Evaluation of the outcome of laparoscopic one anastomosis gastric bypass among obese patients with type 2 diabetes mellitus; a prospective study

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Background
Laparoscopic one-anastomosis gastric bypass (OAGB) was introduced as a simple (one anastomosis) operation combining both restrictive and malabsorptive functions, thus suitable for obese patients with metabolic derangements like type 2 diabetes mellitus (T2DM). The aim of this study was to evaluate the outcome of OAGB among obese patients with T2DM.

Patients and methods
A sample of 40 individuals with a BMI greater than 35 kg/m^2 and T2DM was prospectively recruited from the obesity clinic, Suez Canal University teaching hospital and Suez Canal Authority hospital, city of Ismailia, Egypt. The patients underwent laparoscopic OAGB operation and were offered a follow-up for a period of 12 months.

Results
The mean;Deg;BM;Deg;I of the patients demonstrated a statistically significant decline from 49.2 kg/m^2 preoperatively to 34.2 kg/m^2 at the end of the follow-up. Regarding diabetes status, the mean fasting blood sugar decreased significantly from 226 to 104 mg/dl. Moreover, the mean glycosylated hemoglobin decreased from 8.4 to 6.3%. Overall, 42.5% of the patients showed complete diabetic remission at the end of the follow-up, whereas 35% showed partial remission. The rest of the patients (22.5%) did not fulfill the criterion, yet showed improvement in their fasting blood sugar and glycosylated hemoglobin levels from their preoperative values.

Conclusion
Laparoscopic OAGB had proved to be an effective surgical treatment for both obesity and T2DM.

Keywords:
bariatric surgery, metabolic disorders, obesity, type 2 diabetes

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Introduction

Obesity has been previously recognized as a disease of its own and a global epidemic affecting nearly 650 million adults and 340 million adolescents and children worldwide [1]. In Egypt, it has become an alarming health issue within the past two decades, with recent figures highlighting that Egypt has the highest national mean BMI in the world – nearly 26.3 kg/m^2–and it is ranked as the seventh most overweight country in the world [2]. Obesity is a well-established risk factor for several metabolic and chronic disorders; obese patients are prone to excessive risks of elevated blood pressure and hypertension, cardiovascular complications, hyperlipidemia and atherosclerotic diseases, thromboembolic disorders, various gastrointestinal disorders, and diabetes [3]. Obesity can also increase the risks of psychiatric morbidities, such as depression and anxiety, as well as impaired quality of life [1]. The risk of malignancies increases exponentially in obese patients as well [4]. Besides, obesity has profound economic effect and accounts for significant proportion of the total health care expenditures [5,6].

On the contrary, type 2 diabetes mellitus (T2DM) is a global health problem that affected almost 7% of the global population in 2010, an estimate which is expected to rise by 73% in 2030 [7]. T2DM is a major medical and financial burden to the countries mainly owing to the crippling complications that involve mostly all systems and organs of the body [8]. Over the past few decades, both clinical and experimental studies demonstrated a strong, independent, link between obesity and T2DM; it was shown that the likelihood and severity of T2DM are closely linked with incremental increase in the BMI and that overweight and obese patients have three and seven

times greater risks of diabetes compared with those of healthy weight, respectively [9]. The prevalence of diabesity, a term used to describe concurrent existence of both obesity and diabetes mellitus, has been steadily increasing among different parts of the world to reach an epidemic level [9]. Various theories were proposed for the association between both disorders including the effect of body fat distribution and adipokines on insulin sensitivity and glucose metabolism [10,11].

This was the trigger that initiated the era of bariatric and metabolic surgery, a more-or-less radical method that can simultaneously treat obesity and the associated metabolic derangements like T2DM [12]. Laparoscopic one-anastomosis gastric bypass (OAGB), a simplified procedure of laparoscopic Roux-en-Y gastric bypass, has proved itself as a worthy bariatric procedure that provides effective weight loss and remission of obesity-related metabolic disorders; several studies reported that OAGB led to effective weight loss and T2DM control; besides, these studies indicated a technical superiority of OAGB over many bariatric operations regarding feasibility and safety [13–15]. Upon its appearance, OAGB showed many advantages, such as one less anastomosis, shorter operative time, lower risk of anastomotic leakage and internal herniation, shorter learning curve, and the ease of reversibility [16].

Thus, we aimed to evaluate the outcome of OAGB on obese patients with T2DM.

Patients and methods

We performed a prospective, observational study that consecutively recruited morbidly obese patients, who were scheduled to undergo OAGB at the obesity clinic, Suez Canal University teaching hospital and Suez Canal Authority hospital, city of Ismailia, Egypt. The study was initiated after obtaining the ethical approval from the responsible ethics committee and written informed consents from eligible patients.

Patients were deemed eligible for the present study if they were adults (age 18–65 years old), had a BMI of more than or equal to 35 kg/m^2, and had concomitant T2DM. The diagnosis of T2DM was based on the latest version of the American Diabetes Association (ADA) criteria [17]. The selected patients were examined perioperatively to collect the baseline data including demographic data, body measurements, BMI, fasting blood sugar (FBS), glycosylated hemoglobin (HbA1c), and Homeostatic Model Assessment-Insulin Resistance (HOMA-IR). The patients were observed over a follow-up period of 12 months. All operations were performed by the same surgical team and with the same operative set.

The primary outcome of this study was to assess the change in glycemic parameters (FBS, HbA1c, and HOMA-IR) at the end of first year after OAGB procedure. However, the secondary outcome was to assess the rate of T2DM remission at the end of first year after OAGB procedure. According to ADA, T2DM complete remission is characterized as HbA1c below the level of 5.7% and FBS below the level of 100 mg/dl for at least 1 year after the procedure. On the contrary, partial remission is identified as HbA1c below the level of 6.4% and FBS below the level of 125 mg/dl [18].

Descriptive statistics were presented as mean±SD for continuous data and as number and percent for categorical data. Data analysis was conducted by SPSS 15.0 (SPSS Inc., Chicago, Illinois, USA), and *P* value less than 0.05 was counted as significant difference. To compare continuous variables, a paired *t* test and Wilcoxon signed-rank test were used for parametric and nonparametric data, respectively.

Results

The age range of the cases under study ranged from 20 to 60 years old, with a mean age of 39.5 years old. The majority of the cases were females (65%), and also the majority had a university degree (77.5%) with 20% having a high school diploma and 2.5% had basic education (Table 1).

The mean BMI before operation was 49.4 kg/m^2, and then the mean BMI was reduced to 45 kg/m^2 3 months after surgery, then to 42 kg/m^2 6 months postoperatively, 39.4 kg/m^2 at 9 months postoperatively, and finally, in the last assessment at 12 months postoperatively, the mean BMI reached 34.2 kg/m^2. The perioperative

Table 1 Frequency distribution of the studied cases according to their demographic data (*N*=40)

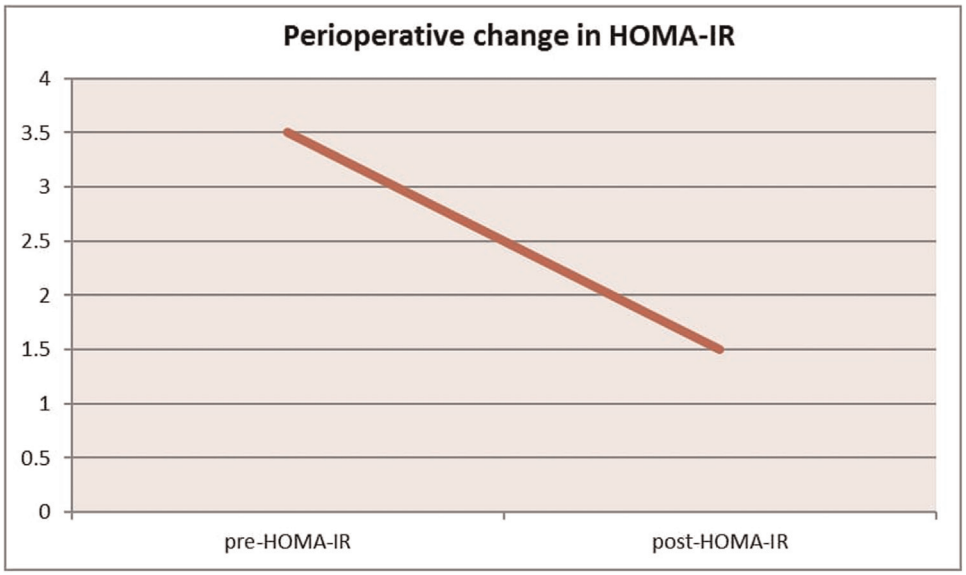
Variables	Frequency	Percentage
Age (years)		
Mean±SD	39.5±8.6	
Range	20–60	
Sex		
Male	14	35
Female	26	65
Education		
University	31	77.5
High school	8	20
Basic	1	2.5
Illiterate	0	0

change in the mean BMI was statistically significant ($P<0.05$) (Fig. 1).

The preoperative mean FBS value was 226 mg/dl, which significant decreased to 183, 157, 119 mg/dl, and finally reached 104 mg/dl at 3, 6, 9, and 12 months after the operation, respectively. The perioperative change in the mean FBS values was statistically significant ($P<0.05$) (Fig. 2). As for the mean HbA1c values of the study patients, the preoperative mean value was 8.4%. This value was decreased significantly to reach 7% at the sixth month of follow-up and 6.3% at the end of follow-up ($P<0.05$) (Fig. 3). Regarding the perioperative change in cases' HOMA-IR mean score. The mean preoperative score was 3.5 and decreased to 1.5 at the end of the follow-up. The perioperative change in the mean HOMA-IR score was statistically significant ($P<0.05$) (Fig. 4).

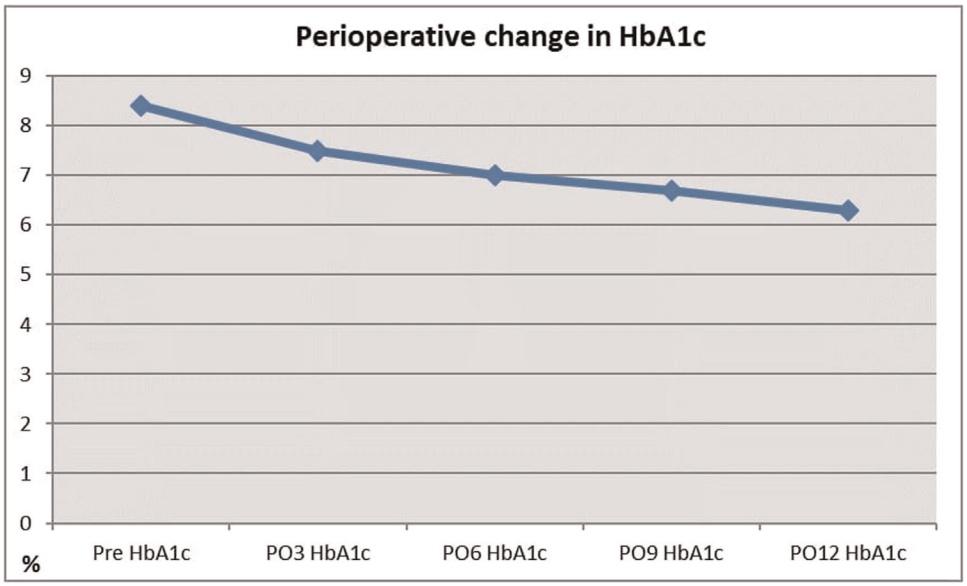
At the end of the follow-up, 42.5% of the patients fulfilled the ADA criteria for complete diabetic remission, 35% fulfilled the criteria for partial remission, and 22.5% did not fulfill either criterion, yet showed improvement in their FBS and HbA1c

Figure 1



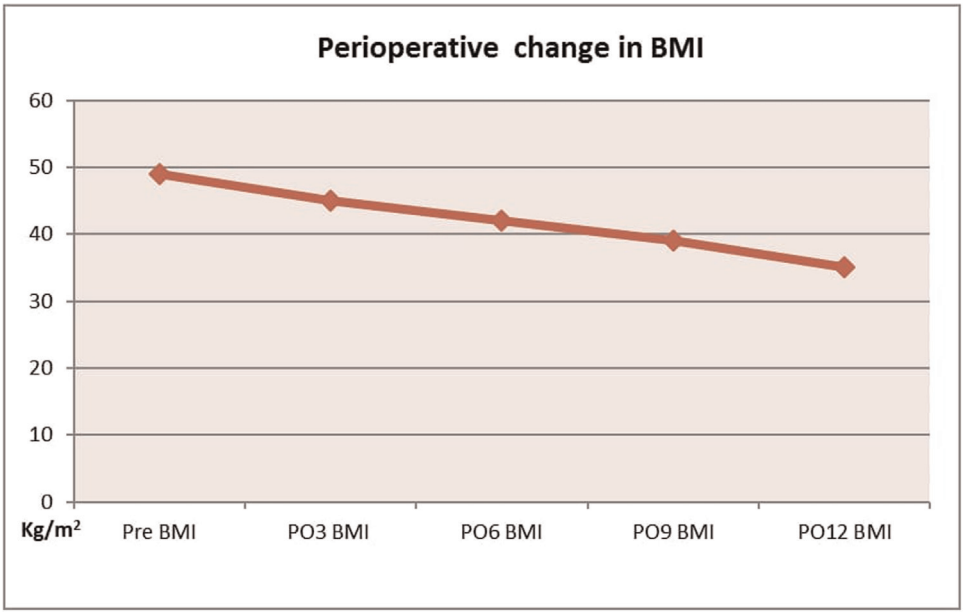
Graphical presentation to the perioperative change in the cases' BMI (N=40). χ^2=0.016, P value less than 0.05.

Figure 2



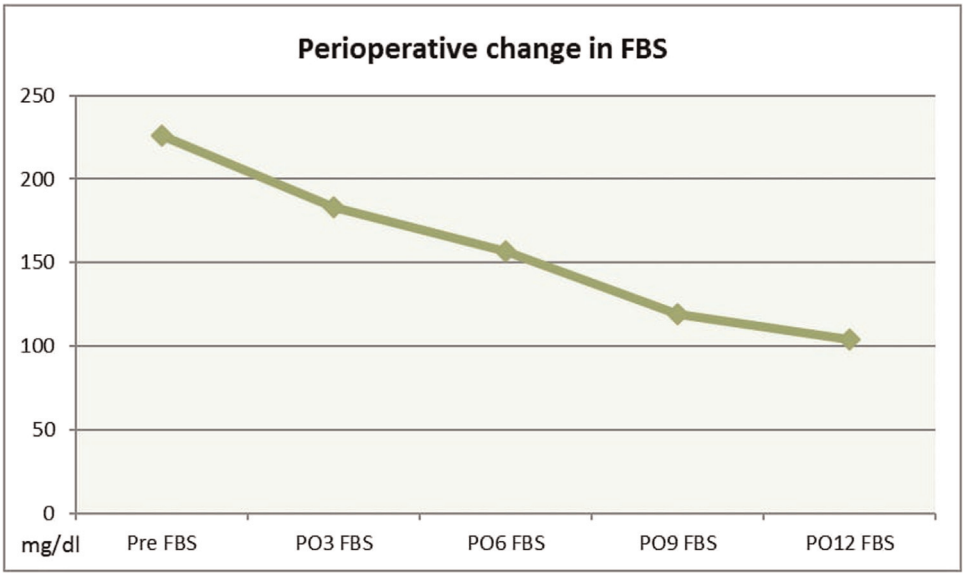
Graphical presentation to the perioperative change in the cases' fasting blood sugar (FBS) (N=40). χ^2=0.001, P value less than 0.05.

Figure 3



Graphical presentation to the perioperative change in the cases' glycosylated hemoglobin (HbA1c) (N=40). χ^2=0.02, P value less than 0.05.

Figure 4



Graphical presentation to the perioperative change in the cases' Homeostatic Model Assessment-Insulin Resistance (HOMA-IR) (N=40). χ^2=0.00, P value less than 0.05.

levels from their preoperative values; however, they were still under medical treatment (Table 2).

Table 2 Frequency distribution of the studied cases according to their diabetic remission (*N*=40)

Variables	Frequency	Percentage
DM remission		
Complete remission	17	42.5
Partial remission	14	35
Improvement	9	22.5

DM, diabetes mellitus.

Discussion

The prevalence of diabesity, a term used to describe concurrent existence of both obesity and diabetes mellitus, has been steadily increasing among different parts of the world to reach an epidemic level [9]. Although OAGB has proven its efficacy in term of weight loss among morbidly obese patients, the effect of procedure on T2DM control is not fully understood yet, especially in countries with high prevalence of T2DM such as Egypt [19]. In the present study, the efficacy of OAGB was examined,

as well as its diabetic control/remission ability. On year after the operation, the FBS, HbA1c, and HOMA-IR exhibited statistically significant reductions. Overall, 42.5% of the patients fulfilled the ADA criteria for complete diabetic remission, and 35% fulfilled the criteria for partial remission. Besides, the OAGB led to a statistically significant reduction in the BMI at the end of follow-up.

Although the exact mechanisms that drive significant improvements in glycemic parameters following OAGB in obese patients with T2DM have not been fully elucidate yet, several factors are thought to contribute to better glycemic control following the procedure. OAGB leads to effective caloric restriction and weight loss, which lead to subsequent improvement in insulin sensitivity through significant suppression of adipocytokines, inflammatory status, and lipotoxicity [20]. Besides the effect of weight loss and caloric restriction, the OAGB has independent effects on glycemic control such as alterations in bile acid composition, gut microbiota, gut hormones, and adipose tissue metabolism [20,21].

Our study confirms the positive effect of OAGB on glycemic control of obese patients with T2DM. The results demonstrated that nearly two-thirds of the patients achieved T2DM remission, whether complete or partial, 1 year after the procedure. Such findings are line with Abd-El-Hafez and Abd-El Aziz [22], who demonstrated that the OAGB led to a significant reduction in the FBS, HbA1c, and HOMA-IR, and that nearly 87.5% of the patients achieved T2DM remission, whether complete or partial, 1 year after the procedure. In the report of Kular *et al.* [23] on more than 60 obese patients with T2DM, the OAGB led to complete or partial remission of diabetes in 93.2% of the cases. Coskun [24] reported significant reductions in the FBS and HbA1c 1 year after OAGB. The same findings were reported by Kim and Hur [25] and Lee *et al.* [26]. The diabetic remission in the study by Musella *et al.* [27], including both complete and partial remission, was 87% after 1 year from operation.Concerning weight loss, the mean BMI before operation was 49.4 kg/m^2, and the mean BMI was reduced to 34.2 kg/m^2 1 year after the operation. The perioperative change in the mean BMI was statistically significant. In line with these findings, Wang *et al.* [28] reported on 423 OAGB patients a decrease in the mean BMI among from 44.2 kg/m^2 preoperatively to 29.2 kg/m^2 1 year postoperative, with a mean percent excess weight loss of 69.3%. Moreover, Chakhtoura *et al.* [29] reported a similar BMI decline from 40.9 to 31.9 kg/m^2, with a mean excess weight loss (%EWL) of 63% through a 1-year follow-up study on 100 patients with OAGB. Piazza *et al.* [30] examined 197 patients with OAGB for 1 year postoperatively and noticed a decline in the mean BMI from 52.9 to 39.4 kg/m^2, with a mean %EWL of 65%. Noun *et al.* [31] examined 923 OAGB patients and found a decline in the mean BMI from 42.5 to 28.3 kg/m^2 after 1 year of follow-up with a mean %EWL of 69.9%. Musella *et al* [27] examined 974 OAGB patients and reported a decrease in the mean BMI from 48 kg/m^2 preoperatively to 31.8 kg/m^2 1 year postoperatively, with a mean %EWL of 70%.

Conclusion

Comparing the results of the present study with the aforementioned literature showed a consensus regarding the positive effect of OAGB on diabetic control and body weight reduction, aided to the confirmed safety and feasibility of this procedure.

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Conflicts of interest

There are no conflicts of interest.

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