better outcomes in terms of weight loss in the short and medium-term, its relatively operative simplicity, and the low operation risk.^[6,7] Having said that, approximately 30% of patients undergoing laparoscopic SG (LSG) as a result of morbid obesity require revision surgery due to insufficient weight loss and WR.^[8,9] The present study reports on a retrospective evaluation of patients with WR and weight loss failure throughout a 4-year follow-up after



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LSG. The study investigates the factors that may contribute to these problems.

Materials and Methods

The data of patients who underwent LSG in a single center as treatment for morbid obesity between January 2014 and May 2016 were reviewed and analyzed retrospectively. The study included patients aged 18–65 years. Patients undergoing bariatric surgical procedures other than LSG and revision surgery were excluded from the study. Body mass index (BMI) was measured prior to surgery in all patients. Comorbid conditions, hypertension (use of antihypertensives), diabetes (use of anti-diabetic drugs or insulin), smoking status, and alcohol use were recorded. The BMI of all patients was above 40 kg/m². All procedures were performed by a single surgeon, following the same procedure. A Jackson-Pratt drain was routinely placed into the abdominal cavity. Methylene blue was perorally administered 3 days after surgery for control purposes, after which a diet regimen was initiated.^[7,10] Drains were removed on post-operative days 4 or 5 and the patients were discharged. The patients underwent a control examination and BMI measurement at 4 years (The patients were followed up for 4 years. During the 4-year follow-up period, it was performed with a dietitian at 1, 3, and 6 months for the first 6 months, and then every 6 months. Control examinations and BMI measurements were evaluated. During this period, the same diet program was applied to all patients).

The long-term outcomes were analyzed in terms of percentage of excess weight loss (%EWL) which is considered successful if the patient achieved 50% after 4 years. %EWL = weight loss/excess weight × 100, where excess weight = total weight pre-bariatric surgery – ideal weight.^[9] WR was defined as an increase of at least 10% of the lowest post-operative weight.^[11]

The patients were divided into two groups, as patients with and without weight loss failure at 4 years. Similarly, patients were divided into two groups as patients with and without WR at 4 years. The demographic data of the patients, as well as the pre-operative and post-operative findings, were entered onto the Statistical Package for the Social Sciences (SPSS) software, and the data of the two groups were compared. Board of ethics approval for this study was obtained from the ethics commission of local University. Approval no: 2019/6-19 Approval date: 17/09/2019.

Statistical Analysis

Descriptive statistics included mean, standard deviation, median, minimum, maximum, frequency, and ratio values. A Kolmogorov–Smirnov test was used to test whether the variables were normally distributed. A Mann–Whitney U-test was used for the analysis of quantitative independent variables. A Chi-square test was used for the analysis of qualitative variables and a Fisher's exact test was used if the conditions were not met for a Chi-square test. SPSS version 22.0 software was used for the analysis.

Results

A total of 186 patients were enrolled in this retrospective study from between the specified study dates (A total of 186 patients were included in this retrospective study between the dates specified). Of the total, three patients were lost to follow-up (did not regularly attend control visits) and four patients underwent revision surgery, and so were excluded from the study. The study was completed with 179 patients. The demographic data of the patients are presented in Table 1. At the end of 4 years, no significant difference was found in terms of age, BMI, remission of diabetes and hypertension, and alcohol use between patients with and without WR ($p > 0.05$). The proportion of male patients was significantly higher in the group of patients who re-gained weight than in those who did not re-gain weight at the end of 4 years. The proportion of smokers was significantly lower in the group of patients who re-gained weight than in those who did not re-gain weight at the end of 4 years (Table 2). The rate of weight loss failure at 1 and 2 years did not differ significantly between with and without WR at 4 years ($p > 0.05$). There was no significant difference in terms of age, gender, pre-operative BMI, diabetes, hypertension, alcohol use, and smoking status at the end of 4 years between patients with and without weight loss failure ($p > 0.05$) (Table 3).

Discussion

The study was completed on a total of 179 patients who were followed up for 4 years following LSG. At the end of 4 years, weight loss failure was observed in 29 patients (16.2%) and WR was observed after surgery in 92 patients (51.4%). When the factors affecting the outcomes were evaluated, no statistically significant parameter was identified other than smoking status and male gender (When the factors affecting the results were evaluated, no statistically significant parameter was detected except smoking status and male gender).

Table 1. The general characteristics and demographic data

	Min	Max	Median	Mean±SD	n	%
Age	17	65	36	35.5±10.3		
Sex						
Female					124	69.3
Male					55	30.7
BMI	40	59	46	45.8±3.5		
BMI						
≤45					87	48.6
>45					92	51.4
DM					122	68.2
HT					88	49.2
Smoke					46	25.7
Alcohol					19	10.6
1 year %EWL	42	99	68	68.9±11.2		
2 year %EWL	40	100	73	73.3±12.8		
3 year %EWL	35	100	76	75.6±13.2		
4 year %EWL	20	100	66	65.8±16.4		
Weight regain						
1 year					0	0.0
2 year					3	1.7
3 year					19	10.6
4 year					92	51.4
Weight loss failure						
1 year					5	2.8
2 year					5	2.8
3 year					8	4.5
4 year					29	16.2

BMI: Body mass index; DM: Diabetes mellitus; HT: Hypertension; %EWL: Percent excess weight loss.

LSG is one of the most widely performed bariatric surgical methods worldwide, with notable weight loss success reported in the short- and medium-term.^[12] The number of publications reporting short- and medium-term outcomes has increased with the widespread use of this procedure. In a study involving 1050 patients undergoing LSG, Nocca et al.^[13] reported a 5-year %EWL of 65.9%. Similarly, 2-year and 5-year %EWL was reported to be 57.1% and 50.7% in a retrospective study by Catheline et al.^[14] There are similar studies in the literature supporting these results,^[15,16] although other studies in the literature report 20–25% weight loss due to insufficient weight loss and WR over time.^[16,17] In a series of 96 cases, Lemanu et al.^[18] reported a 5-year %EWL of 40% following LSG. Similarly, Keren et al.^[19] reported a 5-year %EWL of 45% in a study involving 130 patients who underwent LSG. The mean %EWL was

found to be 66% (65.8±16.4) in the present study. When compared to the literature, it would seem to be a successful procedure in terms of ensuring weight loss.

When patients are evaluated after LSG, a mean %EWL greater than 50% is considered to indicate a successful procedure, although this value may not indicate the same level of success in all patients. Research studies in the literature investigating inadequate weight loss have often focused on comparisons of different surgical procedures.^[20,21] In their retrospective study, Yormaz et al.^[22] compared antral resection lengths in patients undergoing LSG. Similarly, a prospective randomized study compared two patient groups undergoing LSG with antral resection, one 2 cm distant and the other 6 cm distant to the pylorus, and after 2 years, %EWL was significantly higher in the first group.^[23] In the present study, 29 patients (16.2%) recorded

Table 2. Characteristics of patients who regain weight (At the end of the 4th year)

	Weight regain (-)				Weight regain (+)				p
	Mean±SD	n	%	Median	Mean±SD	n	%	Median	
Age	35.7±10.4			36.0	35.3±10.2			35.0	0.915
Sex									
Female		69	79.3			55	59.8		0.005 X ²
Male		18	20.7			37	40.2		
BMI	45.9±3.8			46.0	45.7±3.2			45.0	0.971
BMI									
≤45		40	46.0			47	51.1		0.494 X ²
>45		47	54.0			45	48.9		
DM		56	64.4			66	71.7		0.290 X ²
HT		42	48.3			46	50.0		0.818 X ²
Smoke		30	34.5			16	17.4		0.009 X ²
Alcohol		13	14.9			6	6.5		0.068 X ²
%EWL									
1 year	68.1±11.2			67.0	69.7±11.2			70.0	0.340
2 year	73.1±12.9			73.0	73.5±12.8			74.5	0.651
3 year	76.3±12.2			75.0	75.0±14.1			76.0	0.700
4 year	76.6±11.6			77.0	55.5±13.5			56.5	0.000
Weight regain									
1 year		0	0.0			0	0.0		1.000 X ²
2 year		0	0.0			3	3.3		0.246 X ²
3 year		5	5.7			14	15.2		0.040 X ²
Weight loss failure									
1 year		3	3.4			2	2.2		0.605 X ²
2 year		2	2.3			3	3.3		0.696 X ²
3 year		1	1.1			7	7.6		0.037 X ²

^mMann-whitney-u test/X² Ki-kare test (Fischer test); BMI: body mass index; DM: diabetes mellitus; HT: hypertension; %EWL: Percent excess weight loss.

weight loss failure at 4 years. When patients with and without weight loss failure were compared, factors such as pre-operative comorbidities, smoking status, and alcohol use were found to have no effect on the %EWL.

WR is a known factor following LSG, as in any other bariatric surgical method. WR may be related to various factors and may be attributed to a primary or secondary failure of surgery. Primary failure is defined as an incomplete resection of the gastric fundus (>250 ml), while secondary failure is defined as a gradual increase in gastric volume with a resulting increase in appetite, leading to weight increase. In a study of 284 cases, Misra et al.^[12] observed WR in 50 patients (17.6%) 3 years after LSG, and the number of cases increased to 111 (39.1%) at the end of 5 years. Similarly, Saliba et al.^[24] showed WR following

LSG in 5.7% of patients at 2 years and in 75% of patients at 6 years. In the present study, WR was observed in 19 patients (10.6%) at 3 years and in 92 patients (51.4%) at 4 years. This was consistent with the literature. The authors consider that the close follow-up of patients following LSG particularly after 3 years would contribute to the early recognition and treatment of patients who are prone to WR.

The male gender was found to be a risk factor when the group of patients with WR at 4 years was compared with those without WR. Interestingly, the rate of WR was significantly lower among smokers. In their study, Lent et al.^[25] identified no significant relationship between smoking and bariatric surgical procedures, while Maniscalco et al.^[26] found that smoking had no significant effect on

Table 3. Patients with and without weight loss failure (At the end of the 4th year)

	Weight loss failure (-)				Weight loss failure (+)				p
	Mean±SD	n	%	Median	Mean±SD	n	%	Median	
Age	35.5±10.4			35.0	35.3±9.7			37.0	0.977 ^m
Sex									
Female		104	69.3			20	69.0		0.969 X ²
Male		46	30.7			9	31.0		
BMI	45.6±3.5			45.0	46.7±3.6			47.0	0.123 ^m
BMI									
≤45		76	50.7			11	37.9		0.209 X ²
>45		74	49.3			18	62.1		
DM		99	66.0			23	79.3		0.159 X ²
HT		73	48.7			15	51.7		0.763 X ²
Smoke		40	26.7			6	20.7		0.500 X ²
Alcohol		16	10.7			3	10.3		0.959 X ²
%EWL									
1 year	69.9±11.0			68.5	63.6±10.6			62.0	0.007 ^m
2 year	75.4±12.2			76.0	62.4±10.4			63.0	0.000 ^m
3 year	78.5±11.4			78.0	60.7±11.7			60.0	0.000 ^m
4 year	70.7±12.5			69.5	40.2±8.2			43.0	0.000 ^m
Weight Regain									
1 year		0	0.0			0	0.0		1.000 X ²
2 year		0	0.0			3	10.3		0.004 X ²
3 year		12	8.0			7	24.1		0.010 X ²
Weight loss failure									
1 year		3	2.0			2	6.9		0.185 X ²
2 year		2	1.3			3	10.3		0.031 X ²
3 year		1	0.7			7	24.1		0.000 X ²

^mMann–whitney U-test/χ² Chi-square test (Fischer test); BMI: Body mass index; DM: Diabetes mellitus; HT: Hypertension; %EWL: Percent excess weight loss.

the outcomes of bariatric procedures. The results of the present study may be attributed to the single-center study design and small number of patients, and so, the authors believe there is a need for studies involving a larger case series. The limitations of the study include its single-center, retrospective study design, the relatively small number of patients.

Conclusion

The short- and long-term results of the present study suggest that LSG is an effective bariatric surgery procedure. WR was at the lowest levels in the first 3 years after LSG and showed a progressive increase at the end of 4 years. The analysis of patients with weight loss failure and WR identified no parameter other than male gender and

smoking that affected the outcomes. The authors recommend close follow-up for the 3 years after LSG.

Disclosures

Peer-review: Externally peer-reviewed.

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