

# Effect of Sleeve Gastrectomy on Metabolic Status in Type 2 Obese Diabetics

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## Abstract

**Background:** Limited data are available about evaluation of the effects of sleeve gastrectomy on the glycaemic control on diabetes mellitus. The objective of this study is to evaluate the effectiveness of sleeve gastrectomy in improving the control of glycemic status in obese diabetic patients.

**Patients and methods:** This is retrospective cross sectional study to review the maintain data base collected between May 2018 to April 2021 in department of laparoscopic surgery at Farwaniyah hospital-Kuwait.

A total 120 patients with diabetes mellitus who had undergone laparoscopic sleeve gastrectomy were studied at 3 months and 6 months of follow up visits, collected data about variation in Body Mass Index (BMI). And glycosylated haemoglobin (HbA1c), and fasting blood glucose were analyzed.

**Results:** Of the 120 diabetic patients with ≥ 6 months post-operative follow up 48 diabetic patients (40%) are still taking medications for diabetes mellitus and 72 diabetic patients (60%) are resolved at 3 months and 6 months of follow up. HbA1c has decreased from 9.22±1.36 (n=18) preoperatively to 6.02±0.22 after 3 months of surgery and 30 diabetic patients, HbA1c become 5.88±0.22 after 6 months.

Body Mass Index (BMI) has decreased from 47.43±11.33 in the sample of the study (120 diabetic patients) preoperatively to 37.82±6.80 at 3 months and to 33.25±3.12 Kg/m after 6 months of surgery. Patients with short duration of diabetes less than 5 years have had better weight loss after surgery and achieved greater resolution rates (euglycemic state).

**Conclusion:** Sleeve gastrectomy has improved the glycemic control in obese diabetic patients in the for of improvement and resolution and also succeeded in reduction of the body weight in the sample of the study.

**Keywords:** Diabetes; Metabolism; Sleeve gastrectomy; Diabetes control; Excess weight loss; Bariatric operation

## Introduction

Obesity is a very great concern as it is increased in all developed and developing countries and it has various complications, like diabetes mellitus, cardiovascular diseases, pulmonary problems, musculoskeletal disorders and certain types of cancers. The increasing prevalence of obesity is associated with a great rise in the development of type 2 diabetes mellitus [1,2]. The World Health Organization has reported that Gulf countries have the highest rates of obesity in the world. Kuwait, Bahrain, Saudi Arabia and United Arab Emirates are in the list of top ten counties worldwide in the prevalence of

obesity [3]. In Kuwait, 36% of men and 48% of women are obese, this indicates high prevalence of obesity in Kuwait [4].

Insulin resistance and obesity are the main components of metabolic syndrome and result in impaired glucose metabolism. Various treatment methods are used to prevent and treat obesity including diet and behavioral therapy, lifestyle modification and use of drugs [5]. Pories et al. [6] have reported that most of current therapies are not effective in providing sustained weight loss and bariatric surgeries are more effective in sustained weight loss and more effective in treatment of type 2 diabetes mellitus.

It is clearly evident now days by recent studies that reported the success in bariatric surgeries reaches about 90% in treating and complete remission in type 2 diabetes in morbid obesity in diabetes [7]. Laparoscopic sleeve gastrectomy (LSG) is the most popular bariatric surgery preferred by surgeon as it has a relative minimal invasive procedure and less complications, easy to do and short time of the procedure, about 90 minutes compared with gastric bypass operation [8].

LSG is done by permanent removal of two thirds of the stomach, thus hormonal changes have produced in ghrelin, glucagon like peptide-1 (GLP-1) and peptide YY have recently reported [9,10].

Resection of the fundus of the stomach which is the site of secretion of ghrelin secretion, results in quicker gastric emptying, that in turn propels the food more rapidly into the power that many clear the results of hormonal changes that occur after LSG and about 50-60% excess weight loss on short term [11-13].

Resolution of type 2 diabetes was reported in a study done by Vidal et al. [14] in about 70% of non-insulin dependent diabetes mellitus patients and improvement in 15.4% at 12 months and in 76.9% and 15.4% respectively at 18 months after LSG.

## Patients and Methods

This is a retrospective cross-sectional study to review the maintained data base collected between May 2018 to April 2021 in the department of laparoscopic surgery in Farwaniyah hospital-Kuwait.

A total 120 obese diabetic patients were included who had undergone laparoscopic sleeve gastrectomy and their metabolic state and BMI (Body Mass Index) were evaluated at 3 months and 6 months of follow up visits, the collected data were about variation in BMI and HbA1c and fasting blood glucose. The information included socio-demographic data and co-morbid conditions at the time of surgery, preoperative and post-operative weight loss. The post-operative weight loss was evaluated in terms of BMI, percentage of excess weight loss (% EWL) and percentage of total weight loss (% TWL) the association between these parameters and type 2 diabetes mellitus at 3 and 6 months of follow up.

## Aim of the work

This is a retrospective cross sectional study to evaluate the impact and effect of LSG operation on total weight loss and its effects on metabolic control of the obese diabetics.

## Results

Totally 120 patients with type 2 diabetes mellitus, who underwent LSG in laparoscopic surgical department in Farwaniyah hospital in Kuwait were included in the period from first May 2018 to end of April 2021.

Regarding sex of the majority of obese diabetic patients were females (90 patients) and 30 males (25% of the study sample), with an average mean of patients was 44.5 ± 5.2 years (Table 1). The duration of diabetes was more than 5 years in 45 obese diabetic patients. Preoperative glycosylated haemoglobin

**Table 1:** Total sample demographic characteristics (n = 120).

Characteristic	Value
<b>Age (y)</b>	
Mean	44.5±15.2 years
Range	21-62
Gender	30 (25)
Female	90(75)
Male	30(25)
Type 2 diabetes	120
Duration of diabetes ≥5 y	48(72)

**Table 2:** Use of antidiabetic medications in study sample.

Use of Medications (n = 120)			
Medication	Baseline (n = 120)	3months (n = 120)	6 months (n = 120)
Oral hypoglycaemic agent	100(83.3)	33(27.5)	39(32.5)
Insulin	20(16.7)	11(9.2%)	9 (7.5%)

**Table 3:** Glycaemic control after bariatric surgery.

Diabetes status after surgery (Total Population)		
Status	3 months (n = 120)	6 months (n = 120)
Improved	21(17.5)	48(40.0)
Resolved	40(33.3)	72(60.0)

(HbA1c) was 9.22±1.36% and the average mean of BMI body Mass Index was 47.43 ± 6.80 kg/m<sup>2</sup>. All 120 patients were on medical treatment by antidiabetic oral hypoglycaemic drugs in 100 patients 83.3% and insulin in 20 patients 16.7% of total patients (Table 2).

The body mass index (BMI) had decreased from 47.43 ± 6.80 kg/m<sup>2</sup> preoperative to 37.8±6.8 (n = 120) after LSG at 3 months after the operation and to 33.3 ± 0.3.12 at 6 months after LSG (Table 3). The mean average of glycosylated haemoglobin (HbA1c) is declined from 9.7 ± 1.3 preoperatively to 6.3±0.22 at 3 months and 5.9 ± 0.22 at 6 months after the operation (Table 4).

Clinical resolution and remission of type 2 diabetes mellitus was recorded 40 diabetic patients after 3 months of LSG and in 72 diabetic patients (60.00%) after 6 months of operation. Improvements of metabolic control was recorded in 21 diabetic patients, they are still using oral hypoglycemic drugs and insulin at 3 months of the operation and 48 (40%) diabetic patients at 6 months of LSG.

Diabetic patients with recent onset less than 5 years of duration has better chance in improvement (Figures 1-3), where 60% of patients 72 diabetic patients got full remission and they were having diabetes less than 5 years compared to 48 diabetic patients with a duration of diabetes more than 5 years of age with significant statistical difference (P value =0.003).

**Discussion**

Obesity is a major health problem in type 2 diabetes in western countries and in gulf countries like Kuwait, also diabetes mellitus is considered as a sequence of morbid obesity. Bariatric surgery seems to be the most effective method of treatment than other model of treatment like diet and medical treatment.

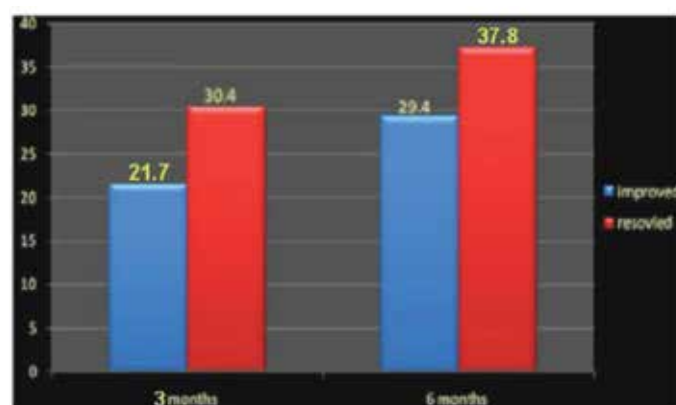
In this study complete remission of type 2 diabetes which is defines as fasting blood glucose <123 md/dl and HbA1c less than 6.5% for at least 6 months after surgery in absence of using antidiabetic drugs [15]. This was achieved in 72 diabetic patients in 60% of 120 diabetic patients included in this study.

This result coincide with Vidal et al. [16], they reported that 75% of diabetic patients have complete remission after bariatric operation. However in similar designed RCT comparing intensive medical treatment (IMT) with medical therapy plus LSG or Roux-en-Y gastric By Pass ((RYGB) in morbid obese with

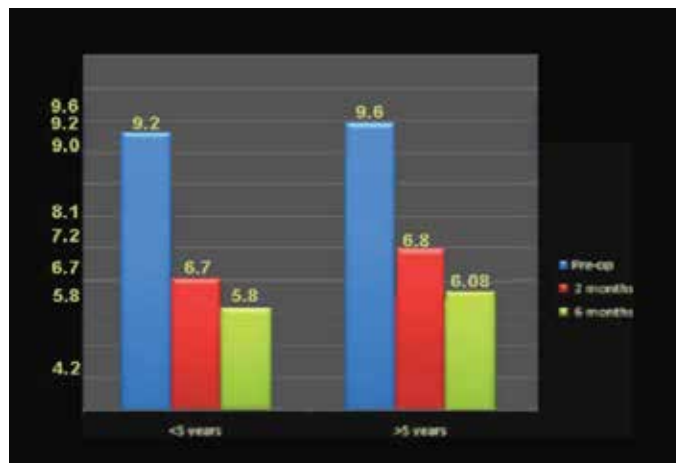
**Table 4:** EWL, BMI, HbA1c baseline and 3 and 6 months postoperatively.

Variable	Preoperatively	3 Months	6 months
% EWL	0	21.7 ± 8.2 (n = 120)	35.6 ± 2.2 (n = 120)
BMI (kg/m)	47.4 ± 11.3 (n = 120)	37.8 ± 6.8 (n = 120)	33.3 ± 3.12 (n = 120)
HbA1C (%)	9.7 ± 1.3 (n = 120)	6.3 ± 0.22 (n = 18)	5.9 ± 0.3 (n = 30)
Fasting blood glucose (mg/dL)	250 ± 16.8 (n = 120)	133.6 ± 8.03 (n = 120)	120.2 ± 4.07 (n = 120)

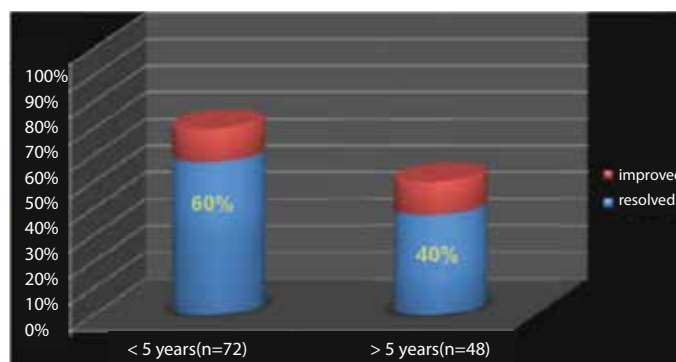
%EWL = percentage of excess weight loss; BMI = body mass index; HbA1c = glycosylated hemoglobin



**Figure 1:** Mean %EWL in patients with diabetes according to diabetes outcome.



**Figure 2:** Mean HbA1c in patients with diabetes according to diabetes outcome.



**Figure 3:** Resolution (%) of diabetes at six months after sleeve gastrectomy according to diabetes duration.

poor control of their glycemic control (HbA1c=9) with complete remission observed after 1 year of follow up was 42% in the RYGB and 37% in LSG group to only 12% in the ITM group [17].

In a retrospective study done by Rosenthal et al. [18] the study conducted on 30 obese diabetic patients and 735% of them were taking antidiabetic medication preoperatively and remission of type 2 diabetes mellitus was reported in 27% of diabetic patients after LSG at 2 months and 63% at 6 months of follow up. HbA1c levels have declined from  $6.36 \pm 0.82$  in 14 diabetic patients before LSG surgery to  $6.02 \pm 0.57\%$  of total Haemoglobin in 11 diabetic patients at 2 months after surgery and  $5.92 \pm 0.33$  in 12 diabetic patients at 6 months after surgery.

Also the same scenario observed like our study in decrease in BMI from  $46.12 \pm 10.86$  kg/m<sup>2</sup> in 30 obese diabetic patients before the operation to  $38.27 \pm 6.59$  kg/m<sup>2</sup> at 2 months and declined to  $35.78 \pm 5.11$  kg/m<sup>2</sup> at 6 months after LSG surgery, also a greater weight loss was recorded among obese diabetic patients with shorter duration of diabetes mellitus (less than 5 years) and greater weight reduction and loss after surgery that achieved higher remission rates, this finding coincide with our results (Table 4).

In this study The body mass index (BMI) had decreased from  $47.43 \pm 6.80$ kg/m<sup>2</sup> preoperative to  $37.8 \pm 0.6.8$  (n = 120) after LSG at 3 months after the operation and to  $33.3 \pm 0.3.12$ at 6 months after LSG (Table 4), this finding coincide with Peterli et al. [19], Body weight and body mass index decreased markedly (P < 0.002) and comparably after either procedure. Excess BMI loss was similar at 3 months ( $43.3 \pm 12.1\%$  vs.  $39.4 \pm 9.4\%$ , P > 0.36). After surgery, patients had markedly increased postprandial plasma insulin and GLP-1 levels, respectively (P < 0.01) after both of these surgical procedures, which favour improved glucose homeostasis. Compared with LSG, LRYGB patients had early and augmented insulin responses as early as 1-week postoperative; potentially mediating improved early glycemic control. After 3 months, no significant difference was observed with respect to insulin and GLP-1 secretion between the 2 procedures.

In recent years, it is reported that there is marked increase in LSG than RYGB due to many advantages as it reserves the physiology of upper gastrointestinal tract and the integrity of the pylorus, and there is no intestinal bypass, and it is not associated with nutritional deficiencies and also can be converted to RYGB when the effects of LSG is not satisfactory [16,20]. Many epidemiological studies have demonstrated that LSG is effective as RYGB on remission and improvement of type 2 diabetes mellitus in obese diabetic patients [21-23].

In this study our results coincide with the systematic review done by Gill et al. 2019 (24), that showed that resolution of type 2 diabetes mellitus was reported in 70% of obese diabetic patients after LSG (in our study 60% of patients have had remission of type 2 diabetes mellitus). Pham et al. [25] have reported that remission of type 2 diabetes was 60.2% after RYGB and 52% after LSG at 6 months of both operation, this results goes hand to hand with the results of our study.

Karamanakos et al. [9] have reported additional benefits for obese diabetic patients undergo LSG included lack of a need for adjustments as in gastric band operation and avoidance of needles; also LSG restricts the size of the stomach by removing the fundus of the stomach so that gherlin hormone level is decreased.

Our results has provided an additional support to these data and show that the duration of diabetes mellitus is an important preoperative predictor diabetes mellitus outcome after LSG surgery where patients with duration of diabetes less than 5 years have had improvement and resolution rates than diabetic patients who have had diabetes mellitus for more than 5 years duration, so this provides an important issue where early surgical intervention should be recommended for obese diabetic patients and this was supported by many epidemiological studies [26].

Since the our primary objective of the study is to evaluate the impact of sleeve gastrectomy on the Excess Weight loss and the potential mechanisms that explaining the remission and resolution or improvement in the glycemic profile of the morbid obese diabetic patients, as the beneficial effects of LSG metabolic surgery are mediated through significant decrease in caloric intake after surgery due to food restriction and this forces the body to use the internal energy resources, and ectopic fat in hepatic tissue and other fat

stores are mobilized and utilized as a source of energy so that this exerts immediate effect on insulin sensitivity and blood glucose levels that observed during the first 10 -20 days after bariatric surgery [27].

The weight loss after LSG surgery is associated with diabetes improvement [16], and even improvement occurs before the beginning of weight loss and this may be attributed to changes in gut hormones secretion [25].

The hormones mainly involved in improvement of glycaemic profile after LSG metabolic surgery are mainly ghrelin and GLP-1, where ghrelin hormone is secreted by the fundus of the stomach and is responsible about promoting the human appetite and it is reported in many studies that its high levels is associated with marked increase in insulin resistance [28,29]

The gastric theory can explain this dramatic decrease in ghrelin hormone as a result of gastric fundus resection [28,30],as removal of the fundus of the stomach is associated with reduction of the sense of hunger and also may improve the sensitivity of insulin .

Moreover reduction in ghrelin hormone seems to accelerate the gastric emptying and intestinal transit, with regulation of GLP-1 secreted by enter endocrine cells in the bowel this was defined as hindgut theory [31,32]. GLP-1 causes normalization of blood glucose levels and up regulating insulin synthesis and proinsulin gene expression as well as increasing insulin sensitivity in the peripheral human tissues [28]. However the hormonal mechanisms involved after bariatric surgeries is not completely understood [33].

## Conclusion

The present study elucidated that LSG surgery succeeded in resolution of type 2 diabetes mellitus in 60% of obese diabetic patients we hope that the next research work is to investigate hormonal factors that resulted in such remission and improvement of this metabolic status and aim to measure GLP-Ghrelin hormone, test insulin sensitivity MOMA-IR and serum leptin before and after bariatric operations.

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