*Clinical Research*

# A Comparison of Laparoscopic Sleeve Gastrectomy and Laparoscopic Roux-En-Y Gastric Bypass for Changes in Lipid Profiles

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**ABSTRACT**

**Objective:** Obesity is known to be one of the most important health problems leading to dyslipidemia. In this study, we aimed to examine the lipid profile changes in the postoperative 6th month of morbidly obese patients who underwent Laparoscopic Sleeve Gastrectomy (LSG) and Laparoscopic Roux-en-Y Gastric Bypass (LRYGB).

**Material and Method:** Patients who underwent bariatric surgery for morbid obesity between September 2022 and January 2023 at Ministry of Health University Umraniye Training and Research Hospital General Surgery Clinic were retrospectively analyzed. Age, gender and comorbidities of the patients, as well as preoperative period and postoperative 6th month weight, BMI, %EWL, HDL, LDL, cholesterol, triglyceride, glucose and also HbA1c values of individiuals with type 2 DM were recorded.

**Results:** A hundred twenty-three patients were included in the study and 21 patients were excluded for various reasons, and a total of 102 patients were analyzed. LSG group showed significant increase in LDL, and HDL, and significant decrease in triglyceride, glucose and HbA1c levels at 6th months after the operation (p =0.004, p <0.001, p <0.001, p <0.001, p <0.001, respectively). LRYGB group showed significant decrease in cholesterol, triglyceride, glucose and HbA1c levels at 6th months after the operation (p =0.008, p <0.001, p <0.001, p <0.001, respectively). There was no statistically significant difference between the groups in terms of surgical success rate (p =0.548).

**Conclusion:** Significant improvements in weight loss, lipid profiles, fasting glucose and HbA1C values occur after both LSG and LRYGB surgeries. Both surgeries reveal effective results in the treatment of patients with hyperlipidemia.

***Keywords:*** *Lipid Profile, Weight Loss, Bariatric Surgery.*

**ÖZ**

**Lipid Profillerindeki Değişiklikler Açısından Laparoskopik Sleeve Gastrektomi ve Laparoskopik Roux-En-Y Gastrik Bypassın Karşılaştırılması**

**Amaç:** Obezitenin dislipidemiye yol açan en önemli sağlık problemlerinden biri olduğu bilinmektedir. Bu çalışmamızda Laparoscopic Sleeve Gastrektomi (LSG) ve Laparoskopik Roux-en-Y Gastrik Bypass (LRYGB) uygulanan morbid obez hastaların postoperatif 6. Aydaki lipid profil değişimlerini incelemeyi amaçladık.

**Gereç ve Yöntem:** Eylül 2022 ile Ocak 2023 tarihleri arasında Sağlık Bakanlığı Üniversitesi Ümraniye Eğitim ve Araştırma Hastanesi Genel Cerrahi Kliniğinde, morbid Obezite nedeniyle Bariatrik cerrahi uygulanan hastalar retrospektif olarak incelendi. Hastaların yaş, cinsiyet ve komorbiditelerin yanısıra preoperatif dönem ve postoperatif 6. Aydaki kilo, BMI, %EWL, HDL, LDL, kolesterol, trigliserid, glikoz değerleri ve DM özgeçmişi olan hastaların HbA1c değerleri kaydedildi.

**Bulgular:** Çalışmaya 123 hasta dahil edildi ve 21 hasta çeşitli nedenlerle çalışma dışı bırakıldı ve toplam 102 hasta analiz edildi. LSG ameliyatından sonra 6. ayda LDL ve HDL'de anlamlı artış, trigliserid, glukoz ve HbA1c düzeylerinde ise anlamlı azalma saptandı (sırasıyla p =0,004, p <0,001, p <0,001, p <0,001, p <0,001). LRYGB ameliyatından sonraki 6. ayda kolesterol, trigliserid, glikoz ve HbA1c düzeylerinde anlamlı düşüş tespit edildi (sırasıyla p =0,008, p <0,001, p <0,001, p <0,001). Cerrahi başarı oranı açısından gruplar arasında istatistiksel olarak anlamlı fark tespit edilmedi (p =0,548).

**Sonuç:** Hem LSG hem de LRYGB ameliyatlarından sonra kilo kaybı, lipid profilleri, açlık glikozu ve HbA1C değerlerinde anlamlı iyileşmeler ortaya çıkmaktadır. Her iki ameliyat da hiperlipidemisi olan hastalarda tedavide etkin sonuçlar vermektedir.

***Anahtar Sözcükler:*** *Lipid Profil, Kilo Kaybı, Bariatrik Cerrahi.*

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It is known that obesity is a serious health problem that causes metabolic, cardiac, neurological, mental and physical disorders and is defined as BMI ≥ 30 kg/m2 according to the Body Mass Index (BMI) (1, 2). Dyslipidemia, which is characterized by low HDL (High Density Lipoprotein), high LDL (Low Density Lipoprotein), and hypertriglycemia in the plasma lipoproteins, is one of the major medical problems caused on by obesity. Serious cardiovascular problems may develop from dyslipidemia when it is coupled with type 2 DM and insulin resistance (3).

Laparoscopic Sleeve Gastrectomy (LSG) is known to

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be the most frequently performed procedure with increasing frequency in terms of its effects on weight loss, being easy to perform and secure, whereas Laparoscopic Roux-en-Y Gastric Bypass (LRYGB) was the most frequently performed bariatric surgical procedure in the past. Although LSG is opted for increasingly in recent years because of its comparable therapeutic outcomes and technical simplicity, discussions about its effect on comorbidities such as lipid profile and type-2 diabetes remission continue (4-7).

In this study, we aimed to examine the lipid profile changes in the postoperative 6th month of morbidly obese patients who underwent LSG and LRYGB.

## MATERIAL AND METHOD

### Study Proctocol

Patients who underwent bariatric surgery for morbid obesity between September 2022 and January 2023 at the Ministry of Health University Umraniye Training and Research Hospital General Surgery Clinic were retrospectively analyzed. Patients aged 18-65 years and meeting the 1991 The National Institutes of Health (NIH) bariatric surgery criteria were included in the study (8). Approval for the study was obtained from the ethics committee of our hospital (05.07.2023/219141281).

The type of bariatric surgery to be performed was decided by the bariatric surgery team. In this context, LSG was preferred in young patients, patients with a BMI of 50 and above, while LRYGB was preferred in patients with severe gastroesophageal reflux and uncontrolled type-2 Diabetes mellitus (DM).

Age, gender and comorbidities of the patients, as well as preoperative and postoperative 6th month weight, BMI, %EWL, HDL, LDL, cholesterol, triglyceride, fasting glucose values and also HbA1c values of individiuals with type 2 DM were recorded.

Glycosed hemoglobin (HbA1C) was calculated by high performance liquid chromatography (HPLC) method. HPLC is known as an analysis technique used to separate and quantify the components in a mixture.

### Formulas for calculations of some parameters

BMI was calculated with the formula kg/m$^2$.

EWL% was calculated with; (initial weight (kg) – current weight (kg) / initial weight (kg) – ideal weight) x 100.

Ideal weight (kg): 25 x height (m$^2$).

Surgery was considered successful for patients with an EWL% of 50% or more at the end of 6 months (9).

### Definitions

The difference between preoperative and postoperative cholesterol, LDL, HDL, triglyceride, glucose and hemoglobin A1c are named delta-cholesterol, delta-LDL, delta-HDL, delta-triglyceride, delta-glucose, and delta-HbA1c respectively.

### Surgical Technique

The small bowel was divided 80 cm distal to the ligament of Treitz after the LRYGB 50–60 cc gastric pouch was prepared. The prepared gastric pouch was anastomosed to the distal segment of the divided intestine. 110 cm distal to the gastrojejunostomy, the proximal segment of the divided small bowel was anastomosed to the small intestine. A 110 cm alimentary limb and an 80 cm biliopancreatic limb were created as a result.

Using 38 French oro-gastric bougies positioned along the lesser curvature, LSG was performed by vertically resecting the stomach between 1 cm lateral of the esophagogastric junction and 4-5 cm proximal to the pylorus.

### Statical Analysis

SPSS program version 26 (IBM Corp. Released 2019 IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp) was used to analyze the data. The normality of the continuous data was tested using Shapiro-Wilk test. Since all the continuous data distributed non-normally, they are expressed as median (25% to 75% quartiles) and Mann whitney U test was chosen for the comparison of two independent continuous groups. For the comparison of two related continuous groups, Wilcoxon test was utilized. Categoric data were expressed as frequency (%) and compared using Chi-Square. The level of statistical significance was set to $p < 0.05$.

## RESULTS

A hundred twenty-three patients were investigated for the study and and 21 patients were excluded for various reasons, a total of 102 patients included finally. Patient flow chart is illustrated in figure 1.

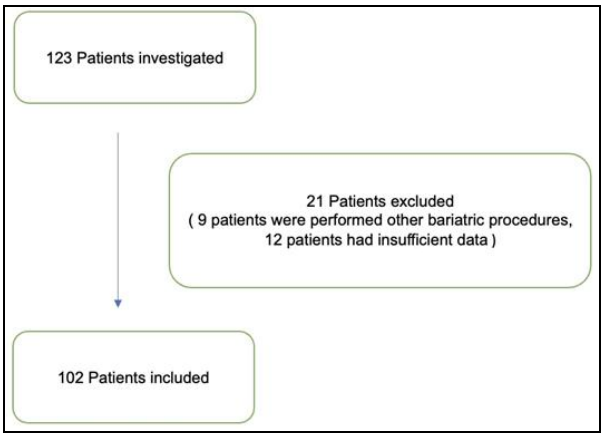


***Figure 1.*** *Flow chart.*

The median age of the included patients were 38 (33 to 46) and 84 (82.4%) of them were female. The median preoperative BMI was 44 (41 to 49) and weight was 120kg (109 to 132). A total of 51 (50%) patients had diabetes mellitus and 26 (25.5%) hypertension. The

median preoperative cholesterol was 184 (166 to 211), preoperative LDL was 107 (89 to 128), HDL was 44 (39 to 53), triglyceride was 145 (92 to 200), glucose was 97 (88 to 116), and HbA1c was 6.6 (6 to 7.6). Twenty-eight (27.5%) of the patients were in LRYGB group, and 74 (72.5%) were in LSG group (Table 1).

When compared in terms of the basic characteristics, there were significant but minor differences in age, glucose, HbA1c and hypertension variables between the groups. No significant difference was detected between the groups in terms of other variables and the groups were found to be comparable (Table 1).

***Table 1.*** *Basic characteristics of the toal study population and the comparison of the basic characteristics among groups.*

| | **Total Population** | **LSG n =74** | **LRYGB n =28** | **p value** |
|---|---|---|---|---|
| **Age** (Median (25% to 75% quartiles) | 38 (33 to 46) | 37 (31 to 45) | 43 (36 to 48) | **0.041** |
| **Sex (female)**n (%) | 84 (82.4%) | 60 (81.1%) | 24 (85.7%) | 0.410 |
| **Diabetes Mellitus,** n (%) | 51 (50%) | 34 (45.9%) | 17 (60.7%) | 0.183 |
| **Hypertension,** n (%) | 26 (25.5%) | 15 (20.3%) | 11 (39.3%) | **0.049** |
| **Preoperative weight (kg)** (Median (25% to 75% quartiles) | 120 (109 to 132) | 121 (112 to 132) | 115 (106 to 125) | 0.081 |
| **Preoperative BMI (kg/m$^2$)** (Median (25% to 75% quartiles) | 44 (41 to 49) | 44 (42 to 48) | 43 (40 to 50) | 0.334 |
| **Preoperative cholesterol (mg/dL)** (Median (25% to 75% quartiles) | 184 (166 to 211) | 183 (162 to 200) | 185 (169 to 228) | 0.337 |
| **Preoperative LDL (mg/dL)** (Median (25% to 75% quartiles) | 107 (89 to 128) | 108 (88 to 126) | 107 (97 to 133) | 0.738 |
| **Preoperative HDL (mg/dL)** (Median (25% to 75% quartiles) | 44 (39 to 53) | 44 (39 to 53) | 45 (40 to 54) | 0.576 |
| **Preoperative triglyceride (mg/dL)** (Median (25% to 75% quartiles) | 145 (92 to 200) | 135 (90 to 193) | 166 (118 to 266) | 0.102 |
| **Preoperative glucose (mg/dL)** (Median (25% to 75% quartiles) | 97 (88 to 116) | 94 (87 to 108) | 114 (97 to 178) | **<0.001** |
| **Preoperative HbA1c (%)** (Median (25% to 75% quartiles) | 6.6 (6 to 7.6) | 6.5 (6 to 6.80) | 8.25 (5.98 to 9.32) | **0.016** |

*BMI: Body-mass index, HbA1c: Hemoglobin A1c, HDL: High-density Lipoprotein, LDL: Low-density Lipoprotein.*

We investigated whether LSG and LRYGB procedures resulted in significant alterations in the lipid and glucose profile. LSG were detected significant increase in LDL, and HDL, and significant decrease in triglyceride, glucose and HbA1c levels at 6th months after the operation (p =0.004, p <0.001, p <0.001, p <0.001, p <0.001, respectively). LRYGB were detected significant decrease in cholesterol, triglyceride, glucose and HbA1c levels at 6th months after the operation (p =0.008, p <0.001, p <0.001, p <0.001, respectively) (Table 2).

***Table 2.*** *The comparison of preoperative and 6-months postoperative lipid and glucose profile values between groups.*

| | **LSG** | | | **LRYGB** | | |
|---|---|---|---|---|---|---|
| | **Preoperative** | **Postoperative** | **p** | **Preoperative** | **Postoperative** | **p** |
| **Cholesterol (mg/dL)** (Median (25% to 75% quartiles) | 183 (162 to 200) | 182 (166 to 212) | 0.076 | 185 (169 to 228) | 177 (148 to 208) | **0.008** |
| **LDL (mg/dL)** (Median (25% to 75% quartiles) | 108 (88 to 126) | 115 (97 to 137) | **0.004** | 107 (97 to 133) | 104 (83 to 123) | 0.279 |
| **HDL (mg/dL)** (Median (25% to 75% quartiles) | 44 (39 to 53) | 50 (43 to 57) | **<0.001** | 44.5 (40 to 54) | 49 (39.3 to 54) | 0.301 |
| **Triglyceride (mg/dL)** (Median (25% to 75% quartiles) | 135 (90 to 193) | 97 (73 to 122) | **<0.001** | 166 (117 to 265) | 107 (76 to 125) | **<0.001** |
| **Glucose (mg/dL)** (Median (25% to 75% quartiles) | 94 (87 to 108) | 86 (80 to 91) | **<0.001** | 114 (97 to 178) | 90 (84 to 104) | **<0.001** |
| **HbA1c (%)** (Median (25% to 75% quartiles) | 6.65 (6.3 to 7.1) | 5.65 (5.1 to 6.1) | **<0.001** | 8.8 (7.3 to 9.8) | 6.1 (5.5 to 6.6) | **<0.001** |

*HbA1c: Hemoglobin A1c, HDL: High-density Lipoprotein, LDL: Low-density Lipoprotein.*

Groups were compared in terms of changes in blood values at 6 months after surgery. In LRYGB group, compared to LSG group, a significantly greater decrease was observed in cholesterol, LDL, glucose and HbA1c levels 6 months after the operation (p <0.001, p =0.019, p =0.005, p =0.004 respectively). There were no significant difference between the groups in terms of HDL and triglyceride change (Table 3).

***Table 3.*** *The comparison of the effects of LSG and LRYGB procedures on lipid and glucose profile 6 months after surgery.*

| | **LSG** *(Median (25% to 75% quartiles))* | **LRYGB** *(Median (25% to 75% quartiles))* | **p value** |
|---|---|---|---|
| **Delta cholesterol** | -8 (-20.3 to 15) | 17.5 (-4.3 to 39.8) | **<0.001** |
| **Delta LDL** | -7 (-22 to 5.5) | 6 (-8.3 to 22.8) | **0.019** |
| **Delta HDL** | -4.5 (-12.3 to 0.3) | -1.5 (-7 to 4) | 0.064 |
| **Delta Triglyceride** | 33 (6.5 to 74.5) | 52 (23.8 to 99.5) | 0.127 |
| **Delta Glucose** | 9 (1.5 to 19) | 23.5 (6 to 66) | **0.005** |
| **Delta HbA1c** | 1.1 (0.5 to 1.6) | 2.1 (1.1 to 3.7) | **0.004** |

*HbA1c: Hemoglobin A1c, HDL: High-density Lipoprotein, LDL: Low-density Lipoprotein.*

The median excess weight loss (EWL) at the 6-month mark following LSG was 67.8% (57.9 to 78.5), while in LRYGB group, it stood at 64.8% (56.7 to 77.1). The disparity in EWL between the groups was not significant (p =0.651). Employing a benchmark of 50% EWL as the threshold for a "successful procedure (SP)" six months post-operation, it was observed that within LSG cohort 64 individuals (86.5%) met this criterion, whereas in LRYGB cohort 23 individuals (85.2%) achieved the same categorization of a "successful procedure." Once again, the difference between the groups in terms of success rate did not yield statistically significant results (p =0.548) (Table 4).

***Table 4.*** *Comparison of the success measures of the procedures.*

| | **LSG** *(Median (25% to 75% quartiles))* | **LRYGB** *(Median (25% to 75% quartiles))* | **p value** |
|---|---|---|---|
| **EWL (%)** | 67.8 (57.9 to 78.5) | 64.8 (56.7 to 77.1) | 0.651 |
| **Successful procedure** | 64 (86.5%) | 23 (85.2%) | 0.548 |

*EWL: Excess weght loss.*

## DISCUSSION

Regarding the distribution of demographic data, there are minor differences between the groups. In the LSG operation, HDL and LDL values significantly increased, cholesterol values did not significantly change, and triglyceride, glucose, and HbA1C values significantly decreased. In the LRYGB procedure, no significant change was detected in HDL and LDL values, but a significant decrease was detected in cholesterol, triglyceride, glucose and HbA1C values. When we analyzed the positive improvements between the groups, we discovered that the LRYGB group's significant decline in glucose and HbA1C values was significantly more, but the changes in triglycerides were similar. While increase in the HDL value was significantly higher in the LSG group, there was not a significant difference in the LRYGB group. There was not a significant change in the LRYGB group's LDL value, however the LSG group's LDL value significantly increased.

Cunha et al. (10) examined the effects of LSG, LRYGB and Adjustable Gastric Band (AGB) procedures on lipid profile, glucose and HbA1C values. They came to the conclusion that while HDL and triglyceride alterations between the LSG and LRYGB groups improved similarly, the LRYGB group's LDL and total cholesterol values dramatically decreased. The lipid profile changes induced by the LRYGB procedure were examined by Garcia-Marirrodriga et al. (11) at the 6th, 12th, and 18th months following surgery. All lipid profile values showed a significant decline when the study's sixth-month data were analyzed. According to Spivak et al. (12) examined the effects of LRYGB, LSG and AGB procedures on lipid profile and they found that the decrease in cholesterol and LDL values was significantly greater in the LRYGB group compared to the LSG group, while increase in HDL value was significantly higher in the LSG group compared to the LRYGB group. Benaiges et al. (13) in study where comparing the changes in lipid profile values of morbidly obese patients treated with LSG and LRYGB at 1st year after surgery, positive improvement in all parameters (significant decrease in LDL, triglyceride and cholesterol values, significant increase in HDL value) were detected in LRYGB group. But while significant positive improvement in HDL and triglyceride values were detected in the patients of the LSG group, no significant difference in LDL and cholesterol values was detected. Regarding changes in the sixth month following surgery, our study observed a significant rise in HDL and LDL values, no significant change in cholesterol, and a significant decrease in triglyceride values in the LSG group. While HDL and LDL values did no change in the LRYGB group, cholesterol and triglyceride values did significantly decline.

Qi Tang et al. (14) compared the effects of LSG and LRYGB procedures on type-2 DM, the fasting glucose and HbA1C values of the patients in the 2nd year after surgery and they were observed significant decreases in both groups, but significantly more decreases were found in the patients in the LSG group. Hodgson et al. (15) examined the effects of LSG and LRYGB on type-2 DM at the end of the 1st year after surgery and they found similar significant decrease in HbA1C and fasting glucose values in both groups, but they found significantly more type-2 DM remission in LRYGB group patients. In our study, we found a significant decrease in HbA1c and fasting glucose in both groups, but we found a significantly higher decrease in the LRYGB group compared to the LSG group.

Salminen et al. (16) compared the 10-year results of LSG and LRYGB procedures in their study (SLEEVE PASS) and Peterli et al. (17) compared the 5-year results of morbidly obese patients who underwent LSG and LRYGB in their study (SM-BOSS), they obtained similar results between the groups in terms of EWL% decrease in both studies. In our study, we detected

similar results between groups in terms of both EWL% and successful procedure.

The primary limitations of this study can be categorized as being retrospective, single-centered, and having a small number of patients. Another limitation of the study is that the groups could not be homogenized in terms of the surgical technique choices due to its retrospective character.

As a conclusion, both LSG and LRYGB operations had a significant positive effect on patients with dyslipidemia. The LRYGB group exhibits a greater improvement in this area. Studies with longer follow-up periods and larger populations are needed to investigate the reason for the increase in LDL and cholesterol values in the LSG group at the sixth month. Both groups experienced a considerable decline in fasting glucose levels and HbA1c values, while the LRYGB group experienced a more pronounced decline. There are no differences between the surgical techniques in terms of effective weight loss outcomes.

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