Role of sleeve gastrectomy in control of type 2 diabetes – a prospective clinical study

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Received 3 December 2018
Accepted 1 January 2019

The Egyptian Journal of Surgery 2019, 38:267–271

Background
Bariatric surgery has prompted weight loss and improved glycemic control in obese patients with high prevalence of type 2 diabetes mellitus (DM) through different techniques, increasing the popularity of bariatric and metabolic operations. Surgeons are faced with patients with relatively more sever type 2 DM disease.
Aim
The aim was to determine the efficacies of weight-reducing operations on DM control, especially laparoscopic sleeve gastrectomy (LSG), and to explore the correlation between high level of preoperative Hba1c as well as preoperative morbidity and postoperative outcomes after LSG.
Patients and methods
A prospective study was conducted between August 2015 and August 2017 at Al-Zahra University hospital. A total of 40 patients were included in this study with morbid obesity with BMI ranged from 35 to 45 kg/m^2 and aged ranged from 30–55 years old. They had poorly controlled type 2 DM with hemoglobin A1C more than 7.5% after conventional treatment. All patients were operated by the same surgeon to avoid any procedural biasness. At each follow-up visit, weight loss and glycemic control status were evaluated.
Result
We included 40 patients who underwent LSG, and all completed 12 months of follow-up regarding remission of type 2 DM. In relation to glycemic control, the procedure demonstrated remission of DM up to 60% after 1 year of surgery.
Conclusion
Bariatric surgery (LSG) is not only a weight reduction surgery but a metabolic surgery, which can cure most of the metabolic syndrome. It is considered the most-effective long-term treatment modality of type 2 diabetes in obese patients.

Keywords:
diabetes mellitus, laparoscopic sleeve gastrectomy, obesity reduction

Egyptian J Surgery 38:267–271

1110-1121

Introduction

Obesity and type 2 DM are currently the most common chronic diseases in western countries [1]. Both diseases are closely related and difficult to control by current medical treatment including diet control, medication, and behavior modification [2]. Performing bariatric operation on patients who have type 2 diabetes mellitus (DM) is considered a highly effective procedure for controlling glucose blood levels and improving type 2 DM [3]. Obesity has an adverse effect on the body in people with type 2 DM [4], and approximately 90% of patients who manifest this condition are also overweight or obese, which indicates that obesity has great influence in the pathogenesis of this disease [5]. There is strong evidence that bariatric operations mostly laparoscopic sleeve gastrectomy (LSG) can cure most of the associated type 2 DM in morbidly obese patients [6]. The bariatric intervention should be a part of comprehensive weight management program, with the availability of lifelong lifestyle support and medical monitoring. DM is a representative of the major chronic health conditions that could be ameliorated or even remitted with significant amount of weight loss and metabolic changes that occur after bariatric surgery [7].

Obesity is a strong independent risk factor for type 2 DM, coronary heart diseases, and many metabolic disorder and associated with increased mortality [7]. Type 2 DM fueled by an obesity epidemic has emerged as a major health problem worldwide [8]. Initiation of bariatric surgery for the treatment of type 2 diabetes started from the report by Pories *et al*. [9] in 1995. Strong evidence has shown that sleeve gastrectomy is effective in the treatment for severe

 DOI: 10.4103/ejs.ejs_195_18

obesity, with BMI more than 35 kg, and it results in marked improvement of type 2 DM control. Metabolic surgery is focused on type 2 diabetes treatment in mildly obese or overweight, as reported in 2011 and in 2012 by Lee and colleagues regarding the treatment of metabolic syndrome [10,11]. Bariatric surgery is effective and a safe treatment for morbid obesity. The efficacy of bariatric procedures in the induction and maintenance of weight loss is largely superior to that obtainable by current medical therapies. This sustained weight loss has a profound effect on obesity-related comorbidities, particularly type 2 diabetes [12].

Patients and methods

A prospective study was conducted at Al Zahraa University hospital during the period from August 2015 to August 2017. Patients included were of both sexes. Fifteen (37.5%) cases were men and 25 (62.5%) cases were women, and their age ranged from 25–55 years (Table 1). They attempted lifestyle modification but failed to maintain sustained weight loss. Their BMI ranged from 35–55 kg/m^2. They all had type 2 DM. All patients were evaluated and explained every concern, including risks and benefits of the procedure. A team of surgeons, cardiologist, and endocrinologist performed screening of the patients.

Inclusion criteria

The following were the inclusion criteria:

(1) Age: 25–65 years.
(2) BMI greater than or equal to 35 kg/m^2.
(3) Type 2 DM.

Exclusion criteria

The following were the exclusion criteria:

(1) Type IDM.
(2) Age below 20 years.
(3) Previous abdominal surgery.
(4) Pregnant.
(5) Patient with major abdominal surgery.

Table 1 (Sleeve gastrectomy) personal characteristics

Variables	Sleeve gastrectomy
Age (mean±SD)	37.73±9.35
Sex [*n* (%)]	
Male	15 (37.5)
Female	25 (62.5)

Preoperative preparation

All patients were subjected to the following:

(1) Complete history taking including feeding history.
(2) History of previous trials of weight loss either surgical or nonsurgical, as previous bariatric surgery is excluded.
(3) History of type 2 DM type with onset, course, duration medication, controlled or not, and if the patient was on oral medication or insulin.
(4) Cardiac or respiratory problem.
(5) Hypertension.
(6) All routine investigation with upper gastrointestinal tract endoscopy, echo cardiograph, and pulmonary function.
(7) Measurement of weight and BMI.
(8) Abdominal examination for scar and hernia orifices.
(9) Lastly consultation for proper control of diabetes before the surgical procedure.

The surgical operation was done by five trocars. The division of gastric greater curvature vascular supply standing at 4 cm from the pylorus and proceeding upward until the angle of Hiss is carried out with radiofrequency harmonic. The gastric resection was performed using liner stapler, and the resection of the main part of the fundus and corpus of the stomach is started 2–8 cm proximally to the pylorus. The stapler is applied alongside a 36 (Fr) calibrating bougie strictly positioned against lesser curvature to obtain 80–100 ml gastric volume. In case of presence of large gastric antrum, it was resected closer to the pylorus as much as possible, but in case of only dilated gastric fundus, it was resected completely aided by its good dissection till exposure and resection of fundic bed of fat. The last shot of stapling was fired at least 1 cm distal to esophagus gastric junction, Green for the first fire at the distal part of the stomach for more strength and the remaining was blue. Intraoperative methylene blue test was routinely performed at the end of the operation to check if there is leak or not and to evaluate the volume and shape of sleeve with application of drain.

In the postoperative period, patients were observed intensely on the day of the operation, and on the fourth day postoperatively, oral gastrografin was done to allow patient to drink with maintenance intravenous fluid. Antibiotics were continued for a period of 5 days. The patients were discharged and followed up at least in the first week, second week, fourth week, and 12 weeks. At each follow-up visit, weight loss and glycemic control status [fasting blood sugar, post prandial blood sugar (PPBS)], hemoglobin

A1C (HbA1C), and hypoglycemic treatment were evaluated.

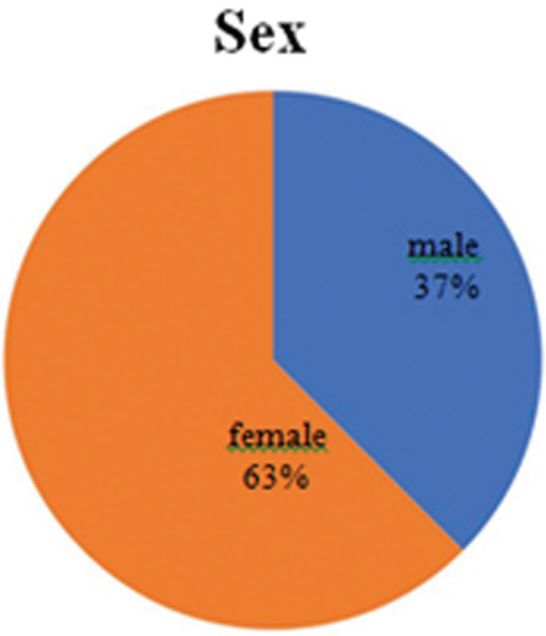
Results

Between August 2015 and August 2017, we performed 40 cases of sleeve gastrectomy operation for treating obesity and its related comorbidity (type 2 DM). All patients were diabetic before surgery and were diagnosed according to American Diabetes Association guidelines. The primary clinical outcome was evaluation of real diabetes remission after LSG by assessment of glucose.

The variability among patients shows 15 were men and 25 were women (Fig. 1), with BMI of 35–55 kg/m^2 and HbA1C was 10 (7.5–15%). The follow-up lasted for 24 months with clinical examinations of anthropometric measurement and routine laboratory test, with glucose metabolism assessment every 3 months. Diabetes remission after LSG was defined as fasting blood glucose level less than 100 mg/dl and HbA1C less than 7%. The mean operative time was 50–120 min, and average was 80 min. Medical and biochemical characteristics are shown in Tables 2 and 3. Mean hospital stay was 4.7±0.9 days.

No postoperative complications, no staple leak, no bleeding, no other major complication, and no death occurred. The change in mean BMI, mean HbA1c, and their minimum and maximum values is shown in (Table 4, Figs 2–5).

Figure 1



Sex distribution in the study group.

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Table 2 Study group (sleeve gastrectomy) regarding biochemical characteristics

Characteristics	Mean±SD
C-peptide	3.77±1.25
BMI baseline	51.93±9.78
FBS baseline	145.27±12.78
HbA1c baseline	8.21±0.88

FBS, fasting blood sugar.

Table 3 (Sleeve gastrectomy) medical characteristics

Variables	*n* (%)
Distribution of obesity	
Peripheral	4 (13.3)
Central	10 (33.3)
Both	16 (53.3)
Duration of DM (years)	
<5 years	18 (60)
>5 years	12 (40)
Preoperative medication	
OHG	22 (73.3)
Insulin	8 (26.7)
Status of DM (according to baseline HbA1c)	
Less control, i.e. >8.5%	10 (33.3)
Better control, i.e. <8.5%	20 (66.7)
C-peptide	
<3 ng/ml	6 (20.0)
>3 ng/ml	24 (80.0)

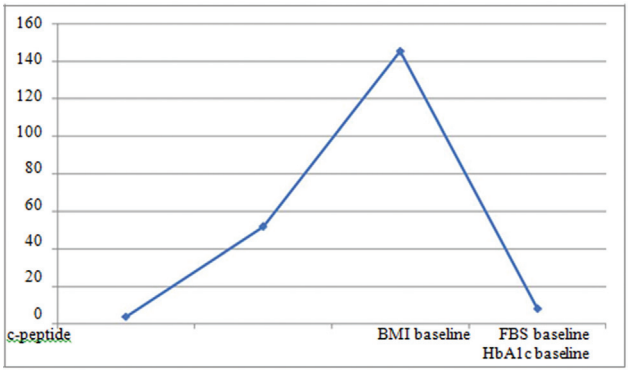
DM, diabetes mellitus.

Table 4 The change in mean BMI, mean HbA1c, mean in fasting blood sugar, and their minimum and maximum values are depicted

Variables	Mean (minimum–maximum)	*P* value
BMI		
Preoperative	39.33±3.66 (35–50.3)	<0.001
First month	35.84±3.22 (29.7– 46.2)	
Third month	32.77±3.11 (27.3–46)	
Sixth month	29.34±3.2 (25.6–34.8)	
Ninth month	27.56±2.26 (23.8–35.2)	
12th month	25.51±2.26 (20.3–33.6)	
HbA1c		
Preoperative	9.24±1.87 (5.2–15.02)	<0.001
First month	7.86±1.3 (5–11.5)	
Third month	7.04±1.27 (4.6–12.42)	
Sixth month	6.72±1.13 (4.71–10.64)	
Ninth month	6.37±0.96 (4.82–10.31)	
12th month	6.14±0.76 (4.7–8.35)	
FBS		
Preoperative	145.27±12.78	>0.001
Three months	132.47±11.31	
Six months	124.20±10.99	
Total change	21.07±11.79	

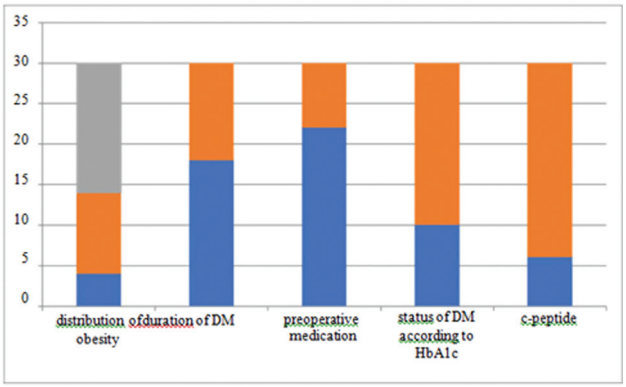
FBS, fasting blood sugar.

Figure 2



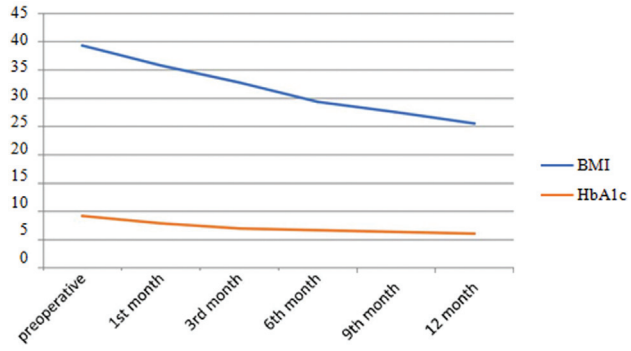
Biochemical characteristics in the study group.

Figure 3



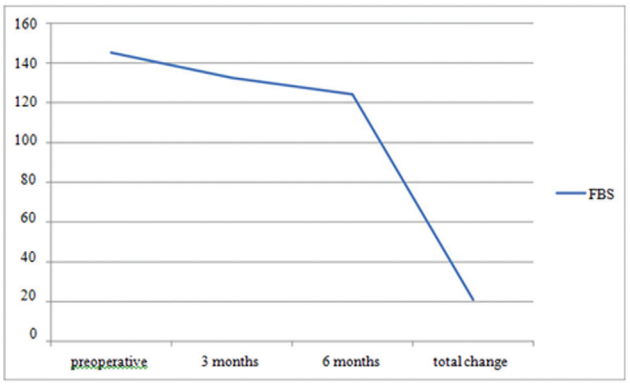
(Sleeve gastrectomy) medical characteristics.

Figure 4



Preoperative and postoperative comparison BMI and HbA1c.

Figure 5



Preoperative and postoperative comparison fasting blood sugar.

Discussion

Bariatric surgery is currently the most efficient method for treating obesity, and significant improvement in glycemic control has been observed in individuals with diabetes subjected to this surgery [13]. The popularity of sleeve gastrectomy among surgeons is owing to its simplicity and reproducibility. Its mechanism includes improvement of glucose control and type 2 DM before attempting weight loss surgery together with major caloric restriction [14].

Schauter *et al.* [15] performed SG on 150 obese patients with uncontrolled type 2 DM, and showed improvement after operation, and HbA1C was 6% or less, with no major late surgical complications. The mean operative time was 50 : 120 min, and BMI was changed to 20–25 kg/m^2 along the period of follow-up. Milone *et al.* [16] reported after operation of SG diabetes remission after 1 year, in which BMI was 2.33+4.48 after 1 year, with reduction of HbA1C to less than 6%.

Kazunori *et al.* [17] reported resolution of DM in 92.9% of cases and improvement in 71 of cases, and the mean postoperative hospital stay after SG was 3.2 days. However, in another study by Dobri *et al.* [18], the mean postoperative hospital stay was 3.6 days. Gastrin hormone has anti-insulin effect, so postoperative reduction of gastrin hormone by excision of funds in LSG improves insulin sensitivity [18]. In our study, the operative time range was 80–130. The range of BMI preoperatively was 35–55 kg/m^2. The mean postoperative hospital stay was 5 days (range: 4–7 days). Postoperatively, at the follow-up period, the reduction of HbA1c was less than 7%, which is in agreement with other study, with no major complication and no operative mortality. Our study suggests that bariatric surgery especially LSG which is the most common bariatric operation nowadays is considered the best long-term treatment of type 2 diabetes. This study and other previous studies have strongly recommended that laparoscopic sleeve gastrectomy (LSG) as a metabolic surgery should be included in DM treatment in less obese populations with BMI of 25–35 kg/m^2 and in the morbidly obese populations with BMI more than 35 kg/m^2.Treating

patients with uncontrolled type 2 diabetes by metabolic operation is very effective. LSG is one of several procedures for treating morbid obesity and its related comorbidities [19]. Our study revealed positive correlation between BMI loss and diabetes remission.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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