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Effect of laparoscopic mini-gastric bypass on diabetes in morbidly obese patients

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ABSTRACT

Introduction: The effect of bariatric surgery on type 2 diabetes mellitus, which is usually seen with obesity, remains to be detailed.

Materials and Methods: Patients with type 2 diabetes mellitus who underwent laparoscopic mini-gastric bypass surgery between April 2011 and April 2013 were included in the study retrospectively. Demographic variables [age, gender, body mass index (BMI, kg/m^2)], and laboratory findings [fasting plasma glucose (mg/dL) and glycosylated hemoglobin (HbA1c, %)] were evaluated. Measurement of BMI and laboratory investigations were performed in preoperative period and at postoperative 1st, 3rd, 6th, and 12th months.

Results: Type 2 diabetes mellitus was detected in 26 of 94 patients (27.7%) who underwent laparoscopic mini-gastric bypass surgery. There were 18 female patients (69.2%) and 8 male patients (30.8%), and mean age was 40.7±10 years. Preoperatively, 23 patients were under insulin therapy, and 3 were under oral anti-diabetic treatment. Mean BMI was calculated as 45±5.9 kg/m^2. During evaluation of the patients at 1st (n=26), 3rd (n=26), 6th (n=23), and 12th months (n=14), mean BMI was 40±5.7, 33.7±5.1, 26.9±5.3, and 22.4±6.73 kg/m^2, respectively. Mean fasting plasma glucose level changed from 217±70.2 mg/dL preoperatively to 134±28.8 mg/dL at 1st month, 137±45.4 mg/dL at 3rd month, 116±23.8 mg/dL at 6th month, and 100±28.8 mg/dL at 12th month. HbA1c level of less than 7% was achieved in 18 patients (69%) at 1st month, 23 patients (88%) at 3rd month, 21 patients (91%) at 6th month, and 11 patients (78%) at 12th month. At the end of 1 year, oral anti-diabetic use was required in only 3 of 14 patients who were followed-up.

Conclusion: Remission in type 2 diabetes mellitus occurred in 78% of the patients based on laboratory values at end of first year after bariatric surgery, and none of the patients required parenteral use of insulin. In light of these data, laparoscopic mini-gastric bypass can be considered an effective method of treatment of type 2 diabetes mellitus and concurrent surgical treatment of morbid obesity.

Keywords: Bariatric surgery; diabetes; mini-gastric bypass; obesity.

Introduction

The global rise in the incidence of obesity and its close association with Type 2 diabetes mellitus represents one of the most challenging contemporary issues in both developed and developing countries.[1,2] Although lifestyle

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modifications and medical treatment are the mainstay treatment of obesity and Type 2 diabetes mellitus, within the last decades, weight loss surgery has been proven to be an effective and durable solution, especially for morbidly obese diabetic patients.[3,4]

In previous studies, remission in Type 2 diabetes mellitus has been reported after the commonly performed bariatric procedures, including adjustable gastric banding, laparoscopic Roux-en-Y gastric bypass (LRYGB) and duodenal switch and biliopancreatic diversion.[1,3–5] However, it is generally accepted that bypass operations have more powerful effects on Type 2 diabetes mellitus than non-bypass operations.[4] Therefore, LRYGB is considered to be the gold standard in metabolic surgery due to its higher efficiency and low mortality rates.[1,3,6] Although the mechanisms that lead to biochemical and clinical remission of Type 2 diabetes mellitus have not been explained in detail, many international diabetic associations now recognize bariatric surgery as an effective treatment option for obese patients with Type 2 diabetes mellitus.[4–6]

Because of the high complication rate of LRYGB as a technically demanding procedure for inexperienced surgeons, laparoscopic mini-gastric bypass (LMGB), which was introduced by Rutledge in 1997, has been reported to be a safe alternative to LRYGB, with similar efficacy in weight reduction and resolution of metabolic complications, including diabetes.[1,3]

The aim of the present study was to evaluate the short-term efficacy and safety of LMBG in obese and diabetic patients.

Materials and Methods

The present study was approved by the Institutional Review Board for Bezmialem Vakif University Faculty of Medicine. An informed consent was obtained from the patients.

A retrospective review of a prospectively maintained database of all morbidly obese patients treated with LMGB as a primary bariatric surgery between April 2011 and April 2013 was performed. Diabetic patients with a body mass index (BMI) of at least >35 kg/m^2 were offered LMGB after failure of conservative treatment and following a complete evaluation by a multidisciplinary team. Type 2 diabetes mellitus was diagnosed according to the criteria defined by the American Diabetes Association (ADA).[1,3] Exclusion criteria were as follows: refusal of entry into the clinical trial, eating disorders, contraindications for general anesthesia, and presence of acute severe systemic infection or hyperglycemia-associated advanced vascular complications. Remission of diabetes, which was defined as glycosylated hemoglobin (HbA1c) level of ≤7% according to ADA criteria, was regarded as the primary endpoint.

The database included patients' preoperative demographic and anthropometric features including BMI (kg/m^2), total body weight (kg), excess weight loss (EWL) (%), laboratory findings including fasting glucose (g/dL) and HbA1c (%), type of anti-diabetic treatment, and follow-up information.

Laparoscopic MGB was performed by a single surgeon. The operative technique was described elsewhere.[7] Prophylactic antibiotics (cefazolin sodium, 2 g, intravenous) were given intravenously at the induction of anesthesia. Low molecular weight heparin, starting the evening before surgery until the end of the 2nd postoperative week, and elastic stockings during hospitalization were used for prophylaxis against thromboembolism.

Patient follow-up was scheduled for the 1st, 3rd, 6th, and 12th postoperative months in the first year. Postoperative data evaluated were BMI (kg/m^2), total body weight (kg), EWL (%), fasting glucose (mg/dL), HbA1c (%), and need for anti-diabetic treatment.

Continuous variables were expressed as mean±standard deviation. Categorical variables were expressed as frequencies.

Results

Among 94 patients who underwent LMGB, 26 (27.7%) of them had Type 2 diabetes mellitus, with a mean age of 40.7±1 years. There were 18 female (69.2%) and 8 male (30.8%) patients. Anthropometric variables and laboratory findings are given in Table 1. Preoperatively, 23 patients (88.5%) were under insulin treatment for Type 2 diabetes mellitus. The mean follow-up was 8.8 months.

Laboratory and clinical outcomes are summarized in Table 1. After one year, BMI and total body weight had decreased to 22.4±6.7 kg/m^2 and 61±14.5 kg, respectively. The percentage of EWL at the postoperative 12th month was calculated as 75.1±13.2.

Glucose levels decreased to 100±28.8 g/dL at the postoperative 12th month. In addition, mean HbA1c was detected as 5.79±1.3% and 6.70±1.6% at the 6th and 12th month follow-up, respectively. Grouping of the patients based on the

Table 1. Anthropometric variables and laboratory findings of the patients during the follow-up period

Parameter	Preoperative	PO-1 (n=26)	PO-3 (n=26)	PO-6 (n=23)	PO-12 (n=14)
Body mass index (kg/m^2)	45±5.9	40±5.7	33.7±5.1	26.9±5.3	22.4±6.7
Body weight (kg)	122±20.2	108±19.5	91±15.5	76±14	61±14.5
Excess body weight loss (%)	0	22±6.1	42.2±7.0	58.6±11.0	75.1±13.2
Glucose (g/dL)	218±70.2	134±28.8	137±45.4	116±23.8	100±28.8
HbA1c (%)	9.03±0.9	6.74±0.6	6.86±1.3	5.79±1.3	6.70±1.6

PO: Postoperative month.

Table 2. Grouping of the patients based on HbA1c

Time period	Number of patients with HbA1c ≤7%	Number of patients with HbA1c >7%
PO-1 (n=26)	18 (69%)	8 (31%)
PO-3 (n=26)	23 (88%)	3 (12%)
PO-6 (n=23)	21 (91%)	2 (9%)
PO-12 (n=14)	11 (78%)	3 (22%)

PO: Postoperative month.

HbA1c level as ≤7% or >7% revealed that remission of Type 2 diabetes mellitus had occurred in 78% of the patients at the postoperative 12th month (Table 2).

Among 14 patients who could be followed at the postoperative 12th month, only three of them were under oral antidiabetic treatment. Insulin treatment was not required in any of them.

Discussion

The goal of the present study was to determine the effect of LMGB on Type 2 diabetes mellitus remission in obese patients. Our results showed that there was a marked reduction in fasting glucose (from 218±70.2 g/dL to 75.1±13.2 g/dL) and HbA1c. In addition, biochemical and clinical analysis revealed a diabetic remission rate of 78% at the postoperative 12th month, which was slightly below the levels reported (up to 87.1%) in several studies.[1,2] Although more follow-up results are needed, we expect that resolution of hyperglycemia will occur when the problems underlying this issue are clarified and corrected.

For the last decades, the observation of successful hyperglycemia control after gastric bypass and biliopancreatic diversion led researchers to investigate the mechanisms associated with glycemic control.[3] In previous studies, it was shown that duodenal-jejunal exclusion, independent of any significant weight loss, caused this reduction in glucose levels.[1,8,9] Additionally, there are some benefits of LMGB, including a decreased ghrelin effect by excluding the gastric fundus and more rapid hindgut exposure through bypassing the long proximal intestine.[3] Lee et al. proposed that maintaining a steeper angulation at the gastrojejunal anastomosis with their modification of surgical techniques caused a considerable foregut exclusion and better prevention of bile reflux.[1] All these mechanisms could possibly interrupt the dysregulation of both the adipo-insular and entero-insular axis in Type 2 diabetes mellitus patients. Secretion of a group of hormones by the gut affecting beta cell secretion of insulin and its resistance in the periphery is the so-called entero-insular axis and is regarded as the leading theory explaining hyperglycemia control after bariatric surgery. Increased glucagon-like peptide (GLP-1) after gastric bypass and decreased ghrelin after sleeve gastrectomy are the hormonal changes occurring after gastrointestinal reconstruction.[5] Although the exact mechanism cannot be explained by these findings, the effect of bariatric surgery on diabetes can be multifactorial.

The association between the type of bariatric surgery and remission of diabetes was shown to be two-tailed. Control of hyperglycemia can be caused by both regulation of the adipo-insular and entero-insular axis and loss of weight. As a restrictive procedure, laparoscopic sleeve gastrectomy (LSG) may also cause remission of diabetes due to the effect of weight loss.[4,10,11] Gill et al. described a diabetic remission rate of 66.2% after LSG with a follow-up period limited to 36 months.[10] It was also shown that the effect of gastric bypass on achieving HbA1c of less than 7% was attributable to weight loss, although it did not preclude the possible contribution of changes in the adipo-insular

and entero-insular axis.[6] However, the relationship between bariatric procedures and Type 2 diabetes mellitus remission was not simply weight loss, because the immediate improvement in blood glucose usually preceded the weight loss.[12] In another study, LRYGB was shown to be superior to LSG in diabetes remission (93% vs. 47%).[13] It was also proven that LMBG was the most effective procedure for reduction of serum glucose levels compared to laparoscopic adjustable gastric banding and LSG.[14] Therefore, gastric bypass procedures should be chosen primarily in diabetic morbidly obese patients if they are eligible for surgical treatment.

Among the types of bariatric procedures, it is known that LRYGB is a technically demanding, long, and difficult procedure, with a long learning curve.[1,11,15] Therefore, morbidity and mortality of LRYGB can be problematic if performed by inexperienced surgeons or applied on a national base.[1] Therefore, LMGB as an alternative procedure has some advantages, including a single and easier gastrojejunal anastomosis by drawing the long mini-gastric tube down rather than pulling the small intestine with thick and short mesenteries up to a short gastric pouch, as in LRYGB.[2,3] Compared to LMGB, it was also shown that LRYGB carried more than three times the risk of major complications.[15]

Laparoscopic MGB in morbidly obese patients with Type 2 diabetes mellitus has been proven to be effective in prospective randomized controlled trials[7,15] and in extensive reports in the literature.[3] Besides the significant weight loss following LMGB, the glycemic control shown by biochemical and laboratory findings proves that LMGB is both a weight-reducing surgery and metabolic surgery.[1] In the present study, EWL value of almost 75% shows the efficacy of LMGB in the first postoperative year. Padwal reported a similar performance of LMGB in producing significant BMI reduction in a meta-analysis of 31 randomized controlled trials.[16] In the study of Lee, with the longest follow-up period for LMGB, this procedure was shown to be effective in several parameters, including BMI reduction and resolution of metabolic syndrome in the long-term period.[1,7] Rutledge, as a pioneer surgeon for LMGB, tried to define the ideal bariatric surgery considering several parameters, including efficacy, safety and its convenience to perform.[7] Because of the presence of all features specified for an ideal surgery, LMGB has been offered to all morbidly obese patients as the primary bariatric procedure in his practice, as in our clinic.

The present study has several limitations. First is the absence of statistical analysis, because only 26 patients were included without any type of control. The retrospective design of the study is another point. Third, long-term data to determine the maintenance of diabetes remission are required, even though the early biochemical and clinical results within the follow-up period limited to 8.8 months were satisfactory in terms of safety and glycemic control. Therefore, further detailed analysis will be possible when more patient data are accumulated in a prospective and randomized manner.

Conclusion

In our opinion, the most important criteria in the selection of a bariatric procedure remain the safety and efficacy in achieving both weight loss and remission of the metabolic consequences of obesity. Despite the intrinsic limitation imposed by a retrospective study, our results seem to confirm that LMGB is both safe and effective for the treatment of morbidly obese diabetic patients.

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