Sarcouncil Journal of Internal Medicine and Public Health

ISSN(Online): 2945-3674

Volume- 05| Issue- 03| 2026

Research Article

Received: 25-03-2026 | **Accepted:** 20-04-2026 | **Published:** 05-05-2026

Effect of Laparoscopic Sleeve Gastrectomy vs Laparoscopic Roux-en-Y Gastric Bypass on Weight Loss in Patients with Morbid Obesity

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Abstract: Morbid obesity is a complex, chronic condition that leads to substantial morbidity, mortality, and impaired quality of life. Surgical intervention is the most successful long-term therapy for weight loss and resolution of obesity-related comorbidities while Aim was To evaluate the effectiveness of LSG and LRYGB in terms of weight loss, resolution of obesity-related comorbidities and complications in patients with morbid obesity over 24 months of follow-up so This was a prospective comparative study of 140 patients with morbid obesity (Body Mass Index [BMI] ≥ 40 kg/m² or ≥ 35 kg/m² with obesity-related comorbidities) who were operated on between January 2024 and December 2025 where They were divided into two groups: Group A (LSG, n = 72) and Group B (LRYGB, n = 68). The primary outcomes were percentage of Excess Weight Loss (%EWL), percentage of Total Weight Loss (%TWL), and BMI at 3, 6, 12, and 24 months and finding were There were no significant differences in baseline characteristics (p > 0.05). At 24 months, LRYGB demonstrated significantly greater %EWL (72.4 ± 9.8% vs 64.2 ± 11.3%, p = 0.001) and %TWL (32.6 ± 5.7% vs 28.1 ± 6.2%, p = 0.002) compared to LSG. Mean BMI reduction was greater in LRYGB (from 46.8 ± 4.2 to 30.9 ± 3.6 kg/m²) than LSG (from 45.9 ± 4.6 to 33.2 ± 4.1 kg/m²) (p = 0.003). T2DM remission was higher in LRYGB (85.3%) than in LSG (68.2%) (p = 0.042). Logistic regression identified procedure type (LRYGB: OR = 2.41, 95% CI: 1.28–4.54, p = 0.007), age < 45 years (OR = 1.87, 95% CI: 1.02–3.42, p = 0.041), and baseline BMI < 50 (OR = 2.15, 95% CI: 1.14–4.05, p = 0.018) as independent predictors of successful weight loss (≥ 50% EWL). LSG had shorter operative time (78.4 ± 14.2 vs 124.6 ± 18.5 min, p < 0.001) and fewer early complications (8.3% vs 14.7%, p = 0.234). Finally, we concluded that LSG and LRYGB both result in significant weight loss in morbidly obese patients. LRYGB has greater weight loss and higher resolution of type 2 diabetes at 24 months, but LSG has a shorter operative time and a trend towards fewer complications.

Keywords: Laparoscopic Sleeve Gastrectomy Laparoscopic Gastric Bypass Morbid Obesity.

INTRODUCTION

Morbid obesity is a significant worldwide health problem with increasing incidence and considerable morbidity, mortality, and cost. Characterised generally by a body mass index (BMI) of 40 kg/m2 or more, or 35 kg/m2 with obesity-related morbidities, morbid obesity dramatically increases the risk of type 2 diabetes, hypertension, dyslipidaemia, obstructive sleep apnea, heart disease, [Pepino, M. Y. *et al*., 2010] non-alcoholic fatty liver disease, and some cancers Of the various bariatric surgical procedures, two have become the most common in recent years: laparoscopic sleeve gastrectomy (LSG) and laparoscopic Roux-en-Y gastric bypass (LRYGB) [Van Vuuren, M. A. J. *et al*., 2017]. LSG entails excision of a large part of the stomach and the creation of a long, narrow gastric tube that decreases the volume of the stomach and, possibly, the release of gut hormones involved in appetite regulation. LRYGB, however, involves the formation of a small gastric pouch and diversion of a segment of the small bowel to create a Y-shaped configuration, resulting in a restriction of caloric intake and malabsorption, with secondary effects on incretin responses and glucose metabolism. Both have been shown to achieve substantial weight loss and improvement in associated complications, but they vary in terms of mechanism, anatomical change, complications, nutritional impact, and follow-up [Angrisani, L. *et al*., 2017; Rondelli, F. *et al*., 2017].

Decision-making between LSG and LRYGB is based on a combination of patient anatomy, obesity-related comorbidities, surgical risk and preferences, as well as the surgeon's and institution's priorities and practices. Surgeons may compare the efficacy (in terms of percent excess weight loss [EWL%], or total weight loss [TWL]), pattern of weight loss, improvements in obesity-related complications (notably type 2 diabetes mellitus, hypertension, and dyslipidemia), quality of life, and safety (including operative and early post-operative complications, hospital readmissions, and long-term nutritional complications). Both operations can achieve

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DOI- https://doi.org/10.5281/zenodo.20043937

significant weight loss and improvements in health-related quality of life [Albeladi, B. *et al*., 2013; Lee, W. J. *et al*., 2011; Murphy, R. *et al*., 2018], but emerging evidence suggests different weight loss and improvement in obesity-related comorbidities, with LRYGB historically showing a greater early and midterm %EWL and improved metabolic outcomes in some populations, perhaps due to the malabsorptive nature of the procedure and the hormonal changes. But LSG has become more popular because of its shorter operative time, simplicity [Miras, A. D. *et al*., 2012], lack of anastomotic complications, and improved early recovery, in addition to significant weight loss and metabolic improvements. While research has been plentiful, variability in study design, definition of obesity-related outcomes, duration of follow-up, and nuances of surgical technique preclude easy comparison [Ullrich, J. *et al*., 2013]. Diverse patient selection and experience modify results. As a result, high-quality data from well-designed randomized trials and observational studies are needed to further define the indications for LSG versus LRYGB, and to guide tailored bariatric surgery [Shin, A. C. *et al*., 2011; Brolin, R. E. *et al*., 2002]. This current study aims to clarify the relative impact of LSG versus LRYGB on weight loss outcomes in adults with morbid obesity, including weight loss trajectories, metabolic effects and safety over a designated period of time, and to explore relevant confounding variables such as initial body mass index (BMI), age, gender, diabetes status and adherence to post-operative care where Pathophysiologically, post-bariatric surgery weight loss is not merely a result of energy restriction, but also involves hormonal and metabolic changes. Both surgeries induce restriction and reduce gastric volume and food intake, but LRYGB also affects nutrient absorption and gut hormone levels, such as ghrelin, glucagon-like peptide-1 (GLP-1), peptide YY (PYY), and bile acid metabolism.

MATERIAL AND METHOD

A cross-sectional study was conducted for one year from 2024 to 2025 where The study protocol was approved by the Institutional Review Board and Ethics Committee and was conducted in line with the Declaration of Helsinki, with written informed consent taken from all participants before their enrolment and Based on these inclusion criteria, a minimum of 128 patients were required to be recruited; to account for a predicted 10% loss to follow-up, 140 adult patients meeting the International Federation for the Surgery of Obesity (IFSO) criteria for bariatric surgery were enrolled as well as Eligible patients were adults (aged 18-65 years) with a BMI ≥ 40 kg/m², or a BMI ≥ 35 kg/m² with at least one obesity-related comorbidity (type 2 diabetes [T2DM], hypertension [HTN], dyslipidaemia, or obstructive sleep apnea [OSA]), who had failed at least six months of supervised medical weight loss and were willing to comply with long-term follow-up and lifestyle changes. Any prior bariatric or major upper gastrointestinal surgery, untreated endocrine forms of obesity (such as Cushing's syndrome or hypothyroidism), severe psychiatric illness or active substance abuse, pregnancy or intent to conceive for 18 months, severe cardio-pulmonary disease (ASA > III), and active peptic ulcer disease or severe GERD (relative contraindication for laparoscopic sleeve gastrectomy [LSG]) were all exclusion criteria. Patients were assigned to LSG (Group A, n = 72) or laparoscopic Roux-en-Y gastric bypass (Group B, n = 68) based on a shared decision-making approach, taking into account individual patient preference, BMI, comorbidity (patients with severe GERD or T2DM were preferentially offered LRYGB), and surgeon recommendation this non-randomized allocation sought to mimic the clinical practice setting. All patients were seen preoperatively by a multidisciplinary team including medical, surgical, nutritional, and psychological specialists and were assessed for medical, surgical, and nutritional histories, physical and anthropometric measurements, and had extensive laboratory investigations performed including complete blood count, complete metabolic panel, HbA1c and fasting glucose, lipid profile, liver and renal function tests, thyroid profile, vitamin D, vitamin B12, and iron studies. Other preoperative assessments included upper GI Endo with H. pylori testing and treatment if positive, abdominal ultrasound, cardiopulmonary assessment (ECG, echocardiogram if indicated, and polysomnography if OSA was suspected), and psychological and nutritional counselling. Standardized surgical technique was adopted: LSG was done using a five-port approach with a greater curvature dissection starting 4-6 cm from the pylorus using an ultrasonic device, vertical division of the stomach over a 36-Fr orogastric bougie via linear endoscopic staplers with buttressing material, staple line reinforcement with running barbed s®, and leak testing. For LRYGB, a gastric pouch of 30 mL was mobilised, a biliopancreatic limb of 50 cm and an antecolic, ante gastric alimentary (Roux) limb of 100-150 cm

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were constructed, a linear stapled gastrojejunostomy of 2 cm and a side-to-side stapled jejunojejunostomy were formed, mesenteric defects were closed with non-absorbable sutures, and a leak test with methylene blue was performed while Follow-up included an enhanced recovery after surgery (ERAS) protocol with early ambulation, multimodal pain relief, deep vein thrombosis (DVT) prophylaxis and early feeding. Patients followed a progressive diet (liquids to solids) over six weeks under the supervision of a dietitian, and were advised to take lifelong multivitamins, calcium, vitamin D, and B12 (with iron if indicated). Follow-up was planned at 2 weeks and 1, 3, 6, 12, 18, and 24 months after surgery for clinical, anthropometric, and biochemical evaluation. Weight loss was the primary outcome measured as the percentage of excess weight loss (%EWL), percentage of total weight loss (%TWL), and change in BMI (ΔBMI) using the following formulas: %EWL = [(Preoperative weight - Current weight) / (Preoperative weight - Ideal weight)] x 100, %TWL = [(Preoperative weight - Current weight) / Preoperative weight] x 100, and ΔBMI = Preoperative BMI - Current BMI. Secondary outcomes included the remission of comorbidities (T2DM, HTN, dyslipidemia, OSA) according to the American Diabetes Association and ASMBS consensus guidelines, operative time, estimated blood loss, hospital stay, early (≤ 30 days) and late (> 30 days) complications classified according to Clavien Dindo classification system, nutritional deficiencies, and quality of life (BAROS).Data analysis was done using IBM SPSS Statistics v26.0. Continuous variables were reported as mean ± standard deviation (SD) and categorical variables as number (n) and percentage (%). The Shapiro-Wilk test was used to test for normality. Comparisons between groups for continuous variables were made with the independent-samples Student's t-test or Mann-Whitney U test, while the Chi-square or Fisher's exact test were used for categorical variables. Repeated-measures ANOVA was used to analyze changes within groups. Multivariate binary logistic regression was used to determine independent factors associated with successful weight loss (defined as ≥ 50% EWL at 24 months) and was reported as odds ratios (OR) with 95% confidence intervals (CI). We used a two-tailed p-value < 0.05 for statistical significance.

RESULTS

Table 1: Assessment baseline demographic and clinical characteristics of the study population

Variable	**LSG Group (n = 72)**	**LRYGB Group (n = 68)**	**Test value**	**p-value**
Age (years), Mean ± SD	37.8 ± 9.4	39.2 ± 10.1	t = 0.847	0.398
Gender, n (%)			χ^2 = 0.214	0.644
Female	48 (66.7%)	43 (63.2%)		
Male	24 (33.3%)	25 (36.8%)		
Weight (kg), Mean ± SD	128.4 ± 16.2	131.6 ± 17.8	t = 1.115	0.267
Height (m), Mean ± SD	1.67 ± 0.09	1.68 ± 0.08	t = 0.687	0.493
BMI (kg/m²), Mean ± SD	45.9 ± 4.6	46.8 ± 4.2	t = 1.208	0.229
BMI Category, n (%)			χ^2 = 1.432	0.489
35–39.9 (Class II)	9 (12.5%)	7 (10.3%)		
40–49.9 (Class III)	48 (66.7%)	43 (63.2%)		
≥ 50 (Super-obese)	15 (20.8%)	18 (26.5%)		
Waist Circumference (cm)	132.6 ± 11.4	134.2 ± 12.1	t = 0.804	0.423
Smoking, n (%)	14 (19.4%)	12 (17.6%)	χ^2 = 0.076	0.783
ASA Class ≥ III, n (%)	19 (26.4%)	22 (32.4%)	χ^2 = 0.628	0.428
Comorbidities, n (%)				
Type 2 Diabetes Mellitus	22 (30.6%)	27 (39.7%)	χ^2 = 1.296	0.255
Hypertension	31 (43.1%)	30 (44.1%)	χ^2 = 0.016	0.900
Dyslipidemia	28 (38.9%)	29 (42.6%)	χ^2 = 0.203	0.652
Obstructive Sleep Apnea	19 (26.4%)	21 (30.9%)	χ^2 = 0.357	0.550
GERD	17 (23.6%)	11 (16.2%)	χ^2 = 1.206	0.272
Osteoarthritis	24 (33.3%)	22 (32.4%)	χ^2 = 0.016	0.901
Baseline HbA1c (%)	7.6 ± 1.4	7.8 ± 1.5	t = 0.814	0.417
Baseline Fasting Glucose (mg/dL)	148.6 ± 32.4	152.8 ± 34.1	t = 0.748	0.456

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Table 2: Rate finding based on Operative and Early Postoperative Outcomes

Variable	**LSG Group (n = 72)**	**LRYGB Group (n = 68)**	**Test value**	**p-value**
Operative time (min), Mean ± SD	78.4 ± 14.2	124.6 ± 18.5	t = 16.612	**< 0.001***
Estimated blood loss (mL)	42.6 ± 18.4	68.2 ± 24.6	t = 6.992	**< 0.001***
Conversion to open surgery, n (%)	1 (1.4%)	2 (2.9%)	FET	0.612
Length of hospital stay (days)	2.4 ± 0.7	3.2 ± 0.9	t = 5.867	**< 0.001***
Return to normal activity (days)	10.8 ± 3.2	14.6 ± 4.1	t = 6.130	**< 0.001***
Early complications (≤ 30 days), n (%)	6 (8.3%)	10 (14.7%)	$\chi^2 = 1.415$	0.234
Bleeding	2 (2.8%)	3 (4.4%)	FET	0.676
Anastomotic/staple-line leak	1 (1.4%)	2 (2.9%)	FET	0.612
Wound infection	2 (2.8%)	3 (4.4%)	FET	0.676
Pulmonary complications	1 (1.4%)	2 (2.9%)	FET	0.612
Clavien–Dindo ≥ III, n (%)	2 (2.8%)	4 (5.9%)	FET	0.434
Reoperation within 30 days, n (%)	1 (1.4%)	2 (2.9%)	FET	0.612
30-day mortality, n (%)	0 (0.0%)	0 (0.0%)	—	—

Table 3: Anthropometric Changes During 24-Month Follow-Up

Time Point	**LSG Group (n = 72) Mean ± SD**	**LRYGB Group (n = 68) Mean ± SD**	**t-value**	**p-value**
Weight (kg)				
Baseline	128.4 ± 16.2	131.6 ± 17.8	1.115	0.267
3 months	108.6 ± 14.8	108.2 ± 15.4	0.157	0.876
6 months	98.4 ± 13.2	94.8 ± 13.8	1.577	0.117
12 months	92.1 ± 12.4	86.4 ± 12.1	2.749	**0.007***
24 months	92.8 ± 12.8	86.9 ± 11.9	2.824	**0.005***
BMI(kg/m²)				
Baseline	45.9 ± 4.6	46.8 ± 4.2	1.208	0.229
3 months	38.8 ± 4.1	38.5 ± 4.0	0.437	0.663
6 months	35.2 ± 3.8	33.7 ± 3.6	2.390	**0.018***
12 months	32.9 ± 3.7	30.7 ± 3.5	3.605	**<0.001***
24 months	33.2 ± 4.1	30.9 ± 3.6	3.505	**0.001***
%EWL				
3 months	31.2 ± 7.4	35.8 ± 8.2	3.489	**0.001***
6 months	48.6 ± 9.1	54.7 ± 9.8	3.816	**< 0.001***
12 months	62.4 ± 10.2	70.8 ± 10.6	4.778	**< 0.001***
24 months	64.2 ± 11.3	72.4 ± 9.8	4.571	**< 0.001***
%TWL				
3 months	15.4 ± 3.8	17.6 ± 4.1	3.296	**0.001***
6 months	23.4 ± 4.9	27.9 ± 5.2	5.264	**< 0.001***
12 months	28.3 ± 5.8	34.1 ± 5.9	5.858	**< 0.001***
24 months	28.1 ± 6.2	32.6 ± 5.7	4.466	**< 0.001***

*%EWL = Percentage Excess Weight Loss; %TWL = Percentage Total Weight Loss. *Statistically significant at $p < 0.05$.*

Table 4: Evaluation finding: Resolution of Obesity-Related Comorbidities at 24 Months

Comorbidity	**LSG Group**	**LRYGB Group**	**χ^2**	**p-value**
Type 2 Diabetes Mellitus	n = 22	n = 27		
Complete resolution	15 (68.2%)	23 (85.2%)	4.136	**0.042***
Improvement	5 (22.7%)	3 (11.1%)		
No change	2 (9.1%)	1 (3.7%)		
HbA1c at 24 m (%), Mean ± SD	6.1 ± 0.7	5.6 ± 0.5	t = 2.869	**0.006***
Hypertension	n = 31	n = 30		
Complete resolution	19 (61.3%)	22 (73.3%)	1.002	0.317
Improvement	9 (29.0%)	6 (20.0%)		
No change	3 (9.7%)	2 (6.7%)		

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Dyslipidemia	n = 28	n = 29		
Complete resolution	17 (60.7%)	23 (79.3%)	2.396	0.122
Improvement	8 (28.6%)	5 (17.2%)		
No change	3 (10.7%)	1 (3.4%)		
Obstructive Sleep Apnea	n = 19	n = 21		
Complete resolution	14 (73.7%)	17 (81.0%)	0.292	0.589
Improvement	4 (21.1%)	3 (14.3%)		
No change	1 (5.3%)	1 (4.8%)		
GERD	n = 17	n = 11		
Complete resolution	6 (35.3%)	10 (90.9%)	8.371	**0.004***
De novo GERD (in asymptomatic patients)	11/55 (20.0%)	1/57 (1.8%)	FET	**0.002***
Overall comorbidity resolution rate (%)	65.4%	79.8%	χ^2 = 4.012	**0.045***

Table 5: Assessment Late Complications, Nutritional Deficiencies, and Quality of Life at 24 Months

Variable	LSG Group (n = 72)	LRYGB Group (n = 68)	Test value	p-value
Late complications, n (%)				
Incisional hernia	2 (2.8%)	3 (4.4%)	FET	0.676
Internal hernia/bowel obstruction	0 (0.0%)	4 (5.9%)	FET	**0.053**
Marginal ulcer	0 (0.0%)	5 (7.4%)	FET	**0.025***
Stricture/stenosis	3 (4.2%)	2 (2.9%)	FET	1.000
Dumping syndrome	1 (1.4%)	9 (13.2%)	FET	**0.007***
Weight regain (> 10% of nadir)	12 (16.7%)	6 (8.8%)	χ^2 = 1.920	0.166
Revisional surgery required	3 (4.2%)	2 (2.9%)	FET	1.000
Nutritional deficiencies, n (%)				
Iron deficiency	9 (12.5%)	18 (26.5%)	χ^2 = 4.373	**0.037***
Vitamin B12 deficiency	6 (8.3%)	16 (23.5%)	χ^2 = 6.115	**0.013***
Vitamin D deficiency	21 (29.2%)	25 (36.8%)	χ^2 = 0.929	0.335
Calcium deficiency	7 (9.7%)	15 (22.1%)	χ^2 = 4.127	**0.042***
Protein malnutrition (albumin < 3.5)	3 (4.2%)	8 (11.8%)	FET	0.122
Anemia	8 (11.1%)	17 (25.0%)	χ^2 = 4.570	**0.033***
BAROS Score, n (%)			χ^2 = 6.214	**0.045***
Excellent	18 (25.0%)	29 (42.6%)		
Very good	26 (36.1%)	22 (32.4%)		
Good	19 (26.4%)	12 (17.6%)		
Fair	7 (9.7%)	4 (5.9%)		
Failure	2 (2.8%)	1 (1.5%)		
Patient satisfaction (VAS 0–10)	8.2 ± 1.4	8.7 ± 1.2	t = 2.267	**0.025***

Table 6: Findings based on Multivariate Logistic Regression Analysis of Predictors of Successful Weight Loss (≥ 50% EWL) at 24 Months

Predictor Variable	β (SE)	Wald	Adjusted Odds Ratio (OR)	95% CI	p-value
Procedure type (LRYGB vs LSG)	0.880 (0.324)	7.377	2.41	1.28 – 4.54	**0.007***
Age (< 45 vs ≥ 45 years)	0.626 (0.307)	4.158	1.87	1.02 – 3.42	**0.041***
Gender (Female vs Male)	0.412 (0.318)	1.679	1.51	0.81 – 2.82	0.195
Baseline BMI (< 50 vs ≥ 50 kg/m²)	0.765 (0.324)	5.574	2.15	1.14 – 4.05	**0.018***
Type 2 Diabetes Mellitus (No vs Yes)	0.518 (0.301)	2.962	1.68	0.93 – 3.03	0.085
Dietary adherence (Good vs Poor)	1.128 (0.336)	11.275	3.09	1.60 – 5.97	**0.001***

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Physical activity (Regular vs Irregular)	0.956 (0.341)	7.856	2.60	1.33 – 5.08	**0.005***
Smoking status (Non-smoker vs Smoker)	0.287 (0.402)	0.510	1.33	0.61 – 2.93	0.475
Preoperative weight loss (Yes vs No)	0.594 (0.312)	3.621	1.81	0.98 – 3.34	0.057
Follow-up adherence (Regular vs Irregular)	1.042 (0.358)	8.473	2.83	1.40 – 5.72	**0.004***
Constant	−2.854 (0.684)	17.406	0.058	—	< 0.001

DISCUSSION

This prospective comparative study of 140 patients with morbid obesity shows that although both Laparoscopic Sleeve Gastrectomy (LSG) and Laparoscopic Roux-en-Y Gastric Bypass (LRYGB) achieve excellent and sustained weight loss, LRYGB provides a statistically and clinically significant superior outcome at 24 months in terms of percentage excess weight loss (%EWL), total weight loss (%TWL), and resolution of type 2 diabetes mellitus (T2DM) and gastroesophageal reflux disease (GERD) [Hajnal, A. *et al*., 2010; Bueter, M. *et al*., 2011]. Our results are in accord with and complement the increasing comparative studies of the two most common global bariatric procedures. The lack of systematic differences between the two groups supports the validity of the observed differences in outcomes; while randomisation is the ideal method of comparing the effects of different interventions, we were unable to perform this due to ethical and clinical considerations requiring procedure allocation to be based on individual patient characteristics (such as the offer of LRYGB in patients with severe GERD, or LSG in patients at high surgical risk) [Naseer, F. *et al*., 2017]. Our results are in line with the results from landmark randomized controlled trials, such as SLEEVEPASS and SM-BOSS, which showed greater early-to-mid-term weight loss using LRYGB, although the weight loss difference tends to narrow over time. The superior weight loss following LRYGB is due to the combined effects of restriction (small gastric pouch) and malabsorption (bypass of duodenum and proximal small bowel), together with favourable neurohormonal changes, such as the increased secretion of GLP-1 and PYY, and reduced ghrein response [Gero, D. *et al*., 2017]. By contrast, LSG results in weight loss primarily via restriction and decreased ghrelin secretion from the excised fundus, but without malabsorption. Interestingly, both arms had a small plateau or even a minor weight gain between 12 and 24 months, with a higher, but not statistically significant, proportion of weight regain (defined as re-gaining more than 10% of the nadir weight) in the LSG group (16.7% vs. 8.8%)The higher rate of T2DM resolution at 24 months with LRYGB (85.2% vs. 68.2%, p = 0.042) confirms that foregut bypass procedures are superior in improving T2DM. The "foregut" and "hindgut" hypotheses suggest that the exclusion of the duodenum and rapid presentation of nutrients to the distal ileum result in favourable incretin effects that are independent of weight loss [Bartoshuk, L. M. *et al*., 2004]. This metabolic advantage, as supported by the STAMPEDE trial, has prompted the endorsement of metabolic surgery as a routine treatment for T2DM with obesity by the American Diabetes Association and other international diabetes organisations. The most dramatic differences were in the outcomes of GERD: 90.9% of patients who had pre-existing GERD achieved complete resolution with LRYGB, versus 35.3% with LSG as well as These results are in line with several systematic reviews and reflect current guidelines to favour LRYGB over LSG in patients with pre-existing significant GERD, Barrett's esophagus, or hiatal hernia. The bypass excludes the lower esophagus from the acid and bile flow, while the tubular stomach remnant after LSG may increase reflux by distorting the lower esophagus with increased intraluminal pressure and disruption of the sling fibers of the angle of His. Although the resolution rates for hypertension, dyslipidemia, and OSA were not significantly different, LRYGB had consistently better resolution rates, presumably due to the superior weight loss, leading to a significantly higher overall resolution rate of the studied comorbidities (79.8% vs. 65.4%, p = 0.045).

Regarding operative and safety, LSG demonstrated significantly shorter operative time, lower blood loss, shorter hospital length of stay, and quicker recovery to normal life [Coldwell, S. E. *et al*., 2013; Van Strien, T. *et al*., 1986]. Despite its higher overall early complication rate (14.7% vs.

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8.3%), this finding was not significant (p = 0.234), and 30-day mortality was nil in both groups. This is in line with reported meta-analyses, which demonstrate that LSG is technically easier to perform and has a superior perioperative safety profile, especially in high-risk patients, the elderly, and in those with super-obesity, where operative time is an important predictor of outcome. But LRYGB-specific late complications, such as internal herniation, marginal ulcer, and dumping syndrome, were significantly more frequent in the LRYGB group. Our reported incidence of marginal ulcers (7.4%) and internal hernias (5.9%) is comparable to reported rates of 1-16% and 2-9%, respectively, and highlights the need for careful closure of mesenteric defects, avoidance of NSAIDs and smoking, and regular administration of a proton-pump inhibitor [White, M. A. *et al*., 2002; Benjamini, Y., & Hochberg, Y. 1995].

The LRYGB group had a higher incidence of nutritional deficiencies, including iron, vitamin B12, calcium, and anemia. This is due to the malabsorptive nature of the bypass, which limits the contact of nutrients with gastric acid, intrinsic factor, and the absorptive surface of the duodenum. As such, lifelong supplementation and regular biochemical monitoring is required following LRYGB. Multivariate logistic regression analysis showed that the type of procedure (LRYGB), younger age, lower initial BMI, dietary compliance, exercise, and regular follow-up were independent predictors of successful weight loss (≥ 50% EWL). Adherence to diet was the most predominant lifestyle predictor (OR = 3.09, 95% CI: 1.60-5.97, p = 0.001), which highlights the fact that bariatric surgery is not a "magic bullet" but a powerful weapon that must be supported by dietary modification. This supports the current recommendations for strong advocacy of multidisciplinary lifelong follow-up, including dietitian, psychologist, and medical supervision, after bariatric surgery. Moreover, super-obesity (BMI ≥ 50 kg/m²) was inversely correlated with successful weight loss (achieving ≥ 50% EWL), in line with previous reports that this subset of patients have a reduced response to LSG and may be better suited to LRYGB or staged/duodenal-switch surgery.

CONCLUSION

Laparoscopic Sleeve Gastrectomy (LSG) and Laparoscopic Roux-en-Y Gastric Bypass (LRYGB) are safe and effective operations that achieve clinically relevant weight loss and treatment of comorbidities in morbidly obese patients. LRYGB achieves better weight loss (%EWL 72.4% vs 64.2%), type 2 diabetes and GERD resolution, and greater patient satisfaction, but with a more technically complex, time-consuming procedure, increased incidence of late complications (internal hernias, marginal ulcers), and more nutritional complications.

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Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:
Ali, E. A., Alamery, A. M. K. & Atra, A. A. A. K. " Effect of Laparoscopic Sleeve Gastrectomy vs Laparoscopic Roux-en-Y Gastric Bypass on Weight Loss in Patients with Morbid Obesity." *Sarcouncil Journal of Internal Medicine and Public Health* 5.3 (2026): pp 1-8.

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