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ORIGINAL ARTICLE

Perioperative and Postoperative Effects of Preoperative Low-Calorie Restrictive Diets on Patients Undergoing Laparoscopic Sleeve Gastrectomy

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Abstract

Objective A restrictive diet applied before bariatric surgery can be required to reduce the liver volume or as a necessity imposed by insurance companies. However, the benefits of preoperative weight loss remain controversial. The present study aimed to investigate the perioperative and postoperative outcomes of a restrictive diet applied before laparoscopic sleeve gastrectomy.

Materials and Methods The data of 128 patients who received surgery in 2015 and 2016 were retrospectively analyzed. All patients were advised to follow a 4-week low-calorie (1000 cal) restrictive diet. Nevertheless, approximately 50% of patients did not accept the diet plan. We divided the patients into two groups as dieters (group 1) and non-dieters (group 2).

Results In group 1, changes in after-diet BMI and liver size were statistically significant ($p < 0.001$). In group 2, mean operation duration, mean hospitalization duration values, mean BMI values, and mean body weight at postoperative 1, 3, 6, and 12 months were statistically significantly higher than in group 1. No statistically significant difference was found between early complication rates of the groups ($p = 0.844$).

Conclusion Low-calorie restrictive diet applied before laparoscopic sleeve gastrectomy has reduced liver volume and shortens surgery and hospitalization time but does not have any significance concerning early complications and weight loss after operation in 1 year. Also, non-adherence of the bariatric surgery candidate patients to the diet seems to be a challenge.

Keywords Bariatric surgery · Liver volume · Preoperative weight loss · Surgical outcomes · Very low-calorie diet

Introduction

Obesity has been related to severe comorbidities and mortality and continues to be an important health problem.[1] Bariatric surgery is currently the most effective treatment for obesity. With the increasing popularity of bariatric surgery, the number of patients needing surgical treatment continues to increase significantly.[2] The most effective and popular bariatric surgical procedures are the laparoscopic sleeve gastrectomy (LSG) and the laparoscopic gastric bypass (LGB).[3, 4] Even though these interventions are relatively safe operations, they may result in severe perioperative and postoperative complications.[5] The most critical acute complications of these operations are bleeding, anastomosis leaking which can lead to death because of the peritonitis and wound infection, and critical chronic complications are stomal stenosis, gastroesophageal reflux, and nutritional deficiencies.[6, 7] For this reason, surgeons tend to prefer less invasive methods to reduce the risk of complications and efficiently decrease body weight. Currently, the LSG is one of the most promising methods.[8, 9] The 1991 National Institutes of Health consensus statement about body mass indices (BMIs) and bariatric surgery did not address some techniques and advancements, including procedures like LSG that have become popular in the last decade, but it has been shown to treat obesity and related disorders effectively and safely. It may be performed as the primary weight-loss procedure or the initial phase of biliopancreatic diversion together with duodenal switch (BPD-DS).[10] A preoperative diet and weight-loss program may be useful in reducing complications. A restrictive diet applied before

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bariatric surgery may reduce liver volume, thus decreasing the frequency of complications by making the surgical procedure easier.[2] Preoperative weight loss is required in many clinics for this reason or as a necessity imposed by insurance companies. Moreover, as an obligation imposed by the insurance company for the patient to qualify for surgical intervention, some clinics force the patients to lose 5–10% of their body weight. However, the benefits of preoperative weight loss have not been evaluated sufficiently, and the postoperative outcomes are still controversial.[11, 12]

In the present study, the perioperative and postoperative outcomes of a restrictive diet applied before LSG were investigated, along with effects on the liver, complications, and weight loss of patients.

Material and Methods

The data of 128 patients who underwent LSG in 2015 and 2016 at private bariatric center because of morbid obesity were retrospectively analyzed. All the patients who were performed LSG were included the study during timescale, and the same surgeon performed the procedure. All the patients were advised to follow a 4-week low-calorie restrictive diet. But, even though possible advantages related to the operation had been explained to all patients, approximately 50% of the patients did not accept the diet plan. In the preoperative period, patients were given an individual diet by considering comorbid diseases in the dietary group. A limiting diet containing 1000 cal of high protein was maintained for 4 weeks which was prescribed and verbal information made by the dietician. We evaluated patients' adherence to the diet according to the occurrence of ketonuria in the weekly urine tests as suggested by Colles et al.[13] The absence of ketones scored 0, a trace amount of ketones scored 1, a small amount scored 2, and a moderate amount scored 3 points. The patients with score 2 and 3 points ended the diet and excluded the study. The patients in the non-dietary groups were not enrolled any weight-loss program preoperatively and were operated on for 3–10 days. Inclusion and exclusion criteria have been showed in Fig. 1.

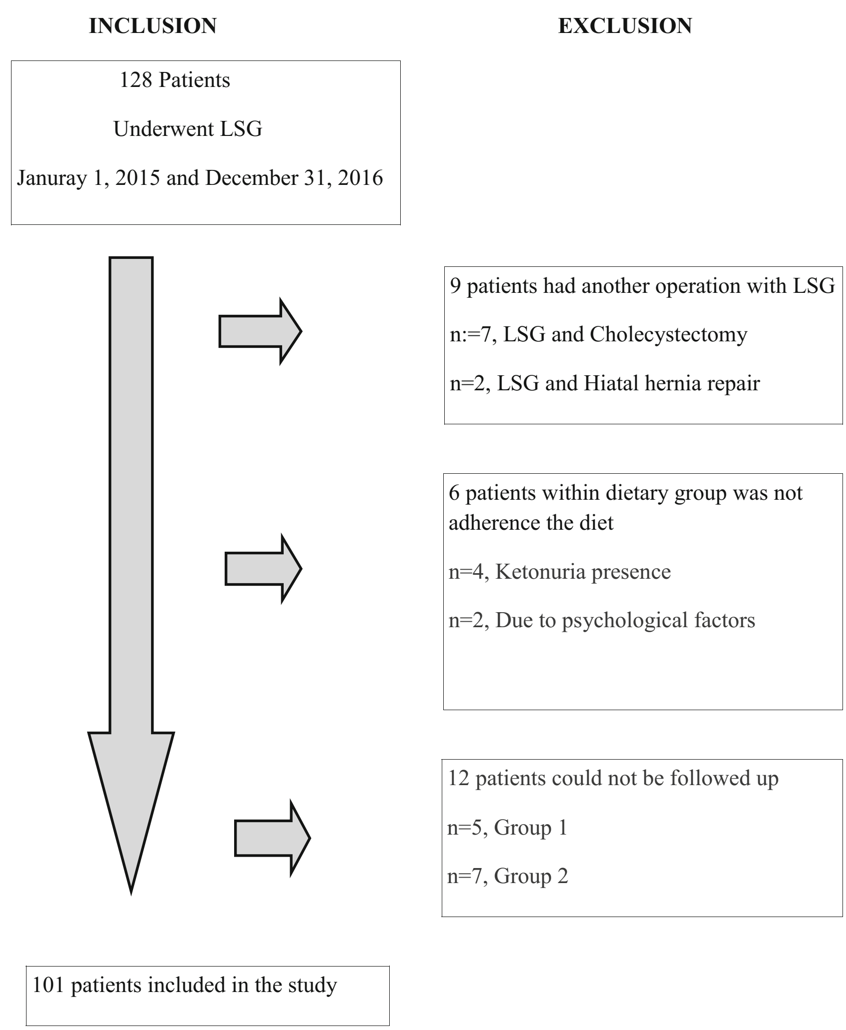

Fig. 1 Flow diagram of study population with patient inclusion and exclusion criteria. A total of 128 patients underwent LSG. *n* = number

Among the rest of patients, 49 patients who continued the diet program were included the group 1 and 52 patients who did not accept to have a diet were included to the group 2. Demographical data, comorbidities accompanying the obesity, preoperative and postoperative early complications, and body weight and BMI at 1, 3, 6, and 12 months of follow up were recorded. Excess weight loss (EWL), excess BMI loss (EBMIL), and proportion of excess BMI loss (%EBMIL) of the patients were calculated. All patients underwent ultrasonography (US) at initial admission, and any possible intra-abdominal pathologies and the size of the left lobe of the liver were examined. The left liver lobe size was measured in top-to-bottom direction at the longest point of the liver. The US procedure was repeated 1 day before the surgery for measuring the left liver lobe. In examining the left liver lobe, the values obtained 1 day before surgery was used as a reference for group 2. For 49 patients in group 1, BMI at the time of the decision to have surgery, weight loss after the diet, and BMI at the time of surgery were recorded, as well as the size of left liver lobe measured by US at the time of admission and after the diet. US procedures were performed by the same radiologist using the same equipment (Toshiba SSA-660 A) for all patients. All patients were administered 1 g Cefazolin sodium as a prophylactic antibiotic before the surgery. Patients wore preoperative venous compression socks and were given 6000 anti-Xa IU Enoxaparin before the surgery for venous thromboembolism prophylaxis.

Surgical Method Each patient was anesthetized in supine position. The 10-mm camera port is inserted at the umbilicus under the laparoscopic vision and by using nonsurgical trocar, and insufflation was performed until 10–12 mm/Hg pressure. Then, the operation ports were placed after placing the patient in reverse Trendelenburg position. By using a vessel sealing device (LigaSure Atlas 10 mm, LS1037), the omentum was separated from the stomach starting about 3 cm proximal to the pylorus to the cardiac notch. After completely separating the fundus level and posterior wall of the stomach, a 32 F silicon gastric tube was placed through the orogastric path. The stomach was dissected using an endoscopic stapler from proximal to the pylorus (starting from the level of the "crow's foot") to the esophagogastric junction. In this step, the surgeon was careful to leave the small antrum (with equal widths of posterior and anterior walls) and to create a narrow tube. A stapler that was suitable for thick tissue (Endo GIA™ 60 mm Articulating Extra-Thick Reload with TriStaple™ Technology) was used in the antrum, and a stapler that was suitable for mid-thickness tissues (Endo GIA™ 60 mm Articulating Medium/Thick Reload with TriStaple™ Technology) was used for the rest of the stomach. After separating the stomach, a bleeding check was performed at the line of sutures. In case of bleeding, hemostasis was achieved by clipping the relevant zone using a laparoscopic clip. The prepyloric zone was clamped using intestinal forceps. Leakage control was performed by applying a physiological saline solution with 150 cc methylene blue through the orogastric calibration tube. An aspiration drain was placed parallel with the line of sutures. The patient started fluid intake after the scope was performed with oral contrast fluid. The complications occurred at the first 30 days after the operation is accepted as an early complication.

Statistical Analysis The statistical analyses were performed using IBM SPSS Statistics ver. 20.0 (IBM Co., Armonk, NY, USA). Descriptive statistics were expressed as number and percentage for categorical variables and as standard deviation, mean value, and minimum and maximum values for numeric variables. If the numerical variables were normally

Table 1 Preoperative data

		Group 1 (*n* 49)		Group 2 (*n* 52)		
		Mean ± SD	Min-Max	Mean ± SD	Min-Max	*p*
Age		37.4 ± 9.2	18–59	37.5 ± 9.6	18–60	0.865
Gender *n* (%)	Women	32 (65.3)		33 (63.5)		0.847
	Men	17 (34.7)		19 (36.5)		
Height (m)		1.66 ± 0.07	1.55–1.79	1.67 ± 0.07	1.53–1.81	0.699
Weight (kg)		124.4 ± 14.1	105–154	124.7 ± 14.1	101–158	0.881
Admission BMI (kg/m^2)		45.1 ± 4.4	38.9–61.6	44.9 ± 4.1	38.7–62.3	0.731
Preoperative BMI (kg/m^2)		43.1 ± 3.9	37.5–58.3	45.1 ± 3.9	38.6–62.2	< 0.001*
Weight loss after diet (kg)		5.5 ± 1.5	3–8.8	*x*	*x*	< 0.001
Size of left liver lobe at admission (cm)		14.2 ± 1.2	12.1–16.8	14.0 ± 1.0	12.1–16.8	0.460
Size of left liver lobe 1 day before operation (cm)		12.6 ± 1.0	11–14.6	14.1 ± 0.9	12.1–16.9	< 0.001*

n number, *m* meter, *kg* kilogram, *cm* centimeter, *x* did not diet

*Statistically significant for group 1

Table 2 Co-morbidity

	Group 1		Group 2		
	n	%	*N*	%	*p*
Patients with co-morbidity	45	91.8	51	98.1	0.196
HT	14	28.6	12	23.1	0.528
DM	21	42.9	21	40.4	0.801
HL	17	34. 7	25	48.1	0.173
OA	14	28.6	21	40.4	0.212
OSAS	12	24.5	20	38.5	0.131
CHF	1	2.0	0	0.0	0.485
CORD	2	4.1	4	7.7	0.679
Others	3	6.1	2	3.8	0.672

HT hypertension, *DM* diabetes mellitus, *HL* hyperlipidemia, *OA* osteoarthritis, *OSAS* obstructive sleep apnea syndrome, *CHF* congestive heart failure, *CORD* chronic obstructive respiratory disease, *n* number

distributed, the independent groups were compared using Student *t* test. Otherwise, Mann-Whitney *U* test was used. The ratios of independent groups were compared using chi-square analysis. Relationships between numeric variables were analyzed using Spearman correlation analysis because the condition of normal distribution was not met. The statistical alpha significance level was set at $p < 0.05$.

Results

Seven patients who underwent cholecystectomy together with LSG, two patients who underwent hiatal hernia repair because of lower esophageal sphincter laxity detected in preoperative endoscopic examination, six patients who were unable to adapt to the diet, five patients who could not complete 12 months follow-up from dietary group, and seven patients who could not complete 12 months follow-up from non-dietary group were excluded from the study. Adherence to the diet of patients is 89% initially dietary group. Two of the patients ended the diet due to psychological factors in this group. The diet of four patients was terminated due to the detection of ketone in their urine tests, and these were excluded from the study. Of 101 patients in the present study, 65 (64.3%) were female, and 36 (35.6%) were male. Mean age was 37.4 years (18–59) in group 1 and 37.5 years (18–60) in group 2. There was no statistically significant difference between group 1 and group 2 in terms of mean age and average values of gender ratios, height, body weight, and BMI and liver size at admission. There was also no significant difference between BMI and liver size during admission and operation in group 2. In group 1, changes in after-diet BMI and liver size were statistically significant ($p < 0.001$ for both) (Table 1).

No statistically significant difference was found between the groups in the rate of comorbid diseases. Among the patients with other diseases, in group 1, one had infertility, one had a history of operation for papillary carcinoma, and one had ankylosing spondylitis. In group 2, one had a severe backache, and one had infertility (Table 2).

The mean operation duration and mean hospitalization duration values of group 2 were statistically significantly higher than in group 1 ($p < 0.001$ for both) (Table 3).

No statistically significant difference was found between the groups in early complication rates ($p = 0.844$) (Table 4).

In group 2, the mean BMI values and mean body weight at postoperative 1, 3, 6, and 12 months were statistically significantly higher than in group 1. No statistically significant difference was found between the rates of decrease in BMI ($p = 1.000$) (Table 5).

Discussion

Obesity is a disease that commonly incorporates type-2 diabetes, arterial hypertension, sleep apnea, orthopedic disorders, non-alcoholic fatty liver disease, and other severe conditions that are less frequently seen.[10] Bariatric surgery is the most effective method of treating morbidly obese patients. It has been documented in recent long-term studies that a significant reduction in mortality and the risk of developing new health-related comorbidities is reduced in patients after bariatric surgery. A low-calorie diet before bariatric surgery is frequently recommended to lower BMI, to protect muscle tissue, to establish a safe surgery zone, and to prepare the patient for surgery. Considering its practicality, Van Wissen et al. reported that a low-calorie diet is a preferred method to reduce liver volume. On average, a low-calorie diet reduces the liver

Table 3 Operation and hospitalization time

	Group 1		Group 2		
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	*p*
Operation duration (min)	91.9 ± 5.4	82–102	97.3 ± 6.0	85–111	< 0.001*
Hospitalization duration (min)	2.7 ± 0.3	2–3	3.0 ± 0.4	2–4	< 0.001*

*Statistically significant

Table 4 Complications

		Group 1		Group 2		
		n	%	*n*	%	*p*
Early Complications	None	37	75.5	42	80.8	0.844
	Hemorrhage	3	6.1	2	3.8	
	Wound Infection	7	14.3	7	13.5	
	Intra-abdominal Abscess	2	4.1	1	1.9	

n number

volume by 2.4% per week.[14] At the end of 4 weeks, the size of the left liver lobe decreased by 1.6 ± 0.2 cm (11.2%) among our patients who continued the diet. Liver volume decreases after diet and weight loss, but its effects on surgical complications and postoperative outcomes are controversial.[12, 15] Alami et al. reported that the liver volume of patients who lost weight before surgery decreased, and this contributed to reducing technical complexity during bariatric surgery.[16] This decrease in complexity enables a better view of the surgical field, which may reduce the duration of surgery. In recent studies, some studies corroborate this idea,[11, 17–19] but some studies report no change in the duration of surgery.[20, 21] Among the patients in the present study, the duration of surgery was significantly shorter in group 1 ($p < 0.001$). For other intraoperative conditions observed in patients who continued the diet and those who did not, differences were unclear.[15] For instance, Riess et al.[22] reported that blood loss requiring transfusion was less frequent in the group with weight loss than in the group with no weight loss; whereas, Van Nieuwenhove et al.[21] reported no difference between two groups. In the present study, there is no difference between the groups. The data are not definitive for preoperative weight loss and duration of hospitalization. As well as studies reporting that weight loss with diet shortened the duration of hospitalization,[11, 17, 23] there are also studies reporting no difference between groups.[19, 20, 24] In the present study, the hospitalization duration of group 1 is significantly shorter.

There are several studies advocating preoperative weight loss to reduce possible postoperative complications. Giordiano et al.[18] reported that an increasing amount of weight loss before the surgery reduces the rate of complications. However, Holderbaum et al.[12] said that preoperative weight loss does not significantly reduce perioperative complications in their recent review. In the present study, there is no significant difference between groups 1 and 2 in terms of complications.

In many studies, the relationship between preoperative and postoperative weight loss was discussed from the aspect of time.[15] There are different results on this topic. Hutcheon et al.[11] reported an increase in EWL percentage of patients who had ≥ 8% weight loss with restrictive diet at the end of first postsurgical year, whereas Alger-Mayer et al.[25] saw a significant relationship between preoperative weight loss and continuing weight loss between the third and fourth postoperative years. Schneider et al.[20] determined that there was no significant change in EWL percentage after 12 months among patients completing insurance-mandated diet. Similarly, Sherman et al.[26] emphasized that preoperative weight loss is not a reliable indicator of postoperative weight loss after LSG. Ries et al.[22] reported that preoperative weight loss did not

Table 5 Change in body mass index (BMI)

		Group 1		Group 2		
		Mean ± SD	Min-Max	Mean ± SD	Min-Max	*p*
Weight	1st	107.2 ± 12.3	90–131	113.5 ± 13.1	90–144	0.015*
	3rd	93.1 ± 11.2	78–115	100.2 ± 12.1	79–125	0.003*
	6th	78.9 ± 9.0	65–99	85.6± 10.3	69–107	0.001*
	12th	67.7 ± 7.8	54–89	71.2 ± 8.2	56–91	0.030*
BMI (kg/m^2)	1st	38.9 ± 3.6	33–53.3	40.9 ± 3.8	34. 9-56. 7	< 0.001*
	3rd	33.8 ± 3.2	29. 4-46.6	36.0 ± 3.4	30. 5-50.2	< 0.001*
	6th	28.6 ± 2.4	25. 7–38.2	30.7 ± 2. 7	27–41.5	< 0.001*
	12th	24.5 ± 1.8	22.4–31.6	25.6 ± 1.9	23.5–32.9	< 0.001*
Decrease in BMI % (%EBMIL) 1stYear		42.9 ± 3.6	33.4–50.8	50.4 ± 5.46	35.5–4.36	1.000

*Statistically significant

increase either the net average weight loss or the postoperative %EWL at 1-year follow-up.

In the present study, EWL and EBMIL were statistically significantly higher in group 1 when compared to group 2. The patients in group 1 lost more weight than patients in group 2 from the aspect of weight at postoperative 1, 3, 6, and 12 months because of the weight lost during the diet period. Thus, BMI values of the patients in group 1 reduced more than in patients in group 2. However, there was no statistically significant difference between the %EBMIL results of the two groups.

In many previous studies, patients having LSG and laparoscopic Roux-en-Y gastric bypass (LRYGB) were grouped, or the patients receiving vertical gastric band were analyzed, and dieting groups were classified by the level of preoperative weight loss. The patients involved in the current study have undergone LSG and are divided into two patient groups, namely the diet and no-diet groups. Given that the process of losing weight after bariatric surgery may last until 24 months, a limitation of this study is that it is based on the findings of 1-year follow-up. Additionally, retrospective results of the study, loss of follow-up, and lack of objective measurements for liver function are also limiting factors. From this aspect, prospective and longer-duration studies are needed.

In conclusion, the data in the present study indicate that a low-calorie restrictive diet applied before LSG surgery reduces liver volume and shortens the duration of surgery and hospitalization but has no effect on postoperative complications and decreased the percentage of BMI at the end of 1-year of follow up. Since the significant positive impact on hospitalization and surgery time, we suggest a low-calorie restrictive diet before surgery of patients with bariatric surgery indication, but non-adherence to the diet seems to be an obstacle for the patients who candidate bariatric surgery.

Author Contribution Uğur Ekici: Conception and design of the work, acquisition and interpretation of the data, drafting the work, final approval, responsible for the study.

Murat Ferhat Ferhatoğlu: Analysis and interpretation of the data, revising the work critically, final approval.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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