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Resolution of Type 2 Diabetes After Sleeve Gastrectomy

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Author`s Contribution

[1,2,3]Substantial contributions to the conception or design of the work; or the acquisition, [4,6]Active participation in active methodology, [5]analysis, or interpretation of data for the work, Drafting the work or revising it critically for important intellectual content

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ABSTRACT

Objective: To determine the resolution of type-II diabetes mellitus (DM) after sleeve gastrectomy (SG) among patients by evaluating glycemic control, medication use, and weight loss.

Methodology: A prospective observational study, was done at the Nescom hospital, Islamabad, from august 2022 to September 2023. Both male and female individuals aged 18 years old or above, morbidly obese with BMI ≥35 kg/m² and with diagnosis of type –II DM undergoing laparoscopic sleeve gastrectomy were included. Laparoscopic sleeve gastrectomy was done using a standardized four-port technique. A possible large curvature of the stomach was resected, starting 6 cm proximal to the pylorus up to the angle of His. The 36-Fr bougie was used to calibrate the sleeve. Postoperative care started with a liquid diet and structured follow-up at POD3, 2 weeks, and 6 months. At each visit, BMI, fasting glucose, and HbA1c were recorded. Data were documented on a study proforma and analyzed using SPSS version 26.

Results: Overall mean age of the individuals was 47 ± 8 years with 63.3% being female and 36.7% males. Before the surgeries, 66.7% required hypoglycemic drugs and 53.3% were on insulin. Average HbA1c decreased significantly from 8.9% preoperatively to 8.2% on POD3, 7.1% at 2 weeks, and 5.9% at 6 months ($p < 0.001$). The plasma glucose levels declined from 202.7 mg/dL (POD3) to 138.4 mg/dL at 2 weeks and 100.8 mg/dL at 6 months ($p < 0.001$). Additionally, the excess weight loss was improved steadily, from 4.1% at POD3 to 11.7% at 2 weeks and 35.1% at 6 months ($p < 0.001$). However, there were no significant gender-based differences were observed in HbA1c, plasma glucose, excess weight loss, or BMI (all $p > 0.05$).

Conclusion: The laparoscopic sleeve gastrectomy observed to be an effective intervention for achieving significant weight loss, improving glycemic control, and reducing plasma glucose levels among obese diabetic patients.

Key words: Obesity, Type-II DM, HbA1c, FBS, Excess weight loss.

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Introduction

Obesity and type 2 diabetes mellitus (T2DM) are major global health concerns, with their prevalence steadily increasing.[1] Obesity is the most common metabolic disorder worldwide, and its occurrence continues to rise rapidly, with more than half of the global population now classified as overweight.[2] In parallel, an estimated 451 million people are currently living with T2DM, a figure expected to reach about 693 million by 2045 equivalent to one in every ten adults.[1] The association between obesity and the development of T2DM, as well as other comorbidities such as dyslipidemia and hypertension, is well established. Excess body weight greatly elevates the lifetime risk of developing type-II DM rising from 7% to 70% in men and from 12% to 74% in women as body mass index increases.[3] The majority of individuals with type-II DM are also affected by obesity, making the coexistence of these conditions a major global concern for both clinical practice and public health. Therefore, effective obesity management is essential for both the prevention and treatment of T2DM.

For individuals with obesity, initial management typically emphasizes lifestyle-based interventions such as

nutritional modification, physical activity, and other non-surgical approaches. If these measures do not achieve sufficient results, surgical options may be considered. The American Diabetes Association (ADA) acknowledged metabolic surgery as an effective therapy not only for excessive body weight but also for its associated health complications.[4-6] Essentially, these procedures work by limiting food consumption and/or decreasing nutrient absorption.[4]

Advances in minimally invasive laparoscopic methods is sleeve gastrostomy have significantly improved bariatric surgery, and numerous randomized controlled trials have demonstrated its effectiveness in achieving glycemic control.[7] Thought the long-term persistence of benefits following SG is very important to determine whether the sustainability of its initial benefits, yet only a few studies have explored these outcomes.[8] Additionally the remission of type-II DM after bariatric surgery is driven by multiple mechanisms such as reduced insulin resistance, elevated bile acids enhancing insulin sensitivity, and increased GLP-1 activity stimulating pancreatic β-cells indicating that its benefits extend well beyond weight reduction.[9,10]

However the choosing which type of bariatric surgery to undergo is primarily the patient's decision, but the surgeon provides guidance toward the most suitable option. Things like existing health problems, how effective the surgery is, possible risks, and how invasive the procedure is should all be considered.[9,11] Based on the turn to the core issue as the Pakistan facing a growing dual burden of obesity and type-II DM, yet conventional therapies often fail to achieve long-term control. However, the SG has been shown internationally to induce weight loss and diabetes remission, but local evidence remains limited. Therefore, present study is significant as it may generate context-specific data on the outcomes of SG in our population, guiding clinical practice, improving patient counselling, and supporting healthcare planning for effective management of obesity and T2DM.

Methodology

This prospective observational study was carried out at NESCOM Hospital, Islamabad. The study duration was 14 months, from August 2022 to September 2023. The study was conducted after obtaining ethical approval from the Hospital ERC Committee (Ref No. NESCOM-44(33)/2024-IMC).

All adult patients aged 18 years or older, of either gender, who were morbidly obese (BMI ≥35 kg/m²) and had a diagnosis of type II diabetes mellitus (duration <10 years and glycated hemoglobin [HbA1c] level ≥6.5%) undergoing laparoscopic sleeve gastrectomy were included. Individuals with a history of previous bariatric surgery, renal or hepatic impairment, or corticosteroid therapy were excluded.

All participants underwent a complete medical history assessment and comprehensive evaluation by a multidisciplinary team, including endocrinologists, psychologists, and surgeons. Verbal and written informed consent was obtained from each patient after explaining the procedure, its benefits, potential complications, and their full right to voluntarily participate or withdraw from the study.

All selected patients underwent laparoscopic sleeve gastrectomy using a standardized four-port technique. The greater curvature of the stomach was resected, starting 6 cm proximal to the pylorus and extending up to the angle of His. A 36-Fr bougie was used to calibrate the gastric sleeve.

Postoperative care included initiation of a liquid-based diet on the third postoperative day, followed by a structured schedule of regular follow-up visits to closely monitor recovery and surgical outcomes. Follow-up visits were scheduled on the third postoperative day, at 2 weeks, and at 6 months postoperatively. During follow-up visits, clinical parameters including BMI, fasting blood glucose level, and HbA1c were monitored.

A successful outcome was defined as achieving an HbA1c level of less than 6.5% in the absence of anti-diabetic medications. Secondary outcomes included reductions in BMI and evaluation of insulin resistance. All study data were documented on a structured proforma and entered into SPSS version 26 for analysis.

Results

Overall 30 patients were selected with an overall mean age of 47 years, of whom 63.3% were female and 36.7% were male. Before the surgery, 66.7% of patients were using hypoglycemic drugs and more than half (53.3%) were on insulin therapy. Overall mean preoperative HbA1c was 8.85%, which progressively decreases to 8.17% on the 3rd postoperative day, 7.07% after 2 weeks, and 5.92% at 6 months after surgeries. Additionally, the plasma glucose levels also improved from a mean of 202.7 mg/dL on the 3rd postoperative day to 138.4 mg/dL at 2 weeks, and 100.8 mg/dL at 6 months after surgeries. The EWL also noted steady improvement, increasing from 4.05% at the 3rd postoperative day to 11.67% after 2 weeks and

reaching 35.08% at 6 months followed by the mean BMI before surgery was 46.7 kg/m² which decreased around 44.2 kg/m² at 2nd week and 38.3 kg/m² on 6th month after surgeries. Table I

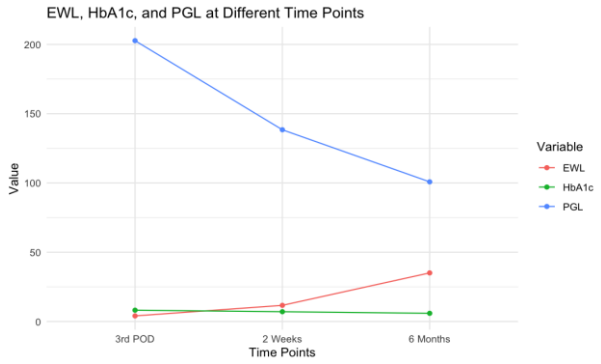

Figure 1. Longitudinal Outcome of Laparoscopic Sleeve Gastrectomy in Pakistani Patients: Weight Loss, Glycemic Control, and PGL

Furthermore, the usage of hypoglycemic drugs was higher in females (73.7%) than males (54.5%), insulin use was nearly identical between females and males (52.6% vs. 54.5% respectively, HbA1c levels before surgery (p=0.69), on the 3rd postoperative day (p=0.82), after 2 weeks (p=0.14), and at 6 months (p=0.91) showed no gender-related differences. Overall mean preoperative HbA1c was 8.9 ± 1.6% in females and 8.7 ± 1.1% in males, which was significantly improved in both female and male patients, with no statistically significant difference p >0.05. Furthermore, the improvements in EWL and Plasma glucose levels were also statistically insignificant according to genders p>0.05, as shown in tables II.

Discussion

Obesity DM has become global public health concerns, posing serious risks to population health. Obesity, in particular, is linked to higher rates of illness and death from numerous diseases.[12] Present study was done on 30 cases to evaluate the resolution of type-II DM after SG among patients by evaluating glycemic control, medication use, and weight loss, with an overall mean age of mean age of 47 years, of whom 63.3% were female and 36.7% were male. These findings are comparable to those reported by Shah M. et al[13] where the mean age of patients was 48.53 ± 5.91 years, with females comprising the majority (63.3%) compared to males (36.7%). Similarly,

Table I: Patient Demographics and Clinical Characteristics.

Variable	Mean (SD)	Median (IQR)	Range
Age (years)	47.06 (8.11)	47.5 (42.00 - 51.00)	35 - 63
Gender			
- Female, n (%)		19 (63.33%)	
- Male, n (%)		11 (36.67%)	
Use of Hypoglycemic Drugs, n (%)		20 (66.67%)	
Insulin Use, n (%)		16 (53.33%)	
HbA1c Before Operation (%)	8.85 (1.42)	8.9 (7.58 - 9.80)	6.70 - 12.90
HbA1c 3rd POD (%)	8.17 (1.04)	8.1 (7.00 - 9.00)	6.50 - 10.00
HbA1c After 2 Weeks (%)	7.07 (0.70)	7.1 (6.50 - 7.50)	6.00 - 8.90
HbA1c at 6 Months (%)	5.92 (0.44)	6.0 (5.80 - 6.10)	5.00 - 6.50
EWL at 3rd POD (%)	4.05 (0.47)	3.9 (3.70 - 4.48)	3.30 - 5.10
EWL at 2 Weeks (%)	11.67 (1.19)	11.45 (11.03 - 12.43)	10.00 - 14.40
EWL at 6 Months (%)	35.08 (2.63)	35.85 (33.33 - 36.67)	30.00 - 39.20
PGL at 3rd POD (mg/dL)	202.7 (23.5)	200.0 (187.2 - 219.0)	156 - 253
PGL at 2 Weeks (mg/dL)	138.4 (30.1)	127.0 (118.5 - 168.2)	98 - 185
PGL at 6 Months (mg/dL)	100.8 (7.23)	100.0 (98.0 - 104.8)	85 - 112
BMI (kg/m²)	46.71 (6.35)	45.65 (43.33 - 49.23)	38.40 - 59.30

Table II: Comparison of Clinical Characteristics by Gender.

Variable	Female (n=19)	Male (n=11)	p-value
Use of Hypoglycemic Drugs, n (%)	14 (73.7%)	6 (54.5%)	0.32
Insulin Use, n (%)	10 (52.6%)	6 (54.5%)	0.93
HbA1c Before Operation (%)	8.9 (1.6)	8.7 (1.1)	0.69
HbA1c 3rd POD (%)	8.2 (1.1)	8.1 (0.9)	0.82
HbA1c After 2 Weeks (%)	7.2 (0.6)	6.8 (0.7)	0.14
HbA1c at 6 Months (%)	5.9 (0.4)	5.9 (0.4)	0.91
EWL at 3rd POD (%)	4.1 (0.5)	4.0 (0.4)	0.54
EWL at 2 Weeks (%)	11.7 (1.2)	11.6 (1.2)	0.81
EWL at 6 Months (%)	34.9 (2.7)	35.4 (2.7)	0.59
PGL at 3rd POD (mg/dL)	202.5 (23.5)	203.1 (24.3)	0.95
PGL at 2 Weeks (mg/dL)	140.2 (29.3)	135.1 (33.2)	0.67
PGL at 6 Months (mg/dL)	100.7 (7.4)	100.9 (7.2)	0.94
BMI (kg/m²)	46.6 (6.6)	46.9 (6.1)	0.87

Ali M et al[14] reported a mean age of 46.6 ± 12.3 years in the LSG group, with a higher proportion of females (62.6%) than males (37.4%). The women predominance across studies may be attributed to the fact that females are generally more likely to seek medical consultation and surgical interventions for obesity, often due to greater concern about body image, health, and quality of life compared to men.

In this study the HbA1c levels showed preoperative HbA1c levels had a mean of 8.85%, which decreased to 8.17% by the 3rd postoperative day, 7.07% at 2 weeks, and further down to 5.92% at 6 months after surgery. In aligns to this study previous studies demonstrating that LSG significantly improves glycemic control in T2D patients, facilitating better long-term management of the disease.[15-17] On the other hand Zoungas et al[18] demonstrate the association of HbA1c levels with vascular complications and death in patients with T2D, indicating the importance of achieving improvements in HbA1c levels through interventions such as LSG to reduce the risk of T2D-related complications.[18] consistently the Mostafa MS et al[19] also observed improvements in glycemic control, with HbA1c levels decreasing progressively from preoperative values of 7.3–11.2 to 6.1–11.1 at 1 year post-surgery, highlighting the metabolic benefits accompanying BMI reduction.

In this study the EWL noted steady improvement, increasing from 4.05% at the 3rd postoperative day to 11.67% after 2 weeks and reaching 35.08% at 6 months followed by the mean BMI before surgery was 46.7 kg/m² which decreased around 44.2 kg/m^2 at 2nd week and 38.3 kg/m^2 on 6th month after surgeries, which consistent with other study where substantial weight reduction observed after LSG.[20] This degree of weight loss not only contributes to improved glycemic control but also enhances overall metabolic health. Consistently Shah M et al[13] reported that there was a significant reduction in BMI, decreasing from 47.69 ± 4.24 kg/m² to 40.03 ± 3.31 kg/m². Consistently, Malik S. et al[21] reported a decrease in mean BMI from 48.45 ± 7.25 kg/m² before surgery to 36.20 ± 4.67 kg/m² at 1-year follow-up, with a mean reduction of 12.25 ± 4.58 kg/m². The slightly higher baseline BMI in above study may reflect differences in patient selection, population characteristics, or severity of obesity at in the patients. However the findings collectively support the effectiveness of bariatric surgery in achieving substantial early and sustained loss of weight.

In this study PGLs showed marked improvements, decreasing from a mean of 202.7 mg/dL at the 3rd POD to 138.4 mg/dL at 2 weeks and 100.8 mg/dL at 6 months. These reductions are indicative of enhanced insulin sensitivity and improved glucose metabolism post-surgery. Such changes are critical for the remission of T2D and support the use of LSG as an effective intervention.[21,22] The study by Shah et al[23] provides insights into the association between branched-chain amino acid levels and improvement in insulin resistance with weight loss [4]. This suggests that LSG-induced weight loss may have a positive impact on plasma glucose levels, potentially leading to better glycemic control in Pakistani patients with T2D.

Interestingly, the study did not find significant differences in outcomes between male and female patients. Female patients exhibited a mean EWL of 4.1% on the 3rd postoperative day, 11.7% at 2 weeks, and 34.9% at 6 months, while male patients had a mean EWL of 4.0%, 11.6%, and 35.4% at the same time points. These results suggest that although both genders benefit from LSG, the extent of weight loss may vary slightly; however, the differences were not statistically significant, indicating that LSG is equally effective for male and female patients. Overall, this study reinforces the efficacy of LSG in improving glycemic control, achieving significant weight loss, and reducing plasma glucose levels in Pakistani patients with T2D. The findings support the broader application of LSG in diverse populations, highlighting its role as a valuable tool in managing obesity-related T2D.

Further research with larger sample sizes and longer follow-up periods is needed to validate these results and explore the underlying mechanisms of the observed benefits. However, this study has several limitations, including a relatively small sample size, a short follow-up period, lack of symptom analysis, and no comparison of other potential effect modifiers. Therefore, future research with larger cohorts and longer follow-up periods is recommended to validate these findings and to assess the long-term sustainability of T2D remission after LSG. Additionally, investigating the lifestyle factors contributing to the ethnic differences observed in glycemic outcomes could help develop more tailored treatment strategies for diverse populations.

Conclusion

Laparoscopic sleeve gastrectomy (LSG) was found to be an effective intervention for achieving significant weight loss, improving glycemic control, and reducing plasma glucose levels among obese patients with type II diabetes

mellitus over a 6-month follow-up period. The outcomes were consistent across both male and female patients.

Overall, the findings support LSG as a valuable therapeutic option for managing obesity and its associated type II diabetes mellitus. However, given certain limitations of the study, larger-scale, multicenter studies with longer follow-up periods are required to validate these findings and further elucidate the underlying mechanisms.

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