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RESEARCH ARTICLE

Behavior of Type 2 Diabetes Mellitus in Morbid Obese Patients Submitted to Gastric Bypass

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Abstract
Introduction Surgical treatment of obesity has not only resulted in weight loss, but also the control of associated diseases in the postoperative period. The aim of this study was to determine the post-op response of type 2 diabetes mellitus (DM2) to gastric bypass.
Methods A historical cohort study was performed involving all the diabetic, morbid obese patients who underwent gastric bypass during the period of May 2000 to October 2006 at the Centro da Obesidade Mórbida. Patient records were reviewed with regard to sex, age, anthropometric measurements, glycemia, glycosylated hemoglobin, pre-op insulin, and DM2 outcome.
Results A total of 125 diabetic, morbid obese patients were operated; they had a mean age of 42.6±9.7 years and body mass index of 49±8.3 kg/m^2. Of these patients, 63 (50.4%) required medication for control of DM2, and the rest managed only with diet.

Of these 63 patients, 43 (68.2%) achieved control of DM2 and were discharged without the need for antidiabetic medication, and 20 (31.7%) were discharged still on medication. One month after surgery, seven more patients discontinued medication for DM2, and 18 months after surgery, 97.6% of the patients showed control of DM2.
Conclusion Gastric bypass is effective in controlling DM2 in morbid obese patients.

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Introduction

Type 2 diabetes mellitus (DM2) is a disease associated with morbid obesity in approximately 20% of patients. The treatment of DM2 is based on diet and the use of medications such as oral hypoglycemics and insulin. Surgical treatment of morbid obesity has not only resulted in weight loss but also the control of comorbidities, such as systemic arterial hypertension, DM2, and dyslipidemia [1, 2]. Recent studies have probed the mechanism by which morbid obese patients control DM2 after bariatric surgery [3–15]. The large majority of these patients are discharged 4 days after surgery without the need for antidiabetic medication. Different responses have been observed after restrictive surgeries, malabsorptive surgeries (Scopinaro, duodenal switch), and combination surgeries (gastric bypass) [8, 13, 14, 16].

Initial results suggest that the control of DM2 in operated patients is not only related to weight loss or change in diet. Intestinal diversion has demonstrated an important role, where it is involved with hormonal factors that are still poorly understood [3, 5–8, 13, 15, 17].

The aim of this study was to determine the postoperative response of DM2 to gastric bypass.

Method

The historical cohort included 660 morbid obese patients submitted to gastric bypass in the period of May 2000 to October 2006. Of these, 125 (18.9%) had DM2 at the time of surgery. All the patients had their anthropometric data recorded at pre-op, along with fasting blood sugar and glycosylated hemoglobin and insulin levels. The measurements of intestinal diversion were taken intra-operatively.

The biliary limb was considered between Treitz's angle and the section site, and the alimentary limb between the gastro-entero anastomosis and the entero-entero anastomosis. The medications utilized by the patients and their modifications were recorded in the medical chart. The diagnostic criteria for DM2 were defined according to the Adult Treatment Panel III [18]. The patients had a post-op follow-up by a multidisciplinary team. The criterion used for the resolution (cure) of DM2 was the control of fasting glycemia in the absence of medications.

Results

A total of 125 morbid obese patients diagnosed with DM2 were studied. Of these, 49 (39.2%) were men, and they had a mean age of 42.6±9.7 years, body mass index (BMI) of 49±8.3 kg/m^2, waist of 135.6±16 cm, and waist-to-hips ratio of 0.99±0.1. Of the 125 patients, 63 (50.4%) needed medication for control of DM2, and the rest managed with only diet.

Of these 63 patients, 43 (68.2%) achieved control of DM2 and were discharged without the need for antidiabetic medication, whereas 20 were discharged still on medication. Of the latter 20 patients, 7 discontinued medication at 1 month after surgery, 3 at 3 months, 2 at 4 months , and 3 at 6, 8, and 10 months. One year after surgery, only 4 patients remained on medication, where 1 interrupted use on the 17th month. Thus, of the 63 patients on medication at pre-op, 60 (95.2%) had control of DM2. The other diabetic patients, who were not on medication at pre-op, maintained glycemic control after surgery. When taking into consideration all the 125 diabetic patients operated, glycemic control not requiring antidiabetic medication was observed in 122 (97.6%). None of these patients showed a return of increased glycemic levels during post-op follow-up, where 22 patients had been operated more than 5 years ago. The three patients who stayed on medication did not show any differences compared with the rest of the group with respect to the factors studied.

The patients who needed medication for DM2 after surgery were compared with those who did not, with respect to the pre-op characteristics and extent of the intestinal diversion performed (Table 1). There was no difference between these two groups with regard to sex, age, BMI, waist, and insulin use ($p>0.05$), but there was a significant difference with respect to glycemia and glycosylated hemoglobin ($p<0.001$).

Discussion

Gastric bypass was shown to be effective in the control of DM2 in morbid obese patients. The rapid response to treatment observed by glycemic control even in the first days after surgery suggests that the participation of hormonal factors are not yet well defined [7, 15].

The patients with more than 5 years follow-up continued with DM2 in control, which provided evidence of the efficacy of the treatment in the long run.

In this study, only pre-op glycemia and glycosylated hemoglobin were identified as factors that influenced the time of response in the control of DM2.

The pathophysiology of DM2 is a subject that stills generates many uncertainties [14]. DM2 is a disease that affects about 150 million people in the world, and this number is expected to grow substantially in the next decades [19]. As it is not a disease restricted to morbid obesity, questions are raised in regard to the effect of gastric bypass in non-obese patients [14]. A study [20] with non-obese diabetic rats showed the control of DM2 after gastric bypass. Therefore, non-obese diabetic patients may also benefit from the surgical treatment for the control of their

Table 1 Pre-operative data of patients with and without medication for DM2

	Remained on antidiabetics after discharge $n=20$	Discontinued antidiabetics at time of discharge $n=43$	Were not on medication of for DM2 $n=62$	p values
Males	7 (35.0%)	17 (39.5%)	25 (40.3%)	0.912
Age (years)	43.9±12.2	44.7±8.6	40.7±9.2	0.085
BMI (kg/m^2)	48.4±8.7	48.9±8.8	49.3±8.0	0.922
Waist (cm)	133.7±16.6	135.8±16.0	136.1±16.0	0.856
Glucose (mg/dl)	205±86	191±75	137±38	<0.001
Glycosylated hemoglobin (%)	7.5±1.6	8.1±2.6	5.9±1.9	<0.001
Insulin (mU/ml)[a]	27.7±24.6	29.0±17.5	28.8±17.9	0.978
Biliary limb (cm)	55±5	58±10	58±9	0.425
Alimentary limb (cm)	166±32	149±43	156±45	0.349

[a] Patients on exogenous insulin use were excluded in the analysis of insulin levels.

disease. Further studies area needed to test this hypothesis and to define which patients can benefit or not from some surgical treatment modality.

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