

Ten years single center bariatric surgery experience

Emre Turgut,¹ Kuntay Kaplan,² Gökalp Okut,³ Emrah Cengiz,² Huseyin Kocaaslan,²
Necip Tolga Baran,² Mehmet Karahan,⁴ Fatih Sumer,⁵ Cemalettin Aydın,²
Cuneyt Kayaalp⁶

¹Department of General Surgery, Health Sciences University Tepecik Training and Research Hospital, Izmir, Turkey

²Department of Gastrointestinal Surgery, Inonu University, Malatya, Turkey

³Department of General Surgery, Health Sciences University Bozyaka Training and Research Hospital, Izmir, Turkey

⁴Department of General Surgery, Kartal Dr. Lütfi Kırdar City Hospital, Istanbul, Turkey

⁵Department of General Surgery, Irmet Hospital International, Istanbul, Turkey

⁶Department of General Surgery, Yeditepe University, Istanbul, Turkey

ABSTRACT

Introduction: Various surgical modalities have been developed to reduce the amount and absorption of nutrients in the fight against obesity. We aimed to share how the single-center experience was affected by the developments in the world and its change over time with the literature.

Materials and Methods: The records of patients who underwent laparoscopic bariatric surgery between May 2010 and December 2020 were reviewed retrospectively. Demographic characteristics of the patients, indications for surgery, preparation for surgery, surgical technique, and post-operative follow-up stages were examined in detail.

Results: A total of 1422 patients underwent bariatric surgery over a 10-year period. Laparoscopic Roux-n-Y Gastric Bypass (LRYGB) was performed in 946 patients and Laparoscopic Sleeve Gastrectomy (LSG) was performed in 476 patients. The operation time ($p<0.001$) and the intraoperative blood loss ($p<0.001$) in LRYGB were significantly higher than LSG. The difference was not significant in terms of length of hospital stay ($p=0.149$) and drain usage ($p=0.782$). While intraoperative complications occurred in 49 (5.1%) patients in LRYGB, this number was 5 (1%) in LSG ($p<0.001$). There was no significant difference in Clavien Dindo class 3 and higher complication rates between the groups ($p=0.782$). Mortality was seen in only 7 (0.5%) patients.

Conclusion: Today, standard techniques are applied in both procedures and the choice is left to the patient. Regardless of the technique applied, laparoscopic bariatric surgery can be applied as an effective and safe method in the treatment of morbid obesity until an alternative treatment is found.

Keywords: Bariatric, bypass, laparoscopic, obesity, sleeve

Introduction

Obesity is one of the most important public health problems of our time due to the increase in its incidence in recent years and the decrease in the quality and duration of

life with the accompanying health problems.^[1] It is known that obesity causes comorbid diseases such as diabetes, hypertension, cardiopulmonary disease, polycystic ovarian disease, and pseudotumor cerebri, which are asso-



Received: 10.09.2021 Accepted: 19.10.2021

Correspondence: Emre Turgut, M.D., Department of General Surgery, Health Sciences University Tepecik Training and Research Hospital, Izmir, Turkey

e-mail: dr.emtrtgt@gmail.com



This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

ciated with increased mortality. It is often not possible to treat each of these diseases individually.^[2] Therefore, various surgical modalities have been developed to reduce the amount and absorption of nutrients in the fight against obesity.

Roux-n-y gastric bypass (RYGB) was considered the gold standard in bariatric surgery,^[3] especially in the USA, but this situation has changed in favor of sleeve gastrectomy over time. Laparoscopic Sleeve Gastrectomy (LSG) (46%) has become the most used technique worldwide. The second most preferred method is Laparoscopic RYGB (LRYGB) (38.2%).^[4]

Most centers started these procedures with open surgery, and over time, after the learning curve was completed, they switched to laparoscopic surgery.^[5] Today, laparoscopic treatment has become the gold standard in bariatric surgery. Surgical technique has developed considerably since it was first applied, and morbidity and mortality rates have decreased gradually.^[6,7] Today, bariatric surgery has become a safely applicable surgery. In this process, the experiences and developments that most centers have gained over time are very important.

As a reflection of all these developments, a 14-year bariatric surgery experience has been formed in our clinic. We aimed to share retrospectively how the single-center experience was affected by the developments in the world and its change over time with the literature.

Materials and Methods

This study was designed as a retrospective study and the approval numbered 2021/1971 of Inonu University Health Sciences Non-Invasive Clinical Research Ethics Committee was obtained. The records of 1422 patients who underwent laparoscopic bariatric surgery due to morbid obesity in Inonu University Turgut Ozal Medical Center General Surgery Clinic between May 2010 and December 2020 were reviewed retrospectively. Open technique RYGB cases starting from 2006 and continuing until February 2012 were excluded from the study.

Indication

In our clinic, bariatric surgery indications were applied as recommended by the World Health Organization.^[8] Patients with BMI >40 kg/m² or >35 kg/m² with a co-morbid disease such as hypertension or type 2 diabetes mellitus were evaluated. Surgery was offered as an option in cases

where the patients had previously tried each of the diet, exercise and medical treatment options adequately, but could not lose weight at the desired level.

Preoperative Evaluation

After a detailed preoperative physical examination, routine CBC and biochemical profile tests were requested from the patients. In addition, the consultations of endocrinology, psychiatry, cardiology, pulmonology, and anesthesiology were taken. After the multidisciplinary evaluation, the patients who were deemed suitable for surgery were given detailed information about the operation types, benefits, harms, and risks through face-to-face interviews. The choice of operation type was left to the patient and each patient was asked to fill in a detailed consent form. Preoperative upper abdominal ultrasonography was requested from all of the patients and upper gastrointestinal system endoscopy examination was requested from patients over 40 years of age.

Surgical Technique

RYGB

Our clinic started bariatric surgery in 2006 in parallel with the developments in the world. RYGB performed with the open technique until 2010. In the open technique, anastomoses were made to the 50th and 150th cm, and circular stapler no 25 was used in the gastrojejunostomy anastomosis. LRYGB was performed for the 1st time in May 2010. At the beginning of laparoscopy, a total of seven trocars, three 10 mm, three 5 mm, and one 15 mm, were used. As learned from the open technique, the gastrojejunostomy anastomosis continued to be performed with the circular stapler no. 25, with the patient swallowing the anvil placed on the nasogastric tube. Omentum majus was transected up to the transverse colon with the thought that it would cause tension in the anastomosis. Anastomoses continued to be made to the 50th and 150th cm. In January 2011, gastrojejunostomy and enteroenterostomy anastomoses were started to be performed manually, intracorporeally. Until February 2012, RYGB continued with open technique alongside laparoscopic surgery. Since then, laparoscopic surgery has become the standard procedure. When we came to April 2012, the number of trocars was reduced to 5 in parallel with the technical progress. In addition, for the 1st time, anastomoses were performed side by side with a laparoscopic linear stapler. By February 2013, this technique was further developed and transec-

tion of the omentum was terminated, assuming that it did not threaten the safety of the anastomosis. Orvil was used in gastrojejunostomy anastomosis between June 2013 and September 2013, but this technique was abandoned in a short time due to technical difficulties and high cost. The technique was standardized in January 2014^[9] and is still being implemented.

Sleeve Gastrectomy

Sleeve Gastrectomy was started in May 2014. A direct laparoscopic technique was used in line with previous experience with LRYGB. Five trocars were used from the beginning. Staples were not used in the first cases. After the gastrocolic and gastrosplenic ligaments were released, gastrotomy was performed from the 4th cm from the pylorus. The 36 fr thorax tube inserted through the left side 12 mm trocar was extended from the gastrotomy to the esophagus. Then, the stomach was transected using an energy device from the side of the thorax tube. The thorax tube was removed, the specimen was removed endoscopically, and the operation was completed by suturing the resection line with 3/0 prolene. Stapleless sleeve gastrectomy continued until January 2015. As of this date, resection was started using laparoscopic linear stapler. After the resection was started with stapler, the dilatation tube was placed orogastrically. In addition, the specimen was started to be removed from the trocar rather than endoscopically. In the first cases, the stapler line continued to be sutured with 3/0 prolene. The suture was then abandoned. In July 2017, clips were introduced for staple line hemostasis. In September 2017, monopolar cautery was used for hemostasis. Later, as a result of studies that compared these two methods^[10,11] it was decided to continue with monopolar cautery for hemostasis and suturing the staple line with 3/0 prolene. Between December 2015 and December 2016, 12 cases underwent jejunioileal bypass alongside LSG. In this technique, side-to-side anastomosis was performed with staples between the 50th cm jejunum and 200th cm ileum from the treitz. Since December 2017, it was thought that antrum resection during sleeve gastrectomy had no effect on weight loss, and later on, the stomach was transected from the 6th cm from the pylorus. The technique has become standard^[12] and is still being implemented.

Postoperative Follow-up

Patients were usually discharged on the 3rd or 4th day. Analgesics, proteins, multivitamins, and anticoagulants

were routinely prescribed during discharge. It was recommended to use analgesics until the pain subsided, to use anticoagulants for the first 1 month, and to continue protein and multivitamin support for the first 6 months. They were called for physical examination on the 15th day after discharge. They were called for physical examination and CBC + routine biochemical profile examination control at the 1st, 2nd, 3rd, 6th and 12th months. From the 1st month, dietitian and psychiatry consultation was requested at each control. After the 1st year, annual controls were deemed sufficient.

Statistical Analysis

Distribution analysis of the normality of numerical data was performed using the Shapiro-Wilk test. Numerical data were expressed as the median (minimum–maximum) and comparisons were made between groups using the Mann-Whitney U test. Categorical data were expressed as frequency and percentage, and comparisons were made between groups using the Chi-square test. $P < 0.05$ was considered significant. IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, N.Y., USA) was used for statistical analysis.

Results

A total of 1422 patients underwent bariatric surgery over a 10-year period. LRYGB was performed in 946 patients and LSG was performed in 476 patients. The patients were divided into two groups as Group 1 who underwent LRYGB and Group 2, who underwent LSG. The median age of Group 1 was 41 (18–72), and the median body mass index was 44.78 (34.60–72.71) kg/m². Of the patients, 669 (70.7%) were female and 277 (29.3%) were male. The median age of Group 2 was 37 (17–68), and the median body mass index was 43.36 (34.48–79.56) kg/m². Of the patients, 370 (77.7%) were female and 106 (22.3%) were male. Other demographic characteristics of the patients are presented in Table 1.

For Group 1, the median operation time was 180 (60–420) min, the median intraoperative blood loss was 40 (0–700) cc, and the median hospitalization time was 4 (2–54) days. The median operation time of Group 2 was 90 (30–300) min, the median blood loss was 20 (0–500) cc, and the median hospital stay was 4 (2–21) days. While drains were placed in 737 (77.9%) patients in Group 1, drains were placed in 381 (80%) patients in Group 2. The operation time ($p < 0.001$) and the intraoperative blood loss ($p < 0.001$)

Table 1. Demographic features of the patients

Gender	Group 1 (n=946)		Group 2 (n=476)		p
	Male, n (%)	Female, n (%)	Male, n (%)	Female, n (%)	
Age	277 (70.7)	669 (29.3)	106 (22.3)	370 (77.7)	0.139
BMI	41 (18-72)		37 (17-68)		<0.001
ASA Score, n (%)	44.78 (34.60-72.71)		43.36 (34.48-79.56)		0.002
ASA I	106 (11.2)		58 (12.2)		0.639
ASA II	645 (68.2)		313 (65.7)		
ASA III	191 (20.2)		103 (21.6)		
ASA IV	6 (0.4)		2 (0.5)		
Comorbid Disease, n (%)					
LD	117 (12.3)		46 (9.6)		0.202
CVD	21 (2.2)		12 (2.5)		0.687
DM	218 (23)		73 (15.3)		0.003
HT	199 (21)		69 (14.4)		0.009
Previous Surgery, n (%)					
Lower abd.	208 (21.9)		103 (21.6)		0.493
Upper abd.	44 (4.6)		15 (3.1)		
Lower + Upper abd.	30 (3.2)		14 (2.9)		

BMI: Body Mass Index; ASA: American Society of Anesthesiologists; LD: Lung Disease; CVD: Cardiovascular Disease; DM: Type 2 Diabetes Mellitus; HT: Hypertension; Abd: Abdomen.

in Group 1 were significantly higher than Group 2. The difference was not significant in terms of length of hospital stay ($p=0.149$) and drain usage ($p=0.782$).

While intraoperative complications occurred in 49 (5.1%) patients in Group 1, this number was 5 (1%) in Group 2 ($p<0.001$). Intraoperative complications were examined under four main headings as anastomosis or staple line leak, injury in the small bowel meso, trocar site bleeding, and intra-abdominal organ injury and were shared in Table 2.

Table 2. Intraoperatif complications

	Grup 1 n (%)	Grup 2 n (%)	p
Staple Line Leakage	25 (2.6)	2 (0.4)	0.004
Mesenter Injury	4 (0.4)	0 (0)	
Trokar Site Bleeding	3 (0.3)	1 (0.2)	
Organ Injury	17 (1.8)	2 (0.4)	

Intraoperative complications were found to be significantly higher in Group 1 than in Group 2.

There was a deviation from the normal postoperative period in 124 (8.7%) of the patients. There were 38 (2.6%) patients with Clavien Dindo class 3 or higher complications. There was no significant difference in Clavien Dindo class 3 and higher complication rates between the groups ($p=0.782$). Mortality was seen in only 7 (0.5%) patients. Number of complications by years according to Clavien Dindo classification are presented in Table 3.

When the case distributions were examined over the years, it was seen that LSG became more preferred than LRYGB. Case distributions by years are shared in Figure 1.

Discussion

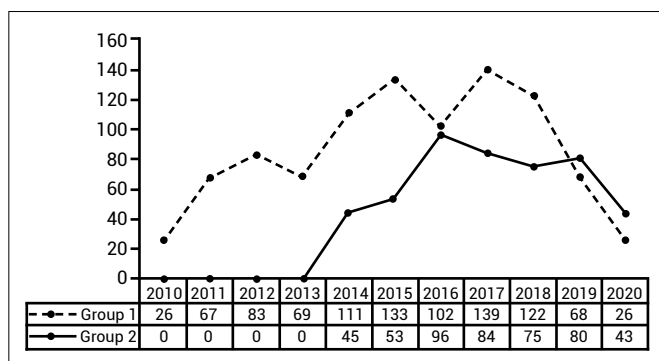
Bariatric surgery continues to be applied increasingly day by day. An effective treatment method that can be an alternative to surgery has not been found yet. When bariatric surgery was started in our clinic, LRYGB was the most preferred method, while LSG has become the most preferred method in parallel with the developments in worldwide.^[13,14]

As seen in this study, operative time, intraoperative blood

Table 3. Number of complications by years according to Clavien Dindo classification

	I	II	IIIa	IIIb	IV	V
2010	2	1	0	2	0	0
2011	3	2	0	1	0	1
2012	2	0	0	1	0	1
2013	3	2	0	0	0	0
2014	16	3	1	0	0	1
2015	6	3	2	3	1	3
2016	4	3	1	3	1	0
2017	9	3	2	4	0	1
2018	11	3	2	4	0	0
2019	4	2	1	0	1	0
2020	3	1	1	0	0	0
Total	63	23	10	18	3	7

85.7% of the total mortality occurred in 2015 and before. Since then, there has been a significant decrease in the mortality rate. However, the same rate was not seen in the number of postoperative complications.

**Figure 1. Case distribution by years.**

loss and intraoperative complication rate are higher in LRYGB than in LSG. In addition, when the two techniques are compared in terms of efficiency, their superiority to each other was not determined.^[15] For these reasons, the rate of application of LSG has become higher over the years compared to LRYGB. In our clinic, the choice of surgical procedure is left to the patient after the advantages and disadvantages are explained.

Bariatric surgery was first started with laparotomy and this process continued for 4 years. In 2010, it was seen in the literature that laparoscopy can be applied safely and the first clinical trials began. Of course, we think that this transition is easier since our clinic already performs many other surgeries laparoscopically. However, in the first cases, 7 trocars were used for ease of movement. As

the technique improved over time, the number of trocars decreased and it was seen that it did not cause any difficulties.

A similar development took place in anastomosis techniques. In the first cases, gastrojejunostomy anastomosis was performed with circular stapler no. 25, as usual with the open technique, and enteroenterostomies were performed side by side by hand. However, with the widespread use of laparoscopic staplers, all anastomoses began to be performed side by side with staplers. A study on this subject showed that the use of linear staplers may be safer.^[16] In addition, since the use of linear staplers is technically easier, this method is still used today. However, intracorporeal suturing is preferred to close the gaps left after staple use.

Getting started with sleeve gastrectomy was easy once the LRYGB learning curve was complete. LSG was initially considered as the first stage of major bariatric surgeries in the literature. But due to its effective weight loss and relatively easy technicality, it quickly became the preferred method around the world. When our clinic started to implement this procedure in 2014, although LRYGB is still the most preferred method, this situation has changed in favor of LSG over time.^[3,4] This was the case with us as well, and when we look at the last 2 years, we have seen that LSG numbers have surpassed LRYGB numbers. Although procedures such as the first-period stapleless LSG or LSG + ileojejunal bypass have been tried to both reduce the cost and increase the efficiency, the technique has become the standard at this point.^[9,12] The use of laparoscopic staplers is the technique of choice here as well, but staple line coagulation has long been the subject of debate. No intervention, use of clips, cauterization and intracorporeal suturing techniques were compared with each other over time^[10,11,17] and it was decided that suturing after cauterization was the best method for hemostasis. It has been observed that this method does not significantly increase the operative time after a certain learning curve is completed.

There was a significant decrease in mortality rates after completion of the learning curve for both techniques. 85.7% of the total mortality occurred in 2015 and before. Since then, there has been a significant decrease in the mortality rate. However, the same rate was not seen in the number of postoperative complications. We think that this is due to the fact that we are an education clinic.

Conclusion

Bariatric surgery started with RYGB with open technique in our clinic. In the light of the developments in the world over the years, the technique first evolved from open surgery to laparoscopic. Later, the choice of surgical procedure shifted from LRYGB to LSG. Today, standard techniques are applied in both procedures and the choice is left to the patient after detailed information is given. Regardless of the technique applied, laparoscopic bariatric surgery can be applied as an effective and safe method in the treatment of morbid obesity until an alternative treatment is found.

Disclosures

Ethics Committee Approval: This study was designed as a retrospective study and the approval numbered 2021/1971 of Inonu University Health Sciences Non-Invasive Clinical Research Ethics Committee was obtained.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – E.T., C.A.; Design – E.T., G.O., K.K.; Supervision – F.S., C.A., C.K.; Materials – M.K., N.T.B., H.K.; Data collection and processing – E.T., G.O., E.C.; Analysis and interpretation – C.K., F.S.; Literature search – E.T., K.K.; Writing – E.T.; Critical review – C.A., C.K.

References

- Seidell JC, Halberstadt J. The global burden of obesity and the challenges of prevention. *Ann Nutr Metab* 2015;66:7–12.
- Pories WJ. Bariatric surgery: risks and rewards. *J Clin Endocrinol Metab* 2008;93:S89–96.
- Angrisani L, Santonicola A, Iovino P, Formisano G, Buchwald H, Scopinaro N. Bariatric Surgery Worldwide 2013. *Obes Surg* 2015;25:1822–32.
- Welbourn R, Hollyman M, Kinsman R, Dixon J, Liem R, Ottoson J, et al. Bariatric surgery worldwide: baseline demographic description and one-year outcomes from the Fourth IFSO Global Registry Report 2018. *Obes Surg* 2019;29:782–95.
- Buchwald H, Avidor Y, Braunwald E, Jensen MD, Pories W, Fahrback K, Schoelles K. Bariatric surgery: a systematic review and meta-analysis. *JAMA*. 2004;292:1724–37.
- Buchwald H, Estok R, Fahrback K, Banel D, Sledge I. Trends in mortality in bariatric surgery: A systematic review and meta-analysis. *Surgery* 2007;142:621–35.
- Cardoso L, Rodrigues D, Gomes L, Carrilho F. Short- and long-term mortality after bariatric surgery: A systematic review and meta-analysis. *Diabetes Obes Metab* 2017;19:1223–32.
- Wirtz VJ. Background Paper 6.18 Obesity. Update on 2004 Background Paper. Published online 2004:38.
- Kayaalp C, Sümer F, Abdullayev A. Laparoscopic Roux-en-Y gastric bypass. *Laparosc Endosc Surg Sci* 2016;23:110–8.
- Gundogan E, Kayaalp C, Aktas A, Saglam K, Sansal M, Uylas U, et al. Randomized controlled trial of monopolar cautery versus clips for staple line bleeding control in Roux-en-Y gastric bypass. *Int J Surg* 2018;58:52–6.
- Sağlam K. Staple line bleeding control with monopolar cautery in laparoscopic sleeve gastrectomy. *Laparosc Endosc Surg Sci* 2019;26:181–4.
- Şansal M, Sağlam K, Gökler C, Sümer F, Kayaalp C. Laparoscopic sleeve gastrectomy technique: How we do it. *Laparosc Endosc Surg Sci* 2018;25:76–80.
- Elder KA, Wolfe BM. Bariatric Surgery: A review of procedures and outcomes. *Gastroenterology* 2007;132:2253–71.
- Sheetz KH, Woodside KJ, Shahinian VB, Dimick JB, Montgomery JR, Waits SA. Trends in bariatric surgery procedures among patients with ESKD in the United States. *Clin J Am Soc Nephrol* 2019;14:1193–9.
- Peterli R, Wölnerhanssen BK, Peters T, Vetter D, Kröll D, Borbély Y, et al. Effect of laparoscopic sleeve gastrectomy vs laparoscopic Roux-en-Y gastric bypass on weight loss in patients with morbid obesity: The SM-BOSS randomized clinical trial. *JAMA* 2018;319:255–65.
- Giordano S, Salminen P, Biancari F, Victorzon M. Linear stapler technique may be safer than circular in gastrojejunal anastomosis for laparoscopic Roux-en-Y gastric bypass: a meta-analysis of comparative studies. *Obes Surg* 2011;21:1958–64.
- Giannopoulos GA, Tzanakis NE, Rallis GE, Efstathiou SP, Tsigris C, Nikiteas NI. Staple line reinforcement in laparoscopic bariatric surgery: does it actually make a difference? A systematic review and meta-analysis. *Surg Endosc* 2010;24:2782–8.