Role of laparoscopic sleeve gastrectomy in the management of type II diabetes mellitus in morbid obese patients

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Background
The authors conducted this series to assess the role of sleeve gastrectomy in the management of type II diabetic patients because the available evidence on its significance in this regard is still lacking.
Patients and methods
The authors conducted our research on 40 type II diabetic morbidly obese patients between August 2020 and December 2021, who underwent laparoscopic sleeve gastrectomy and evaluated for the glycemic control regarding glycosylated hemoglobin and fasting blood glucose levels together with the degree of success of excess body weight loss.
Results
At a 12-month follow-up, 80% of patients had shown remission of diabetes without drug use and none of the seven patients who used to take insulin preoperatively needed to continue on it. Male patients, those who had greater preoperative levels of glycosylated hemoglobin, those who were diagnosed with diabetes since 5 years or more, those with minimal extra body weight loss, and those requiring insulin for diabetic control preoperatively had lower postoperative remission rates.
Conclusion
Type II diabetic obese patients can show remission of diabetes without drug use or at least improved glycemic control to a great extent after sleeve gastrectomy.

Keywords:
diabetes, hyperglycemia, sleeve

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Introduction

Obesity and the health effects it has on both individuals and the society as a whole have become a huge burden [1,2]. According to WHO's Global Report on Diabetes, about 1 in 11 persons have diabetes, which is a significant issue related to a much great extent with obesity [2]. When a long-term durable management for both obesity and type 2 diabetes mellitus (T2DM) in diabetic obese people is the target, lifestyle change, and conventional medical care alone produced ineffective outcomes [3–5]. In turn, this results in a concurrent considerable rise in bariatric procedures during the past 20 years, which had been demonstrated to considerably improve glycemic control in type 2 diabetes [6]. In addition, the development of less invasive surgical methods, enhanced surgical safety, and patients' growing awareness of the long-term risks and benefits of these types of procedures, all contributed to this increase [7–10]. In addition to improving glycemic control, bariatric procedures also improve other obesity-linked cardiovascular issues including hyperlipidemia and hypertension [9–15]. Laparoscopic sleeve gastrectomy (LSG) use as a weight-controlling surgery has increased significantly over the past 10 years, accounting for up to half of all bariatric procedures carried out in North America [16]. This reflects the widespread belief that LSG is technically simpler than gastrointestinal (GI) bypass surgeries and has a lower incidence of complications and nutritional issues. Besides, for high-risk patients who might not tolerate prolonged or more complicated GI bypass surgeries, sleeve gastrectomy is a reasonable solution [17–20].

Aim

Therefore, we carried out our research to assess the impact of sleeve gastrectomy in glycemic control of obese patients suffering from type II DM.

Patients and methods

Our prospective study comprised 40 obese patients with type II diabetes, who had LSG at Tanta University Hospitals' Gastrointestinal Surgery Unit between August 2020 and December 2021.

The information gathered covered the demographics of the patients, the amount of extra body weight lost (EWL), and the glycemic control of DM. At 2, 6, and 12 months, the patients were followed up with frequent visits. The percentage of excess body weight lost (%EWL) and the BMI were used to assess the degree of effective weight reduction. Using the metropolitan height and weight tables [21], the optimal body weight was determined in consideration of the mid-weight and medium frame.

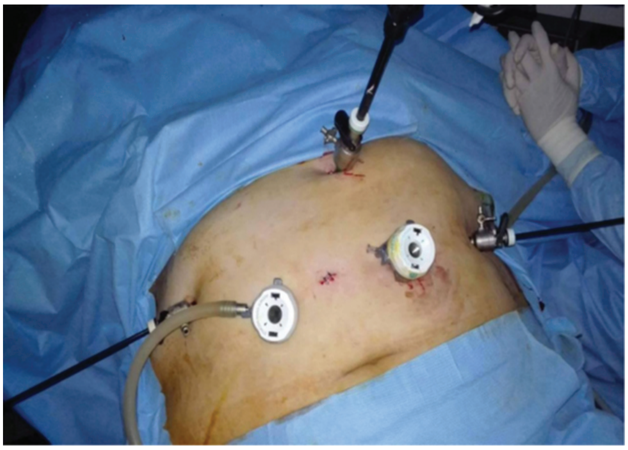
Fasting blood sugar levels, HbA1c levels, and information regarding the need for diabetes control medicines, including the dosage of either oral hypoglycemic pills or insulin, were all measured before surgery and during routine postoperative visits. We included in our analysis those patients who met the requirements for bariatric surgery outlined in the National Institutes of Health Consensus Development Panel Report from 1991 [22]: adult patients with type II DM and a BMI of 35 kg/m^2 or above.

All type II diabetic obese patients who were taking oral hypoglycemic medications alone or in conjunction with insulin before to surgery were included in the study. According to the recommendations of the American Diabetes Association [23], each patient's DM status was classified as either unchanged, improved, or resolved based on the need for postoperative medication, the management of HbA1c, and the fasting blood glucose levels. All patients were evaluated for the types, dosage, and frequency of all antidiabetic medications as well as insulin before surgery and on regular follow-up visits. In the absence of any hypoglycemic medication, individuals with a fasting blood glucose level of less than 125 mg/dl and an HbA1c level of less than 7 mmol/l were judged to have remission of diabetes during the postoperative assessment. A decrease in HbA1c and/or a decrease in diabetes medication types or dose were regarded as a sign of better diabetic status. If no remission or improvement was found, DM was regarded as unaltered.

Surgical technique

Under general anesthesia, a 12 mm left supraumbilical Optiview trocar (Ethicon Endo-Surgery, Cincinnati, Ohio, USA) was utilized to access and insufflate the abdominal cavity, and subsequently four more trocars were inserted as illustrated in Fig. 1. The greater curvature was devascularized starting 6 cm proximal to the pylorus using the harmonic scalpel (Ethicon Endo-Surgery), including the short gastric vessels, until the gastroesophageal junction is fully exposed. The liver was retracted using the epigastric port.

Figure 1



Port sites.

A 38 F bougie tube was inserted through the mouth under vision till the antrum, then 60 mm articulating linear cutter stapler (Ethicon Endo-Surgery) is inserted through the right supraumbilical port transecting the stomach vertically creating the gastric sleeved tube. A leakage test was done regularly using methylene blue dye injected through the bougie before its removal to check for security of the staple line. A drain was placed just to the left of the staple line. The resected part of the stomach was extracted through the right or the left supraumbilical trocars. The port sites were sutured after infiltration of local anesthetic.

Following the surgery, the patients were moved to the ward; oral clear fluids were started within 8 h and were often discharged home on the second postoperative day.

Statistical analysis

Software known as the Statistical Package for the Social Sciences, version 11.5 was used to conduct statistical analyses (SPSS, Chicago, Illinois, USA).

Ethical approval

This research was performed at the Department of General Surgery, Tanta University Hospitals. Ethical Committee approval and written, informed consent were obtained from all participants.

Results

During the study period, 40 type II diabetic obese patients were eligible and included. The patients' demographic criteria are demonstrated in Table 1. Ten patients (25%) had associated comorbidities. All patients had ASA score II with 10 patients diagnosed as diabetic since more than 5 years. The mean operative time was 94.88±14.74, and all cases were operated laparoscopically. The mean hospital stay was 1.05±0.22 (range: 1–2 days). No mortality in this series was documented (Table 1).

Table 1 Distribution of the studied cases according to different parameters (*n*=40)

Variables	*N* (%)
Age (years)	
Mean±SD	45.73±4.41
Median (minimum–maximum)	45.50 (38–55)
Sex	
Male	15 (37.5)
Female	25 (62.5)
Comorbidities	
No	30 (75)
Hypertensive	7 (17.5)
Asthmatic	3 (7.5)
Duration of diabetes	
Less than 5 years	30 (75)
More than 5 years	10 (25)
Operative time	
Mean±SD	94.88±14.74
Median (minimum–maximum)	90 (75–120)
Hospital stay in days	
1	38 (95)
2	2 (5)
Mean±SD	1.05±0.22
Median (minimum–maximum)	1 (1–2)

Follow-up visits were scheduled at 2, 6, and 12 months, which included body weight, BMI, HbA1c value, fasting blood glucose value, and diabetic medications needed by the 40 patients. Of the 40 patients who were taking oral hypoglycemics at baseline, only eight patients needed to continue on it on follow-up.

None of the seven patients (17.5%) needing insulin preoperatively in combination with the oral hypoglycemic needed insulin intake for glycemic control at 2, 6, and 12 months (Table 2). Hyperglycemia was completely controlled in 32 patients (80%) with no need for more oral hypoglycemic drugs or insulin and improved in eight (20%) patients needing only a lower dose of oral hypoglycemic drugs for glycemic control guided by HbA1c and fasting blood glucose values (Table 2). The mean baseline HbA1c was 9.56±1.02% preoperatively, which decreased to 7.46±0.86% at 2 months and furthermore decreased over the first year to reach 5.70±0.51% at 12 months postoperatively. The same for the mean fasting blood glucose levels that improve over 12 months from 169.68±10.66 mg/dl at baseline to 107.60±7.37 mg/dl at 12 months.

Table 2 lists the mean BMI changes over 12 months after sleeve gastrectomy, starting from 46.33±3.60 kg/m^2 preoperatively to 41.27±2.98, 38.74±2.40, and

Table 2 Distribution of the studied cases according to different parameters (*n*=40)

	Preoperatively	At 2 months	At 6 months	At 12 months
BMI				
Mean±SD	46.33±3.60	41.27±2.98	38.74±2.40	29.03±1.20
Median (minimum–maximum)	46 (40–53)	41.25 (36–49)	38.80 (34–45.40)	28.85 (27–32.50)
Percentage of excess weight loss				
Mean±SD	–	23.35±3.01	35±2.15	77.43±9.19
Median (minimum–maximum)	–	23 (17–30)	35 (31–39)	80 (54–88)
Oral hypoglycemic [*n* (%)]				
No	–	32 (80)	32 (80)	32 (80)
Yes	40 (100)	8 (20)	8 (20)	8 (20)
Patients needing insulin [*n* (%)]				
No	33 (82.5)	40 (100)	40 (100)	40 (100)
Yes	7 (17.5)	0	0	0
HbA1C %				
Mean±SD	9.56±1.02	7.46±0.86	6.43±0.76	5.70±0.51
Median (minimum–maximum)	9.50 (7.40–11.50)	7.30 (5.50–8.90)	6.45 (4.50–7.50)	5.60 (4.70–6.70)
Fasting blood glucose (mg/dl)				
Mean±SD	169.68±10.66	143.05±8.55	125.60±7.30	107.60±7.37
Median (minimum–maximum)	170 (143–188)	143 (123–158)	124.50 (111–142)	106 (98–131)
Patient final DM status [*n* (%)]				
Resolved				32 (80)
Improved				8 (20)

DM, diabetes mellitus.

Table 3 Univariate analysis for the parameters affecting resolved (*n*=32) from improved (*n*=8)

	P	Univariate OR (95% CI)
Age (years)	0.488	1.055 (0.906–1.229)
Sex (male)	**0.037***	6.0 (1.115–32.284)
BMI (12 months)	**0.655**	0.865 (0.457–1.636)
Comorbidities		
Hypertensive	**0.622**	0.625 (0.097–4.047)
Asthmatic	**0.999**	–
Duration of diabetes (>5 years)	**0.001***	0.015 (0.001–0.164)
Percentage of excess weight loss (12 months)	**0.003***	1.257 (1.079–1.464)
Patients needing insulin (preoperative)	**0.002***	0.040 (0.005–0.303)
HbA1C % (preoperative)	**0.010***	0.209 (0.064–0.685)

OR, odd's ratio. *Statistically significant at $P \leq 0.05$. The bold values refer to statistically significant variable in prediction of failure of complete remission of diabetes.

29.03±1.20 kg/m^2 at 2, 6, and 12 months postoperatively, respectively.

Our univariate analysis showed that patients taking insulin preoperatively, those with higher HbA1C percentage, and those with onset of DM of more than 5 years had a lower chance of glycemic control after sleeve gastrectomy (Table 3). Also, patients who did not show complete remission had a significantly lower percentage of EWL than those showing complete remission.

Discussion

Due to the lack of GI anastomosis, preservation of the pylorus with resulting unaltered intestinal absorption [8,18,19,24], and also because of being successful in the medium and long-term follow-up with regard to weight loss, LSG is considered one of the safest and most feasible surgical weight-reducing procedures [25–27]. Numerous studies have assessed the metabolic alterations following LSG, such as a decrease in ghrelin, positive changes in bile acids, and incretin [28–30], but the metabolic consequences in T2DM patients remain controversial. Thus, in individuals with T2DM, our series assessed these metabolic effects of glycemic control.

In the past, LSGs was confined as a staging operation to help patients with higher BMIs and greater risk levels lose weight before the traditional second stage GI bypass [19,26,31], but during the past 10 years, LSG became and still on the top of the most performed weight-reducing operation worldwide [16].

In our follow-up data, the mean EWL was 35% at 6 months and about 77% at 12 months, which resembles the reported considerable variety in EWL following LSG, which ranged between 40 and 60% in other studies [13,24–26,29,32–38] and this variety is mainly due to the wide range in BMI at the time of surgery, difference in technical details for each study like the bougie size, the size of the gastric antrum after resection, and also the variable follow-up time.

However, in general, LSG, like other weight-reducing procedures, carries the risk of long-term weight gain in some patients, which may be caused by behavioral and physiological adaptations. This was supported by a large meta-analysis on patients with T2DM who underwent LSG, which found that the average long-term BMI reduction was 10 kg/m^2 [37].

The superiority of bariatric surgeries over medical therapy in T2DM obese patients had been evidenced by multiple randomized clinical trials [3–5]. One of them is the STAMPEDE trial that supported LSG effectiveness over intensive medical therapy for glycemic control after 3 years of follow-up [4].

In our study, remission of hyperglycemia was achieved in 32 patients (80%) with no need for more oral hypoglycemic drugs or insulin and improved in eight (20%) patients needing only a lower dose of oral hypoglycemic drugs for glycemic control guided by HbA1c and fasting blood glucose values. The observed rates are probably close to the remission rates after bypass surgeries [3–5,10–15]. Our univariate analysis revealed that patients who used insulin preoperatively, those who had higher HbA1C percentages, and those who had diabetes for more than 5 years before surgery had a decreased likelihood of attaining the accepted glycemic control. The earlier surgical intervention is therefore very helpful as this observation is probably the result of a more functioning β-cell reserve [11–13,29,38–40].

Our study's flawed short-term follow-up prevented us from accurately calculating the proportion of long-term DM relapse. According to the available data, the late recurrence rate for various bariatric surgery patients ranges from one-third to 50%, depending on how relapse is defined, the number of patients, the type of surgery done, and the duration of follow-up. For instance, the STAMPEDE trial's high 46% relapse rate after 3 years of follow-up following LSG [4], which is much higher than the large retrospective cohort study's 35% incidence of recurrence after 5 years of follow-up following gastric bypass [41]. Even though late relapse of T2DM after bariatric and metabolic surgery is a real phenomenon, Aminian and colleagues found that the glycemic control and cardiovascular risk of patients, who experienced relapse were significantly better than their baseline levels, and none of the patients with relapse was using insulin at follow-up. Even this low success had positive effects on patients' quality of life and costs [42–46]. Therefore, as surgery altered the trajectory of risk variables, we cannot label recurrence as a failure [14].

When interpreting our findings, a few constraints must be kept in mind. First, the short-term follow-up, one-center experience, and absence of a comparator group constrain these analyses.

Conclusions

According to the results of this study, LSG is a successful surgical procedure for the majority of morbidly obese individuals with DM. To determine the effectiveness of LSG on clinical outcomes, not only glycemic control, but also other members of the metabolic syndrome, we need additional prospective clinical trials with a larger sample size and long-term follow-up of obese patients with DM who undergo LSG.

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Conflicts of interest

There are no conflicts of interest.

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