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Riza Gurhan Isil*, Mehmet Mihmanli**, Pinar Yazici***, Canan Tulay Isil°, Uygar Demir, Cemal Kaya, Ozgur Bostanci°°

**Op. Dr., Sisli Hamidiye Etfal Education and Research Hospital, General Surgery Clinic, Sisli, Istanbul, Turkey*
***Prof. Dr., Sisli Hamidiye Etfal Education and Research Hospital, General Surgery Clinic, Sisli, Istanbul, Turkey*
****Op. Dr. Sisli Hamidiye Etfal Education and Research Hospital, General Surgery Clinic, Sisli, Istanbul, Turkey*
°M.D., Sisli Hamidiye Etfal Education and Research Hospital, Anesthesiology Clinic, Sisli, Istanbul, Turkey
°°Assoc. Prof. Dr. Sisli Hamidiye Etfal Education and Research Hospital, General Surgery Clinic, Sisli, Istanbul, Turkey

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BACKGROUND: *Roux-en-Y gastric bypass (RYGB) has been considered as the most efficient method in bariatric surgery. Indeed, Laparoscopic Sleeve Gastrectomy (LSG) which is easier to do, has been increasingly used in the recent years. The aim of the present study was to compare short-and mid-term outcomes of RYGB and LSG.*
METHODS: *Medical records of 62 patients who underwent either RYGB (GroupR) or LSG (GroupL) in our General Surgery Department between 2010 and 2013 were retrospectively reviewed. Demographics, comorbidities, preoperative laboratory values, length of hospital stay and postoperative complications were recorded. During follow-up in the post-operative period, body-mass-index (BMI), excess weight loss (EWL), triglyceride levels (TG), and low-density lipoprotein (LDL) levels were recorded at the 1st, 3rd, 6th, and 12th months.*
RESULTS: *Mean length of hospital stay was significantly higher in GroupR ($p = 0.001$), which was also correlated with BMI. EWL at 1st, 3rd, 6th, and 12th months was significantly higher in GroupR. Hair loss was significantly higher in GroupR ($p < 0.05$). The rates of diabetes mellitus and hypertension in the preoperative period and at 6th and 12th months did not significantly differ between the groups. Preoperative TG and LDL values were significantly higher in GroupR ($p < 0.05$).*
CONCLUS ONS: *This study indicated, that RYGB is statistically more effective than LSG, but LSG has clinically almost the same effect as RYGB, and also hospital stay, postoperative complications as hair loss are decreased in LSG.*

KEY WORDS: Laparoscopic Sleeve Gastrectomy, Morbid Obesity, Roux-en-Y Gastric Bypass

Introduction

Obesity is an important health problem that can cause various disorders and even death by affecting many organs and organ systems, particularly cardiovascular and endocrine systems. Having being reported as one of the 10 riskiest diseases by the World Health Organization, the prevalence of obesity is on the rise in the recent years [1,2]. When compared with the situation 10 years ago, the prevalence rate has increased by 36% in females and 75% in males. Moreover, this unappealing trend has been observed among young adults and even children [3]. The treatment of obesity may be briefly classified under five main headings, which include diet, exercise, behavior, and medical and surgical therapy [4]. According to this classification, surgical therapy must be preferred

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Correspondence to: Rıza Gurhan Isil, Op. Dr., Sisli Hamidiye Etfal Education and Research Hospital, General Surgery Clinic, Halaskargazi Cad. Etfal Sok., 34733 Sisli/Istanbul (e-mail: gurhanisil@hotmail.com)

Appendix 1 - Bariatric Surgery Methods [5]

Restrictive procedures	**Gastric Balloon**	**Gastric Band**	**Sleeve Gastrectomy**	**Gastric Plication**	**Adjustable Gastric Band**
Malabsorptive Procedures	Bilio-Pancreatic Diversion				
Combined Procedures	Roux-en-Y gastrik by Pass	Mini-Gastric Bypass	Duodenal Switch		
Others	Gastric Electrical Stimulation				

Appendix 2 - Bariatric Surgery Consensus decisions [4]

1 Patients with a BMI of ≥ 40 kg/m^2 without coexisting medical problems or, patients with a BMI of ≥ 35 kg/m^2 and 1 or more severe obesity-related complications, (T2DM, hypertension, obstructive sleep apnea)
2 Age between 18 and 65 years
3 Continuation of obesity for at least 3 years
4 No hormonal disease
5 Not to be addicted to alcohol and drugs
6 Patient adaptation to the method to be applied
7 Acceptable operation risk

TABLE I - *Demographics, Hospital stay and Co-morbidities*.

	Group L (n=30)			**Group R (n=30)**			
	Mean±SD	**Med(Min-Max)**		**Mean±SD**	**Med(Min-Max)**		**P**
Age	**37,8 ± 8,2**	**38**	**20 - 55**	**34,1 ± 10,3**	**31**	**15 - 52**	**0,124**
Sex Female	20	%66,7		20 %66.7			1.000
Male	10	%33,3		10 %33.3			
Height (cm)	167.3 ± 10.9	167	150-188	166.0 ± 9.0	166	145-188	0.609
Weight (Kg)	142.2 ± 27.1	141	95-210	154.0 ± 21.0	150	115-190	0.064
BMI (kg/m^2)	51.3 ± 8.5	51	40-77	56.1 ± 7.3	58	41-74	***0.024***
Healthy weight (kg)	60.1 ± 10.2	60	45-81	59.2 ± 9.8	59	39-82	0.728
Hospital stay (Day)	8.5 ± 9.7	7	5-60	9.0 ± 2.6	8	5-15	0.528
DM(n)	20	66.7%		14	46.7%		0.118
HT(n)	17	56.7%		21	70.0%		0.284
Tg(n)	6	20.0%		25	83.3%		***0.001***
LDL(n)	12	40.0%		26	86.7%		***0.001***
Sleep apnea(n)	4	13.3%		6	20.0%		0.488

t-test / Mann-whitney U test / chi-scuare test; DM: Diabetes mellitus Type 2, HT: Hypertension, Tg: Hyper triglyceridemia, LDL: Hyper Low Density Lipoprotein, SD: Standard deviation, Min: Minimum, Max: Maximun.

when other treatment methods fail; however, nonsurgical means of therapy are often associated with limited success, particularly in patients with morbid obesity.

Bariatric surgery methods that have been used in the last half-century can be divided into four categories: gastric restriction, malabsorptive procedures, combined procedures, and others [5] (Table I). Laparoscopic Roux-en-Y gastric bypass (RYGB), laparoscopic adjustable gastric band, laparoscopic sleeve gastrectomy (LSG), laparoscopic mini gastric bypass, and biliopancreatic diversion and duodenal switch have currently become the most commonly used procedures with advancements in laparoscopic methods in the last 20 years [6]. However, there is an ongoing debate over the advantages and disadvantages of each procedure.

The aim of the present study was to comparatively evaluate short-term and mid-term outcomes of RYGB, which has been considered as the most efficient method in bariatric surgery, and LSG, which is easier to do and has been increasingly used in the recent years.

Materials and Methods

In the present study, medical records of 62 patients who underwent either RYGB or LSG for morbid obesity in our General Surgery Department between January 2010 and January 2013 were retrospectively reviewed. The data of patients who were not followed up in the postoperative period, those who underwent surgery because of recurrence, and those whose records were missing were excluded from the analysis. A total of 60 patients (Group L[LSG], n = 30; Group R[RYGB], n = 30) who met the inclusion criteria were included in the study.

Ethical approval for this study was provided from a governmental ethical committee (SHEEAH Ethical Committee, Registration Number: 2015/569). Verbal and written informed consents were obtained from all patients prior to surgery.

Surgery type, age, weight, gender, body mass index (BMI), comorbidities (hypertension, diabetes, hyperlipidemia, and sleep apnea syndrome), preoperative laboratory values [triglyceride (TG) and low-density lipoprotein (LDL) levels], length of hospital stay, postoperative complications, and mortality parameters were recorded. All patients underwent gastroscopy and abdominal ultrasonography in the preoperative period. During follow-up in the postoperative period, BMI, excess weight loss (EWL), triglyceride levels, and LDL levels were recorded at the 1st, 3rd, 6TH, and 12th months.

Preoperative Preparation

All patients were selected for surgical therapy based on Bariatric Surgery Consensus decisions (Table II) and reimbursement criteria of the Social Security Institution in our country [4]. All patients preoperatively underwent upper gastrointestinal tract endoscopy for the evaluation of esophagus, stomach, and duodenum. The patients also underwent upper abdominal ultrasonography for the evaluation of gall bladder stones. In addition, an otorhinolaryngologist, a pulmonologist, a cardiologist, an endocrinologist, a psychiatrist, and an anesthesiologist evaluated the patients.

All patients received preoperative prophylaxis to prevent thromboembolism with enoxaparin sodium 40 mg (Clexane 0.4®, Aventis Pharma, Turkey) and bilateral compression stockings (anti-embolic).

Surgical Techniques

LSG

After the induction of general anesthesia, patients were administered prophylactic antibiotics (ampicillin and sulbactam, 2 g) and placed in a surgical position. After skin preparation with povidone–iodine solution, a 10 mm visiport with 0° optic was introduced into the abdomen 3 cm left lateral to the midline in the area corresponding to the lower one-third portion of the distance between the umbilicus and xiphoid. After carbon dioxide insufflation, a 5 mm trocar was inserted into the epigastric region for the placement of automated liver retractor. After the insertion of other auxiliary ports with a diameter of 15 mm, 10 mm, and 5 mm, automated live retractor was inserted through the subxiphoid region. Dissection was initiated from the greater curvature using a 10-mm LigaSure Atlas (Covidien, Energy Sources Devices, Elancourt, France) opposite to the angular notch at the side of the greater curvature. Dissection was extended 2-6 cm distally to the pylorus and proximally to the angle of His in order to include the left crus. The adhesions at the posterior gastric wall were separated, and a 34-F bougie was inserted into the stomach by the anesthesiology team. Using bougie guidance, two extra thick tissues (Endo GIA, Covidien, USA; 60 mm and 3.5 mm), two moderate thick tissues (Endo GIA, Covidien; 60 mm and 2 mm), and two or three normal tissues (Endo GIA, Covidien; 60 mm and 1.5 mm) were transected 2.6 cm proximal to the pylorus and 1 cm lateral to the angle of His using stapler cartridge. In

Table II - *Changes of EWL*

	Group L (n=30)			Group R (n=30)			
	Mean±SD	Med(Min-Max)		Mean±SD	Med(Min-Max)		P
EWL	**37.8 ± 8.2**	**38**	**20 - 55**	**34.1 ± 10.3**	**31**	**15 - 52**	**0.124**
1st month	23.8 ± 7.0	23	12 - 42	31.6 ± 6.9	31	17 - 50	***0.000***
3rt month	45.7 ± 10.4	45	27 - 66	60.0 ± 7.8	59	42 - 73	***0.000***
6th month	68.1 ± 10.8	70	47 - 93	80.9 ± 4.9	81	69 - 91	***0.000***
12th month	80.9 ± 7.7	82	62 - 98	89.2 ± 3.7	90	79 - 97	***0.000***
1st-3rt months	21.9 ± 8.0*	20	9 - 43	28.4 ± 7.2*	28	10 - 43	***0.001***
1st-6th months	22.4 ± 5.7*	22	9 - 34	20.8 ± 8.5*	20	6 - 40	0.398
1st-12th months	12.8 ± 7.2*	13	0 - 32	8.4 ± 2.6*	7	4 - 15	***0.003***

Independent samples t-test; Repeated measures analysed with variance analysis; SD: Standard deviation, Min: Minimum, Max: Maximun.

case of hemorrhagic spots, stapler line was strengthened with medium-size endoclips. After achieving hemostasis, sterile gauze was placed on the stapler line and checked for leakage using methylene blue. After removal of the tube, sterile gauzes were removed and counted. Stapler line was further strengthened with tissue glue (Tissel, Baxter, USA). The surgery was completed upon removal of the excised portion of the stomach through a 15-mm trocar.

RYGB

After the induction of general anesthesia, patients were administered prophylactic antibiotics (ampicillin and sulbactam, 2 g) and median laparotomy was performed. After general exploration, the stomach was dissected from the side of the lesser curvature of the stomach to the right gastrophrenic ligament. The stomach was transected in its full thickness approximately 3 cm inferior to the right gastroesophageal junction using an 80-mm linear stapler (GIA, Covidien, USA). The stomach was longitudinally separated toward the left gastrophrenic ligament using a 60-mm linear stapler (GIA, Covidien, USA). A gastric pouch with a volume of 30 cc was left in the proximal side, and the jejunum was prepared 50–60 cm distal to the Treitz ligament. Distal jejunal loop was prepared for retrocolic gastrojejunostomy, and anastomosis was performed using a 25-mm circular stapler (Tyco®, US Surgical, Norwalk, CT).
Jejunojejunostomy was performed side-by-side 15 cm distal to the gastrojejunostomy using a 60-mm linear stapler (GIA, Covidien, USA).

Statistical Analysis

Descriptive statistics included mean ± standard deviation and median (minimum, maximum) according to distribution characteristics. The Kolmogorov-Smirnov test was used to test the distribution of the variables. Mann-Whitney U test, independent samples t-test, or analysis of variance was used in the analysis of quantitative data. The chi-square test was used in the analysis of qualitative data. The Spearman's correlation coefficient was used in the correlation analysis. IBM SPSS version 22 was used in the analysis.

Results

Results of the present study suggested that demographic features and comorbidity rates were similar in Group L and Group R (Table I). However, BMI was significantly higher in the Group R patients ($p = 0.024$) (Table I). With respect to operative and postoperative parameters, the mean length of hospital stay was significantly higher in Group R ($p = 0.001$) (Table III). There was a positive correlation between BMI and length of hospital stay ($p < 0.001$, $r = 0.465$).
When postoperative short-term and mid-term follow-up parameters were compared between the groups, EWL in Group R at 1st, 3rd, 6th, and 12th months was significantly higher than that in Group L. In the intragroup analysis, there were significantly higher EWL values at 3rd, 6th, and 12th months compared with the 1st-month value (Table II).
The rate of postoperative complications did not significantly differ between the two groups. Considering short-term and mid-term complications, the rate of hair loss was significantly higher in Group R than in Group L ($p < 0.05$) (Table III).
The rates of diabetes mellitus and hypertension in the preoperative period and at 6th and 12th months did not significantly differ between Group L and Group R. Preoperative TG and LDL values were significantly higher in Group R than in Group L ($p < 0.05$). Changes in other comorbidities in the two groups were presented in Table IV.

Discussion

There has been an increase in the prevalence of obesity in the last 40 years. Obese patients account for 2%–5% of the population in Europe and the US [6].
Because the risk of medical comorbidity is lower in patients who do not exhibit clinical consequences of insulin resistance, determining high-risk patients in terms of mortality and morbidity must be the primary goal. These patients also benefit the most from weight loss [6]. Indeed, obesity was reported to be associated with a 3.3-fold higher risk of cardiovascular death, and diabetes risk was found to be 40-fold higher in patients with BMI > 35 [8-12]. Similarly, the rate of cancer-related deaths was found to be higher in obese patients [13].

Table III - *Postoperative Complications*

	Group L (n=30)		Group R (n=30)		
	N	%	N	%	P
Hair loss	6	20.0%	18	60.0%	***0.002***
Plastic Surgical Operation	1	3.3%	3	10.0%	0.301
Complication	2	6.7%	1	3.3%	0.554

Chi-scuare test (Fischer test)

TABLE IV - *Co-morbidity changes*

		Group L (n=30)		Group R (n=30)		
		N	%	N	%	P
DM	Preop	20	66.7%	14	46.7%	0.118
	6th month	2	6.7%	3	10.0%	0.640
	12th month	0	0.0%	0	0.0%	-
HT	Preop	17	56.7%	21	70.0%	0.284
	6th month	1	3.3%	0	0.0%	1.000
	12th month	1	3.3%	0	0.0%	1.000
TG	Preop	6	20.0%	25	83.3%	***0.000***
	6th month	0	0.0%	0	0.0%	-
	12th month	0	0.0%	0	0.0%	-
LDL	Preop	12	40.0%	26	86.7%	***0.000***
	6th month	0	0.0%	1	3.3%	1.000
	12th month	0	0.0%	0	0.0%	-
Sleep Apnea	Preop	4	13.3%	6	20.0%	0.488
	12th month	0	0.0%	0	0.0%	-

Chi-scuare test (Fischer test)
DM: Diabetes mellitus Type 2, HT: Hypertension, Tg: Hyper triglyceridemia, LDL: Hyper Low Density Lipoprotein

Many approaches have been developed for the treatment of morbid obesity in the last 60 years; however, none of these methods have produced enduring effects as those of surgery. In 1966, Mason and Ito noted weight loss in their patients who underwent subtotal gastrectomy for duodenal ulcer and described for the first time gastric bypass surgery for the treatment of obesity [8].

In bariatric surgery, RYGB is the most commonly employed surgical procedure, particularly in the United States [14,15]. The goal of RYGB is to remove a certain portion of distal stomach, duodenum, and jejunum and leave a gastric pouch with an approximate volume of 30 cc. This procedure leads to both gastric restriction and malabsorption [15,16]. RYGB has become the most commonly preferred method in bariatric surgery owing to bariatric research and clinical experiences accumulated in the last 40 years [17].

The goal of LSG is to reduce gastric volume and remove gastric antrum from which ghrelin, an appetite increaser hormone, is secreted [8]. In 1993, Marceau et al. described this procedure as a restrictive component of biliopancreatic diversion along with the duodenal switch procedure [18]. Biliopancreatic diversion, which is performed as a primary procedure in high-risk patients with morbid obesity, has been developed as the primary option to reduce complications because of the findings of 38% morbidity and up to 6% mortality following RYGB surgery; however, this method has been conducted as a single procedure since 2003 when it was realized that it caused significant weight loss. The short- and mid-term outcomes are satisfactory [19,20]. In our clinic, we have been using the LSG procedure in the recent years. In addition, laparoscopic bariatric surgery has also become our standard practice because of its advantages in many aspects. In the study conducted by Maggard et al. that evaluated patients undergoing bariatric surgery, the length of hospital stay was higher in patients who underwent surgery with the open technique when compared with those who underwent laparoscopic procedure [21].

Moreover, postoperative complications were reported to be more prevalent in patients undergoing surgery with the open technique [17]. The present study found no difference between patients undergoing RYGB with the open technique and those undergoing the LSG procedure with respect to the rate of postoperative complications and length of hospital stay. We believe that the rate of complications would be higher in the open surgery group if there were a larger sample size.

In the literature, from the examination of EWL values, which are used to evaluate the efficiency of surgical therapies, it was concluded that some studies evaluating these two surgical models have not reported a difference in terms of EWL values [22,23,25]. In the present study, although the EWL value in all patients was greater than 60%, which is considered to be acceptable, patients who underwent RYGB procedure significantly achieved higher EWL values. Furthermore, the time to reach 60% EWL value was 5 months in the LSG group, whereas this period was 3 months in the RYGB group. In the study conducted by Karamanakos et al., EWL at 12 months was reported to be 69.7% in the LSG group and 60.5% in the RYGB group [22]. In the present study,

EWL at 12 months was 81% in the LSG group and 89% in the RYGB group. When the data of the present study is compared with that of the literature, 89% EWL ratio may be attributed to the surgical technique (50 cm/150 cm-long loop RYGB) and close monitoring and diet program following surgery.

In the study conducted by Chouillard et al. 200 patients in the LSG group 200 patients in the RYGB group were compared and the morbidity rate was found to be significantly higher in the RYGB group [25]. The present study did not find any significant difference between the two groups with respect to the rate of morbidity, and no mortality was observed in either group. One patient in the LSG group developed fistula that could be treated with medical and percutaneous interventions, and one patient experienced infection at the port insertion site, whereas one patient in the RYGB group developed incisional hernia 7 months postoperatively.

With respect to the improvement in comorbid conditions during the postoperative follow-up period, improvement in the diabetes rates was more remarkable in the RYGB group than in the LSG group [17]. The present study showed no difference in the distribution of cases with diabetes in the two groups. Remission of diabetes was achieved in 20 patients with preoperative diabetes in the LSG group and 14 patients in the RYGB group at the end of the 12-month follow-up period.

Boza et al. evaluated patients with hypertension, which is another comorbid condition frequently found in these patients, and they reported a remission rate of 75%-93% [16,24,26]. The present study also did not find any significant difference between the two groups with respect to the remission rates.

Hair loss associated with vitamin deficiencies is often observed after the procedure causing malabsorption, but studies report a rate of hair loss ranging from 10% to 37% after procedures causing gastric restriction [19,27,28]. The rate of hair loss following LSG procedure was 20% in the present study, whereas this rate was 3-fold higher in the RYGB group. Oral vitamin suplemention was sufficient in the LSG group, in which half of the patients in the RYGB group required intramuscular injections. We consider that 89% EWL rate achieved at 12 months after RYGB procedure accounted for 69% rate of hair loss.

Dyslipidemia is a health problem with increasing prevalence along with obesity, and it is often associated with atherosclerosis [29]. Dyslipidemia often improves in association with a decrease in BMI following bariatric surgery. Although TG and LDL levels were significantly higher in Group R (RYGB) in the preoperative period, there was no significant difference between the two groups at 12 months.

The limitations of the present study include retrospective study design, small number of patients in the two groups (n = 30), higher BMI in Group R patients in the preoperative period than in Group L patients (p = 0.024), and that sleeve gastrectomy was performed using laparoscopic technique and RYGB was performed using open surgical technique.

Conclusion

In conclusion, it may be suggested that the RYGB procedure was more successful than the LSG procedure with respect to achieving ideal body weight in patients with morbid obesity who were followed up for at least 1 year. This study indicated, that RYGB is statistically more effective than LSG, but LSG has also clinically almost the same effect as RYGB, and also hospital stay, postoperative complications as hair loss are decreased in LSG. LSG could also achieve minimum morbidity and mortality and provide remission of comorbid conditions caused by obesity when performed with appropriate patient selection.

in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Riassunto

Il bypass gastrico Roux-en-Y (RYGB) è stato considerato il metodo più efficace di chirurgia bariatrica. D'altra parte la Sleeve Gastrectomia per via laparosocopica (LSG) di esecuzione più semplice, è stata usata sempre di più negli anni recenti, e lo scopo di questo studio è stato quello di comparare ri relativi risultati a breve ed a medio termina.

Si tratta di uno studio retrospettivo sulla documentazione clinica di 62 pazienti sottoposti o a RYGB (Gruppo R) o a LSG (Gruppo L) nel nostro Dipartimento di Chirurgia Generale tra il 2010 ed il 2013, prendendo in esame i dati demografici, le comorbilità, i valori preoperatori di laboratorio, la durata della degenza e le complicanze postoperatorie. Durante il follow-up postoperatorio sono stati registrati al primo, al terzo, al sesto ed al docicesimo mese il BMI, il EWL, il livello dei trigliceridi (TG) e della lipoproteina a bassa densità (LDL). È risultato che la durata delle degenza postoperatoria è stata significativamente maggiore nel Gruppo R (p=0,001) correlata amche con valori significativamente più elevati al 1°, 3°, 6° e 12° mese del BMI ed EWL. Anche la perdita di capelli è risultata significativamente maggiore nel Gruppo R ($p < 0.05$).

La incidenza del diabete mellito e dell'ipertensione in fase preoperatoria ed al 6° ed al 12° mese non è risultata differente tra i due gruppi. TG ed LDL preoperatori erano significativamente più elevati nel Gruppo R ($p<0.05$).

In conclusione lo studio ha indicato che la RYGB è statisticamente più efficace della LSG, ma che quest'ultima

ha praticamente gli stessi effetti clinici della prima, ed anche che degenza postoperatoria, complicanze postoperatorie e perdita dei capelli sono inferiori nella LSG.

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