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Comparison of short-term results: Laparoscopic sleeve gastrectomy (LSG) vs laparoscopic roux-en-y gastric bypass (LRYGB)

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ABSTRACT

Introduction: In this study, it was aimed to compare the short-term results of the effects of LSG and LRYGB procedures on weight loss, laboratory parameters and comorbidities.

Materials and Methods: This retrospective study (February 2021-August 2022) includes the prospectively collected data of the 1-year postoperative follow-up of patients who underwent LSG and LRYGB for morbid obesity. EWL%, the percentage of patients who were successful, laboratory parameters of patients and effects on comorbidities were compared between the groups.

Results: When the two surgical techniques were compared in terms of the changes in fasting glucose, liver function tests, kidney function tests, lipid profile (HDL, LDL, cholesterol, triglyceride) and EWL% in both 6th months and 12th months after surgery, no significant difference was found. In the 1-year results, we detected a significant decrease weight, fasting glucose, creatinine, cholesterol, trigliseride values as well as a significant increase in HDL value in LRYGB group (p=0.001, p=0.004, p=0.023, p=0.039, p=0.004, p=0.002 respectively). No significant decrease in the need for medication in DM, HT and HL. In the 1-year results, we detected significant weight loss, decreased fasting glucose, AST, ALT, Trigliseride, TSH, as well as an increase in HDL in LSG group (p<0.001, p<0.001, p<0.001, p<0.001, p<0.001, p=0.006, and p<0.001 respectively). It is found that LSG significantly reduced the need for medication in DM, HT and HL.

Conclusion: Both LSG and LRYGB have effective results on weight loss at the sixth month and first year follow-up. Without superiority between them, both procedures revealed improvements in liver enzymes, lipid profile and thyroid function tests.

Keywords: Laparoscopic Roux-en-Y Gastric Bypass, Laparoscopic Sleeve Gastrectomy, short-term outcomes

Introduction

It is widely believed that obesity is a chronic disease which leads to excessive fat accumulation in the body, induces a condition of systemic inflammation, and adversely affects a number of organs and systems.[1] Obesity is basically caused by the fact that the calories consumed are more than the calories expended.[2] In addition, insufficient physical activity, unhealthy diet and genetic causes are also factors in the etiology of obesity.[3]

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Since obesity is a complex metabolic disease, a multidisciplinary approach is required in treatment planning. Dietary regulations and medical treatments are the first step of this multidisciplinary approach. In recent years, glucagon-like peptide-1 (GLP-1) analogues like semagulitide and liragulitide have become more popular in medical treatment than other medications. Despite this, medical treatment has yet to achieve the expected effects, and surgery is still the most successful option for treatment of obesity.[3,4]

Indications for surgical treatment of obesity in international guidelines are defined as having a Body Mass Index (BMI) of either 40 kg/m^2 or above or having a BMI between 35 and 40 kg/m^2 and having weight–related comorbidity. These patients must have tried non-surgical methods for at least a year and have not been able to lose weight. This situation was updated by ASMBS and IFSO in 2022 and it was updated as having a BMI of 35 kg/m^2 and above or having a BMI between 30 and 34.9 kg/m^2 and having comorbidity related to weight.[5,6] Laparoscopic Sleeve Gastrectomy (LSG) and Laparoscopic Round-en-Y Gastric Bypass (LRYGB) are the surgical procedures commonly applied for obesity surgery worldwide. While investigations have shown that LSG has similar effects on weight loss and the improvement of comorbidities as LRYGB, which has been the most frequently used bariatric surgery method in the past, the frequency of its application has significantly increased despite the fact that the long-term results are not yet sufficient.[7,8] LRYGB is both restrictive and malabsorptive procedure, whereas LSG is a restrictive surgical procedure. It has been demonstrated that both surgical techniques have positive effects on weight loss and weight-related comorbidities.[9]

In this study, it was aimed to compare the short-term results of the effects of LSG and LRYGB procedures, which are the two most applied procedures of bariatric surgery, on weight loss, laboratory parameters and comorbidities.

Materials and Methods

Study Design and Data Set

This retrospective study (February 2021- August 2022) includes the prospectively collected data of the 1-year postoperative follow-up of patients who underwent LSG and LRYGB for morbid obesity in the Department of General Surgery, Umraniye Education and Research Hospital, University of Health Sciences. The study included obese people between the ages of 18 and 60 years-old who had a BMI of 35 kg/m^2 or above and had received approval from the bariatric surgery council for surgery. People who underwent other bariatric procedures and had insufficient data were not included in the study.

In addition to demographic data such as age and gender, patients' preoperative and postoperative (postoperative 6th month and 1st year) Body Mass Index (BMI), Excess Weight Loss percentage (EWL%), comorbidities, and laboratory results (fasting glucose, thyroid stimulating hormone (TSH), high-density lipoprotein (HDL), low-density lipoprotein (LDL), Cholesterol, Triglyceride, BUN, creatinine, AST and ALT levels) were recorded.

The patients were divided into two groups: the LRYGB Group and the LSG Group. EWL%, the percentage of patients who were successful, laboratory parameters of patients and effects on comorbidities (success in stopping medicinal medication after surgery) were compared between the groups. Only diabetes mellitus (DM), hypertension (HT) and hyperlipidemia (HL) have been recorded as comorbidities and the effects on these comorbidities have been evaluated.

EWL% was taken as the basis to evaluate the patients' postoperative weight loss success, and surgery was considered successful for patients whose EWL was 60% and above at the end of the first year after surgery. The ideal BMI was accepted as 25 kg/m^2 and the ideal weight was calculated with the formula 25 x height (m^2). EWL%= initial weight (kg) – first year weight (kg) / initial weight (kg)-ideal weight x 100 was calculated with the formula.[10]

Surgical Technique

LSG

The operation started with the classical 5 trochar method in the reverse trendelenburg position. The stomach was mobilized along great curvature up to the left crus in cranial and 2-3 cm to the pylorus in caudal. Vertical sleeve gastrectomy was performed using staple with the help of a 38-French oro-gastric bougie, starting 4-6 cm from the pylorus and ending 1-2 cm away from the left hiatal crus. The staple line was reinforced with omentopexy. All patients were operated by the same surgeon and with the same technique.

LRYGB

The operation was performed by standard 5 trocar technique. Stomach was divided horizontally with a staple from the lesser curvature part 5-6 cm distal of the gastroesophageal junction. A gastric pouch was created by dividing the stomach vertically towards the angle of his with staple accompanied by a 38 French oro-gastric bougie. An alimenter limb with the length of 100 cm and a biliopancreatic limb with the length of 80 cm were created. Mesenteric defects were closed. All patients were operated by the same surgeon and with the same technique.

Statical Analysis

We analyzed the collected data using the SPSS program (IBM Corp., Released 2019, IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp). To assess normality, the Shapiro-Wilk test was employed. As none of the continuous variables exhibited a normal distribution, we presented them as medians with interquartile ranges (25% to 75% quartiles). For comparing non-normally distributed independent continuous data, we employed the Mann-Whitney U test, and for non-normally distributed related continuous data, we used Wilcoxon's test. Categorical data were expressed as frequencies (%) and independent variables were analyzed using the Chi-Square test. Fisher Exact test was utilized when necessary. For the comparison of related cathegorical variables, McNemar's test was used. The level of statistical significance was set at $p<0.05$.

Results

After applying the inclusion and exclusion criteria, a total of 62 patients were enrolled to the final analysis. Fifty-three (85.5%) of the patients were female and the median age of the study population was 38 (31-46). Forty-nine (79%) of the patients underwent LSG and 13 (21%) LRYGB. Thirty-three (53.2) of the patients had DM, 20 (32.3%) had HT, 18 (29%) had HL. After six months, 48 (77.4%) of the patients had an EWL% greater than 60%, and after 1 year, 56 (90.3%) of the patients had an EWL% greater than 60%. Basic characteristics of the study population was summarized in Table 1.

Table 1. Basic characteristics of the study population

Age, Median (25% to 75% quartiles)	38 (31-46)
Sex (Female), n (%)	53 (85.5)
LSG, n (%)	49 (79)
LRYGB, n (%)	13 (21)
DM, n (%)	33 (53.2)
HT, n (%)	20 (32.3)
HL, n (%)	18 (29)
Preoperative Weight (kg), Median (25% to 75% quartiles)	120 (106-133)
Preoperative BMI, Median (25% to 75% quartiles)	44 (42-48)
Preoperative fasting glucose, Median (25% to 75% quartiles)	96 (87-109)
Preoperative AST, Median (25% to 75% quartiles)	19 (16-23)
Preoperative ALT, Median (25% to 75% quartiles)	19 (16-27)
Preoperative BUN, Median (25% to 75% quartiles)	24.8 (18.5-30)
Preoperative Creatinine, Median (25% to 75% quartiles)	0.68 (0.61–0.79)
Preoperative HDL, Median (25% to 75% quartiles)	44 (38-53)
Preoperative LDL, Median (25% to 75% quartiles)	112 (94-133)
Preoperative cholesterol, Median (25% to 75% quartiles)	187 (166-210)
Preoperative trigliseride, Median (25% to 75% quartiles)	139 (97-195)
Preoperative TSH, Median (25% to 75% quartiles)	2.09 (1.4–2.65)
6-months EWL>60%, n (%)	48 (77.4)
1-year EWL>60%, n (%)	56 (90.3)

LSG: Laparoscopic Sleeve Gastrectomy; LRYGB: Laparoscopic Roux-en-Y Gastric Bypass; ALT: Alanine Aminotransferase; AST: Aspartate Aminotransferase; HDL: High-density lipoprotein; LDL: low-density lipoprotein; BMI: Body Mass Index; DM: diabetes mellitus; HT: hypertension; HL: hyperlipidemia; EWL: Excess Weight Loss; TSH: thyroid stimulating hormone.

When we assessed the 6-month results of patients who underwent LSG, we observed significant associations with various positive outcomes. These included significant decrease in weight, fasting glucose, AST, ALT, triglycerides, and TSH levels, as well as an increase in HDL level ($p<0.001$, $p=0.014$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, and $p<0.001$ respectively). Similarly in the 1-year results, we detected significant decrease in weight, fasting glucose, AST, ALT, Trigliseride, TSH levels, as well as asignificant increase in HDL level ($p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p=0.006$, and $p<0.001$ respectively). It is found that LSG significantly reduced the requirement for medication in DM, HT and HL ($p<0.001$) (Table 2).

When we assessed the 6-month results of patients who underwent LRYGB, we observed significant associations with various positive outcomes. These included significant decrease in weight, fasting glucose, ALT, TSH, triglycerides levels, and as well as an significant increase in HDL level ($p=0.001$, $p=0.021$, $p=0.009$, $p=0.033$, $p=0.006$, $p=0.0023$ respectively). In the 1-year results, we detected a significant decrease weight, fasting glucose, creatinine, cholesterol, trigliseride levels as well as a significant increase in HDL level ($p=0.001$, $p=0.004$, $p=0.023$, $p=0.039$, $p=0.004$, $p=0.002$ respectively). No significant reduction in requirement for DM, HT, and HL medication was found (Table 3).

When the two surgical techniques were compared in terms of the changes in fasting glucose, liver function tests, kidney function tests, lipid profile (HDL, LDL, cholesterol, triglyceride) and EWL% in 6 months, no significant difference was found. Upon reviewing the one-year results, a significantly higher decrease in creatinine levels was observed among patients who underwent LRYGB compared to LSG ($p=0.042$). However, no significant differences were detected between the two surgical techniques with respect to other variables, including EWL% (Table 4).

Discussion

The majority of bariatric surgery procedures carried out on morbidly obese people are known to be LSG and LRYGB.[11] The short-term effects of these two procedures on weight loss, laboratory findings, and comorbidities (DM, HT, HL) were assessed and compared. In terms of weight loss and laboratory data, it was found that both the LSG and LRYGB procedures improved statistically. Patients underwent LSG and LRYGB procedures discovered significant weight reduction in terms of EWL% of almost 90% and there was no significant difference between the two procedures. In terms of effects on comorbidities (elimination of the need for medical treatment), a significant decrease was detected in LSG group, while no significant difference was detected in LRYGB group. The small number of samples within the LRYGB group patients may be the cause

Table 2. Six months and 1-year results of LSG Group

	Preoperative	6 months	p	1-year	p
Weight, Median (25% to 75% quartiles)	120 (109-136)	85 (75-94)	<0.001	72 (65-85)	<0.001
Glucose, Median (25% to 75% quartiles)	95 (87-107)	89 (85-99)	0.014	84 (78-91)	<0.001
AST, Median (25% to 75% quartiles)	19 (16-23)	15 (13-18)	<0.001	14 (12-18)	<0.001
ALT, Median (25% to 75% quartiles)	21 (16-31)	13 (11-18)	<0.001	13 (10-17)	<0.001
BUN, Median (25% to 75% quartiles)	24.7 (18.5–29.8)	22 (17.7-29.4)	0.066	24.9 (19.3-32.2)	0.342
Creatinine, Median (25% to 75% quartiles)	0.68 (0.59–0.77)	0.65 (0.58-0.73)	0.227	0.67 (0.61-0.74)	0.415
HDL, Median (25% to 75% quartiles)	44 (38-52)	51 (44-59)	<0.001	58 (48-65)	<0.001
LDL, Median (25% to 75% quartiles)	116 (93-134)	113 (99-133)	0.204	100 (92-122)	0.179
Cholesterol, Median (25% to 75% quartiles)	188 (160-212)	178 (157-213)	0.774	177 (151-203)	0.181
Trigliceride, Median (25% to 75% quartiles)	133 (96-188)	95 (70-124)	<0.001	81 (66-97)	<0.001
TSH, Median (25% to 75% quartiles)	2.08 (1.48-2.69)	1.45 (1.17-2.13)	<0.001	1.73 (1.23–2.2)	0.006
DM, n (%)	27 (55.1)	NA	NA	1 (2)	<0.001
HT, n (%)	15 (30.6)	NA	NA	2 (4.1)	<0.001
HL, n (%)	16 (32.7)	NA	NA	1 (2)	<0.001

ALT: Alanine Aminotransferase; AST: Aspartate Aminotransferase; HDL: high-density lipoprotein; LDL: low-density lipoprotein; BMI: Body Mass Index; DM: diabetes mellitus; HT: hypertension; HL: hyperlipidemia; EWL: Excess Weight Loss; TSH: thyroid stimulating hormone.

Table 3. Six months and 1-year results of LRYGB Group

	Preoperative	6 months	p	1-year	p
Weight, Median (25% to 75% quartiles)	120 (109-136)	78 (70-98)	0.001	68 (40-78)	0.001
Glucose, Median (25% to 75% quartiles)	95 (87-107)	93 (85-121)	0.021	81 (76-89)	0.004
AST, Median (25% to 75% quartiles)	19 (16-23)	16 (15-18)	0.183	16 (15-20)	0.599
ALT, Median (25% to 75% quartiles)	21 (16-31)	13 (12-16)	0.009	12 (11-17)	0.071
BUN, mean (min-max)	24.7 (18.5-29.8)	24.7 (21.4-27.4)	0.272	24.8 (23.1-30.1)	0.875
Creatinine, Median (25% to 75% quartiles)	0.68 (0.59-0.77)	0.63 (0.56-0.76)	0.124	0.64 (0.54-0.69)	0.023
HDL, Median (25% to 75% quartiles)	44 (38-52)	50 (40-62)	0.0023	55 (45-59)	0.002
LDL, Median (25% to 75% quartiles)	116 (93-134)	101 (77-135)	0.347	93 (77-117)	0.064
Cholesterol, Median (25% to 75% quartiles)	188 (160-212)	167 (145-220)	0.173	165 (144-188)	0.039
Trigliceride, Median (25% to 75% quartiles)	133 (96-188)	106 (74-150)	0.006	82 (69-112)	0.004
TSH, Median (25% to 75% quartiles)	2.08 (1.48-2.69)	1.08 (0.69-1.44)	0.033	1.28 (0.94-2.08)	0.507
DM, n (%)	6 (46.2)	NA	NA	3 (23.1)	0.999
HT, n (%)	5 (38.5)	NA	NA	1 (7.7)	0.125
HL, n (%)	2 (15.4)	NA	NA	1 (7.7)	0.999

ALT: Alanine Aminotransferase; AST: Aspartate Aminotransferase; HDL: high-density lipoprotein; LDL: low-density lipoprotein; BMI: Body Mass Index; DM: diabetes mellitus; HT: hypertension; HL: hyperlipidemia; EWL: Excess Weight Loss; TSH; thyroid stimulating hormone.

of this outcome. The small sample size of LRYGB patients was the main limitation of the present study. LRYGB group showed improvements in their comorbidities without significance. In 6 months results of our study, in terms of laboratory parameters, significant improvement in only AST value was found in LSG group, unlike LRYGB group, while no significant improvement in any value was found in LRYGB group, unlike LSG group. In first year results of our study, in terms of laboratory parameters, significant improvement in AST, ALT, and TSH values was found in LSG group, unlike LRYGB group, while significant improvement in Creatine and cholesterol values was found in LRYGB group, unlike LSG group.

In their analysis of patients who underwent LRYGB or LSG surgery at the end of a 5-year follow-up period, Toolabi et al.[12] examined the amount of weight loss as well as the remission rate of obesity-related comorbidities such DM, HT, and dyslipidemia. They didn't find a significant difference in the EWL% in the LSG and LRYGB groups in the first year following surgery. In addition, when the results of the surgery were evaluated both after 1 year and after 5 years, no significant difference was found between the two procedures in terms of remission of comorbidities. After 5 years, however, %EWL in LRYGB were higher than LSG. In meta-analysis, Hu et al.[13] compared LRYGB with LSG in terms of their early and late complications, postoperative weight loss, effects on comorbidities, and amount of weight loss. In this study, no significant difference was found between LSG and LRYGB in short-term results in terms of EWL%, but a significant difference was found in favor of LRYGB in terms of EWL% in mid-term results. When they evaluated the improvements of comorbidities, a significant superiority of LRYGB was found in all three comorbidities in early results, no significant difference was found between the two procedures in mid-term results, and a significant difference was found in favor of LRYGB in HT in long-term results. We did not detect a significant difference between the groups in terms of both EWL% and improvements of comorbidities in our study.

In morbidly obese individuals, Woelnerhanssen et al.[14] examined the relationship between weight, circulating adipokines, lipid profiles, and insulin sensitivity after LRYGB and LSG acccording to 1-year follow-up results. In this study, while no significant difference was found in total cholesterol values, a significant improvement in triglyceride, HDL, LDL values was detected in in both procedures. However, no significant difference was detected between the procedures. Benaiges et al.[15] evaluated the effects of two bariatric procedures (LSG and LRYGB) on lipid profiles at the end of the first year of follow-up. A significant increase in HDL value and a significant decrease in triglyceride value were found in both procedures,

Table 4. Comparison of LSG and LRYGB Groups: 6-month and 1-year results

	LSG	LRYGB	p
Delta fasting glucose (6 months)	4 (-6 - 16)	15 (-3 - 19)	0.226
Delta AST (6 months)	3 (-1 - 7)	3 (-1.5 - 5.5)	0.521
Delta ALT (6 months)	7 (1 - 16)	4 (1.5 - 9)	0.354
Delta BUN (6 months)	1.5 (-1.7 - 5)	1.7 (-1.9 – 4.8)	0.931
Delta Creatinine (6 months)	0.02 (-0.07 – 0.09)	0.09 (-0.03 – 0.15)	0.151
Delta HDL (6 months)	-9 (-15 - -1)	-7 (-12 - 1)	0.616
Delta LDL (6 months)	-6 (-25 - 14)	12 (6 - 30)	0.124
Delta cholesterole (6 months)	0 (-21 - 25)	18 (-11 - 33)	0.307
Delta trigliseride (6 months)	33 (11 - 81)	39 (5 - 92)	0.979
Delta TSH (6 months)	0.5 (0.1 – 0.94)	0.73 (0.06 – 1.76)	0.303
Excess weight loss (%)	68 (62 - 79)	61 (55 - 83)	0.346
EWL Success	40 (81.6%)	8 (61.5%)	0.146
Delta fasting glucose (1 year)	11 (3 – 23)	25 (5 - 83)	0.115
Delta AST (1 year)	3 (0 – 10)	1 (-2 – 5)	0.132
Delta ALT (1 year)	7 (0 – 19)	5 (1 - 12)	0.350
Delta BUN (1 year)	-2 (-7.8 – 5.3)	0 (-5.5 – 6.5)	0.697
Delta Creatinine (1 year)	0.02 (-0.06 – 0.11)	0.11 (0.03 – 0.24)	0.042
Delta HDL (1 year)	-12 (-19 - -6)	8 (22 - -6)	0.684
Delta LDL (1 year)	5 (-14 - 25)	17 (12 - 35)	0.078
Delta cholesterole (1 year)	2 (-16 - 34)	22 (8.5 - 37)	0.177
Delta trigliseride (1 year)	45 (18 - 100)	56 (14 - 117)	0.634
Delta TSH (1 year)	0.23 (-0.11 – 0.81)	0.55 (-0.95 – 1.29)	0.849
Excess weight loss (%)	92.2% (77 – 105.9)	94.3% (81.1 – 108.8)	0.659
EWL Success	44 (89.8%)	12 (92.3%)	0.999
Quitting DM medication (1 year)	21 (42.9%)	8 (61.5%)	0.230
Quitting HT medication (1 year)	13 (26.5%)	4 (30.8%)	0.739
Quitting HL medication (1 year)	15 (30.6%)	1 (7.7%)	0.154

"Delta" defines the change of the variable in 6 monts and 1 year period.
ALT: Alanine Aminotransferase; AST: Aspartate Aminotransferase; HDL: high-density lipoprotein; LDL: low-density lipoprotein; BMI: Body Mass Index; DM: diabetes mellitus; HT: hypertension; HL: hyperlipidemia; EWL: Excess Weight Loss; TSH: thyroid stimulating hormone.

but a significant decrease in LDL and total cholesterol was found in the LRYGB procedure, while no significant change was found in the LSG procedure. In our study, no significant difference was found in terms of LDL value in both procedures, but significant improvement was found in both procedures in terms of HDL and triglyceride values. In terms of cholesterol values, the LRYGB procedure demonstrated a significant decrease in end of the first year, whereas the LSG procedure showed no significant change.

Rudnick et al.[16] evaluated the effect of LSG and LRYGB procedures on thyroid function in hypothyroid obese patients and found a significant decrease in TSH value in both procedures, without any difference between procedures. In 6 months results of our study there was a significant decrease in TSH values in both procedures while there was a significant decrease in only LSG group at 1st year follow-up. However, no significant difference was found when the procedures were compared in terms of TSH change.

In their study, Yang et al.[17] analyzed the effects of LRYGB and LSG on fasting levels of ghrelin, glucose, GLP-1, GLP-2, PYY, GIP, insulin, and glucagon in obese individuals and detected a significant decrease in fasting glucose in both procedures, but no significant difference between the procedures. We found a similar result in our study.

Retrospective design of the study, small patient population in LRYGB group, and comparison of just short-term outcomes might all be considered as limitations of this study.

Conclusion

Both LSG and LRYGB have effective results on weight loss at the sixth month and first year follow-up. Without superiority between them, both procedures revealed improvements in liver enzymes, lipid profile and thyroid function tests. Studies including larger patient groups and longer follow-up times are required.

Disclosures

Ethichs Committee Approval: Approval for the study was received from the ethics committee of University of Health Science Umraniye Traning and Research Hospital (15.05.2023/215591172).

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Conflict of Interest: None declared.

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