Assessment of glycosylated hemoglobin as a routine preoperative investigation in bariatric surgery: an Egyptian experience

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Received 3 May 2019
Accepted 8 July 2019

The Egyptian Journal of Surgery 2019, 38:743–747

Obesity is defined as abnormal or excessive fat accumulation that presents a risk to health. Besides being a worldwide public health problem, obesity is a major risk factor for a number of noncommunicable diseases, including diabetes, cardiovascular diseases, and cancer. Once considered a problem only in high-income countries, overweight and obesity are now dramatically on the rise in low-income and middle-income countries, particularly in urban settings. In Egypt, obesity prevalence is on the rise. Weight loss or bariatric surgeries are gaining more and more popularity as a surgical solution to tackle obesity. This is a cross-sectional study conducted at a specialized center of bariatric surgery for 1-year period on 396 patients who underwent bariatric surgeries (sleeve gastrectomy, OAGB) with age range from 15 to 64 years and BMI range from 32 to 76 kg/m^2. All surgical procedures were performed by the same bariatric surgical team. Postoperative follow-up consisted of visits with a multidisciplinary team, including the surgeon, physician assistant, and registered dietitian, at 3 weeks, 3, 6, 9, 12 months, and then yearly. The role of surgery in the treatment of diabetes is evolving. A noteworthy reduction in glycosylated hemoglobin (HbA1c) levels at postoperative was noted in diabetic patients. Our study suggests a relation between HbA1c levels and BMI. This relation states that reduction in BMI (i.e. tackling obesity) leads to reduction in HbA1c. It is of paramount importance to assess the long-term clinical outcomes of the surgical weight loss interventions. Obesity-related comorbidities should be evaluated in depth.

Keywords:
bariatric surgery, glycosylated hemoglobin, laparoscopic surgery, obesity

Egyptian J Surgery 38:743–747

1110-1121

Introduction

Obesity is defined as an abnormal or excessive fat accumulation that presents a risk to health. Besides being a worldwide public health problem, obesity is a major risk factor for a number of noncommunicable diseases, including diabetes, cardiovascular diseases, and cancer. Once considered a problem only in high-income countries, overweight and obesity are now dramatically on the rise in low-income and middle-income countries, particularly in urban settings. In Egypt, obesity prevalence is on the rise, and weight loss or bariatric surgeries are gaining more and more popularity as a surgical solution to tackle obesity.

International studies have not only explored the effects of weight loss but also investigated the associations between weight loss as a result of the surgical interventions and long-term health benefits such as improvement in underlying medical conditions among morbidly obese patients. One interesting study investigated the effect of weight reduction (through bariatric surgery) in accomplishing ideal glycemic control [1].

Many studies have reported the positive outcomes of surgical weight loss interventions, for example, laparoscopic sleeve gastrectomy (LSG) is reported to help achieve optimal glycemic control in diabetic patients. Other studies report Roux-en-Y gastric bypass leads to similar positive results in plasma glucose homeostasis, insulin sensitivity, and beta-cell function in obese people who were not diabetics [2].

Up to our knowledge, no studies have been reported to investigate the health benefits of bariatric surgery in Egypt. Our understanding of our situation in Egypt is not yet documented, especially in patients with diabetes mellitus. Investigating the effect of bariatric surgery on glycemic control status is unchartered territory in Egypt.

The American Diabetes Association (ADA) recommends that all adults should be screened for diabetes mellitus (DM2) at the age of 45 years, regardless of weight [3]. Testing is also recommended for asymptomatic adults of any age who are overweight or obese and who have one or more additional risk factors for diabetes [4].

Consequently, patients with morbid obesity should all have been tested before referral to a specialized care center for obesity. Nevertheless, the prevalence of undetected DM2 in parallel with increased awareness of diabetes risk with increased BMI is not known in patients with morbid obesity.

Glycosylated hemoglobin (HbA1c) is used to evaluate the glycemic control of diabetic patients. HbA1c level less than 7.0% as the primary glycemic control target for diabetics is suggested by the ADA guidelines. The percentage of patients who reach this objective seems to be particularly lower (24%) in the case of patients with less-controlled T2DM [5]. Increasing HbA1c levels were correlated with macrovascular and microvascular diseases, whereas decrease in HbA1c level lowers the prevalence of long-term complications [6].

Our study postulates that there is reduction in HbA1c (towards optimal glycemic control) over a 1-year period following bariatric surgery among patients who have diabetes mellitus in Egypt.

Patients and methods

This is a cross-sectional study conducted at specialized center of bariatric surgery for 1 year period on 396 patients who underwent bariatric surgeries (sleeve gastrectomy, OAGB) with age range from 15 to 64 years and BMI range from 32 to 76 kg/m^2. All surgical procedures were performed by the same bariatric surgical team. Postoperative follow-up consisted of visits with a multidisciplinary team, including the surgeon, physician assistant, and registered dietitian at 3 weeks, 3, 6, 9, 12 months, and then yearly. The patients were instructed to maintain a high-protein, low-fat, calorie-restricted bariatric diet. Diabetic management of the surgical patients was performed by the patient's primary care physician or endocrinologist. HbA1c was measured preoperatively and a minimum twice postoperatively, and weight documentation was done at their 1-year follow-up appointment with the bariatric team.

Diabetes remission was defined as HbA1c less than 6.0% (42 mmol/mol) and no diabetes medications.

We evaluated interactions between all items in the DiaRem score and baseline BMI, but none were significant. Our analysis identified two variables that were associated with remission (partial or complete) of diabetes in all patients with T2D irrespective of insulin use (i.e. age and preoperative HbA1c). In addition, antidiabetic medication was significantly associated with early as well as late remission in the noninsulin T2D group of patients (i.e. use of insulin sensitizing agent other than metformin+Sulf). These three variables and treatment with insulin were used to develop the DiaRem score based on a weighting system for each variable (Table 1). The DiaRem prediction score has a range of 0–22 and was stratified into five groups: 0–2 (highest probability), 3–7, 8–12, 13–17, and 18–22 (lowest probability).

Statistical analysis

Univariate analysis of demographic and clinical laboratory was accomplished using one-way analysis of variance to estimate the significance of different between groups where appropriate. Unpaired *t*-test was used to analyze univariate analysis when appropriate. χ^2-Test was used for categorical data comparison. All statistical analyses were performed using SPSS version 25.0, produced by (H SPSS Inc., Chicago, USA). The difference between groups was considered significant when *P* value was less than 0.05.

Dependent sample *t*-tests were used to test differences in HbA1c in the whole sample (*N*=396), as well as to assess the differences in HbA1c before and after the surgery, separately, and in the diabetic group and

Table 1 A preoperative diabetes remission (DiaRem) score predicting the probability of diabetes remission

Prediction factor	Score
Age (years)	
If age<40, enter 0→	
If age 40–49, enter 1→	
If age 50–59, enter 2→	
If age 60+, enter 3→	
HbA1c (%)	
If HbA1c<6.5, enter 0→	
If HbA1c 6.5–6.9, enter 2→	
If HbA1c 7.0–8.9, enter 4→	
If HbA1c 9.0+, enter 6→	
Other diabetes medications	
If not using sulfonylureas or not using ISA, enter 0→	
If on sulfonylureas and ISA, enter 3→	
Treatment with insulin	
If not using insulin, enter 0→	
If using insulin, enter 10→	
DiaRem Score (sum of individual components)→	

HbA1c, glycosylated hemoglobin; ISA, insulin sensitizing agent.

nondiabetic group. The effects of visit (preoperative and postoperative) on HbA1c were also assessed. We assessed the effect of diabetes, BMI reduction, and visit on lowering HbA1c after the surgery, controlling the patient characteristics.

Results

Demographic data and baseline characteristics

As shown in Table 1, 396 patients underwent bariatric procedures (LSG and OAGB), with age range from 15–64±10.04 years. Prevalence of females is 59.8% and males 40.2%. Mean BMI in the study 43.06±6.181 kg/m^2 and mean HbA1c is 6.35±1.741. Among the participants, 319 were nondiabetic (80.5%) and 77 were known diabetic (19.5%) (Table 2).

We re-derivative in the DiaRem scores according to five different definitions of diabetes remission (classified as 'partial' according to ADA recommendations) by using fasting glucose levels (FG), and/or HbA1c percent levels, and/or the use of antidiabetic medication, and corresponding to five different remission rates (%), as follows: [score-1 (59.4%): FG<100 mg/dl, no medication, score-2 (55.6%): HbA1c<6.0%, no medication, score-3 (46 · 9%): HbA1c<5.7%, no medication, score-4 (46.7%): FG<100 mg/dl, HbA1c<6.0%, score-5: FG<100 mg/dl, HbA1c<5.7%] at 14 months after surgery (Figs 1–4).

Table 2 Demographic data of the participants

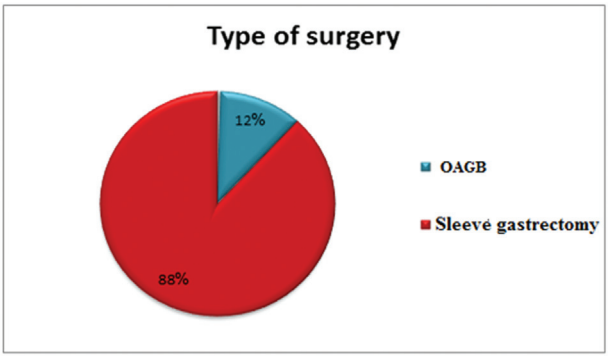
	Minimum	Maximum	Mean	SD	*P* value
Age	15	64	34.34	10.004	0.0001
Weight	78	236	129.83	27.104	0.0001
Height	84	210	158.44	21.232	0.0001
BMI	32	76	43.06	6.181	0.0002
Glycosylated hemoglobin	4	12	6.35	1.741	0.0007

Discussion

There is a lack of information in the literature regarding clinical consequences of weight loss interventions in Egypt; the scope of our study targeted the HbA1c parameter. Up to our knowledge, this study is the first to discus HbA1c. We gathered data on patients who underwent LSG and OAGB and followed them up over a period of 1 year.

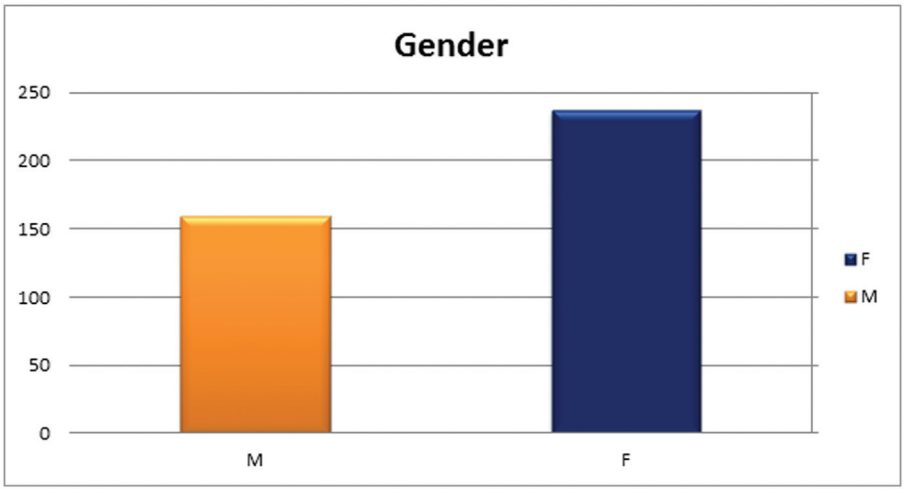
The period of follow-up where we monitor the effect of surgical weight loss interventions on HbA1c parameter was 12 months after the surgery.

Figure 2



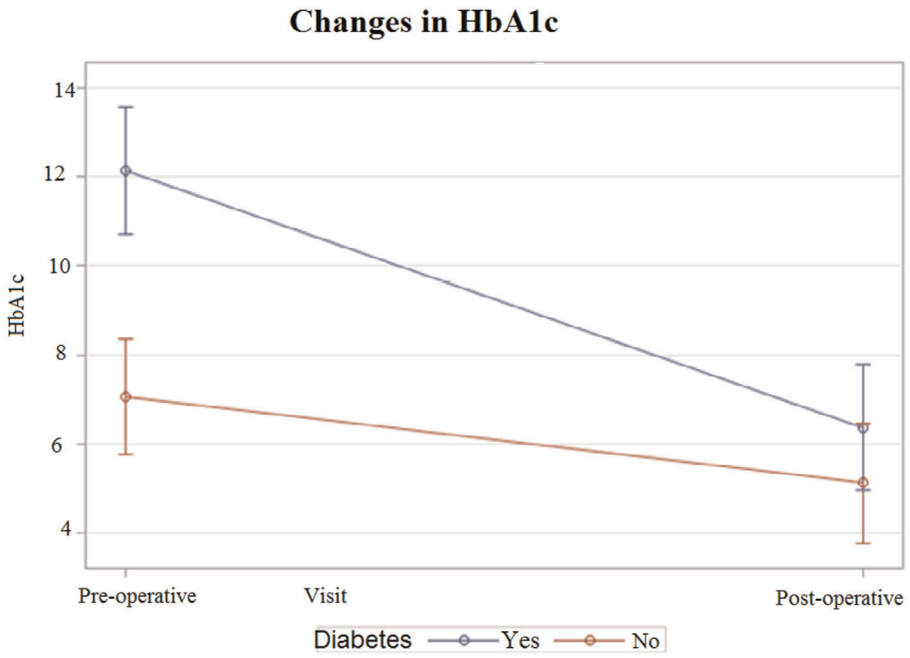
Type of surgery.

Figure 1



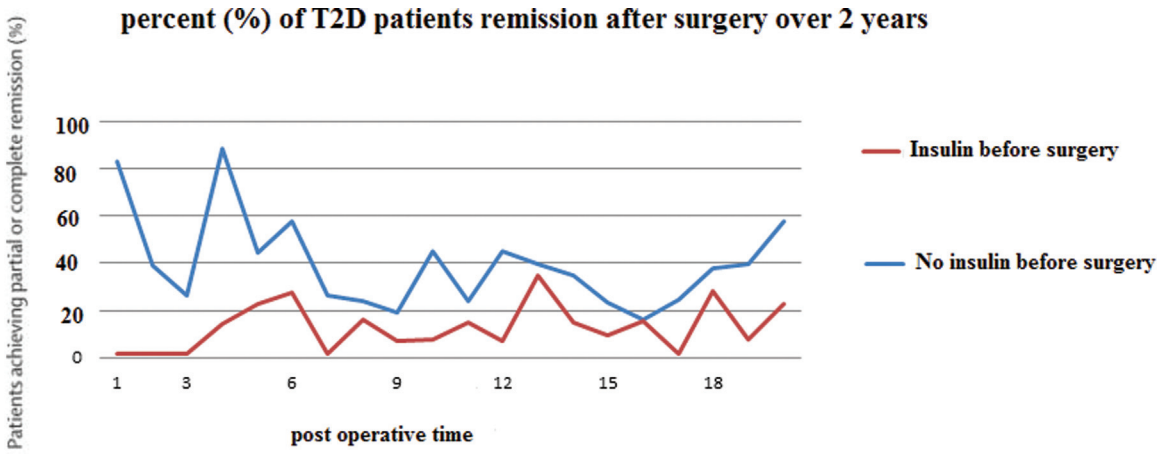
Sex of participants.

Figure 3



Changes of glycosylated hemoglobin.

Figure 4



Percent of T2DM remission.

The HbA1c target of 6.5% or below was met in 52.5% of the diabetic patients. Similar findings are reported from many studies and with various follow-up periods, where they have reported rapid positive effects toward optimal glycemic control after bariatric surgery [7,8]. On another level, three cases of the sample were first diagnosed with diabetes preoperative with HbA1c results. The data provided in our study suggest a robust evidence for the effectiveness of bariatric surgery in improving glycemic control in the sample of Egyptian patients. HbA1c in this sample has not been investigated. Moreover, HbA1c is an important investigative test in bariatric surgeries.

We recommend future studies to be conducted to evaluate the value of weight reduction in benefiting obese patients experiencing other comorbidities. The uniqueness of our study is that we had the ability to link the reduction in HbA1c to both diabetic status and to the reduction in BMI. That is to say at baseline, we recorded that HbA1c was higher in diabetic patients than in nondiabetic patients, whereas postoperatively, insignificant differences were noted between diabetic patients and nondiabetic patients. The reduction in HbA1c levels in our study can be accounted for where diabetes and the greater reduction in BMI is the suggested explanation. Among those who had minimal reduction in BMI

(0–9 kg/m^2), we observed significantly higher HbA1c levels in diabetic patients than in nondiabetic patients, whereas among those who had a large reduction in BMI 10–14 kg/m^2 and more than 14 kg/m^2 [9].

Conclusion

The role of surgery in the treatment of diabetes is evolving. A noteworthy reduction in HbA1c levels at postoperative was noted in diabetic patients.

Our study postulates that there is reduction in HbA1c (toward optimal glycemic control) over a 1-year period following bariatric surgery among patients who have diabetes mellitus.

Given that HbA1c is associated with higher reliability than other tests of glycemia, we suggest a pragmatic approach to closely monitor HbA1c annually in bariatric patients.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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