Type 2 Diabetes Mellitus, Depression and Eating Disorders in Patients Submitted to Bariatric Surgery

Diabetes Mellitus Tipo 2, Depressão e Alterações do Comportamento Alimentar em Doentes Submetidos a Cirurgia Bariátrica

Isabel BRANDÃO[1], Ana Marques PINHO[2], Filipa ARROJADO[1], Ana PINTO-BASTOS[3], José Maia da COSTA[4], Rui COELHO[1], Conceição CALHAU[5], Eva CONCEIÇÃO✉[3]

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ABSTRACT

Introduction: Obesity is associated with a great number of complications, including type 2 diabetes *mellitus* and psychiatric pathology. Bariatric surgery is the best solution to weight loss and improvement of complications in morbid obese patients. This study aims to analyze the evolution of type 2 diabetes *mellitus* and psychopathologic variables before and after bariatric surgery and assess the importance of different variables in weight loss.

Material and Methods: This is a longitudinal study, which evaluates 75 patients before and after bariatric surgery (47 - LAGB – Laparoscopic Adjustable Gastric Band; 19 – RYGB – Roux-en-Y Gastric Bypass; 9 - Sleeve) with a follow-up time between 18 and 46 months. A clinical interview and self report questionnaires were applied - Eating Disorder Examination questionnaire – EDE-Q and Beck Depression Inventory – BDI.

Results: Results show an improvement in type 2 diabetes *mellitus* after surgery (χ^2 (1) = 26.132, $p < 0.001$). There was not a significant improvement among psychiatric pathology when we controlled the analysis for the type of surgery. It was verified that type 2 diabetes *mellitus*, depression and eating disorders in post-operative period are associated with less weight loss. This model explains 27% of weight variance after surgery ($R^2 = 0.265$) and it is significant F (3.33) = 2.981, $p = 0.038$.

Discussion: Type 2 diabetes *mellitus*, psychiatric pathology and eating disorders after surgery influenced weight loss. It was not clear in what way this relation was verified, neither the relation that these metabolic and psychological variables may have during the postoperative period.

Conclusion: Type 2 diabetes *mellitus* improved after surgery. Type 2 diabetes *mellitus*, depression and eating disorders influenced weight loss in the postoperative period. These variables did not influence weight loss in the preoperative period.

Keywords: Bariatric Surgery; Depressive Disorder; Diabetes Mellitus, Type 2; Feeding and Eating Disorders; Obesity, Morbid.

RESUMO

Introdução: A obesidade associa-se a um elevado número de comorbilidades, entre as quais a diabetes mellitus tipo 2 e a patologia psiquiátrica. A cirurgia bariátrica tem demonstrado ser a melhor solução para a perda de peso e a melhoria das complicações nos casos de obesidade mórbida. O objetivo deste estudo é o de analisar a evolução da diabetes mellitus tipo 2 e de variáveis psicopatológicas antes e depois da cirurgia bariátrica e verificar o seu impacto na perda de peso.

Material e Métodos: É um estudo longitudinal, que avalia 75 indivíduos antes e depois de serem submetidos a cirurgia bariátrica (47 - Banda gástrica; 19 – *Bypass* Roux-en-Y gástrico; 9 - *Sleeve* gástrico), com tempo de *follow-up* entre 18 e 46 meses. Os instrumentos de avaliação foram a entrevista clínica e os questionários *Eating Disorder Examination questionnaire* – EDE-Q e *Beck Depression Inventory* – BDI.

Resultados: Verificou-se melhoria relativamente à variável dicotómica diabetes mellitus tipo 2 após a cirurgia (χ^2 (1) = 26,132, $p <$ 0,001). Não ocorreu melhoria significativa em termos de patologia psiquiátrica quando a análise foi controlada para o tipo de cirurgia. Encontrámos uma associação significativa entre as variáveis em estudo no pós-cirúrgico e a perda de peso. Este modelo explica 27% da variação do peso após a cirurgia ($R^2 = 0,265$) e é significativo F (3,33) = 2,981, $p = 0,038$.

Discussão: A diabetes mellitus tipo 2, patologia depressiva ou do comportamento alimentar mostraram estar relacionados com a perda de peso. Não ficou esclarecido em que sentido esta relação é estabelecida, nem a relação que estas variáveis metabólicas e psicológicas possam ter entre si ao longo do período pós cirurgia bariátrica.

Conclusão: A diabetes mellitus tipo 2 evoluiu favoravelmente após a cirurgia. Diabetes mellitus tipo 2, depressão e patologia alimentar no período pós-cirúrgico associaram-se a menor perda de peso. As variáveis estudadas no período pré cirúrgico não contribuíram de forma significativa para a perda de peso.

Palavras-chave: Cirurgia Bariátrica; Comportamento Alimentar; Depressão; Diabetes Mellitus Tipo 2; Obesidade Mórbida.

INTRODUCTION

Obesity may be defined as an excessive body fat accumulation, describing people with Body Mass Index (BMI) higher than 30 kg/m^2 and morbid obesity describing people with BMI higher than 40 kg/m^2.

1. Departamento de Neurociências Clínicas e Saúde Mental. Faculdade de Medicina. Universidade do Porto. Centro Hospitalar de São João. Porto. Portugal.
2. Faculdade de Medicina. Universidade do Porto. Porto. Portugal.
3. Escola de Psicologia. Centro de Investigação em Psicologia. Universidade do Minho. Braga. Portugal.
4. Serviço de Cirurgia. Hospital de Braga. Braga. Portugal.
5. Departamento de Bioquímica. Faculdade de Medicina. Universidade do Porto. Porto. Portugal.
✉ Autor correspondente: Eva Conceição. econceicao@psi.uminho.pt

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It has become a serious health concern due to the increasing number of patients and to associated comorbidities. The number of patients with morbid obesity has doubled over the last 20 years and at least 400 million worldwide are obese.[1,2]

In Portugal, prevalence has increased and, between 2003 and 2005, 52.4% of the Portuguese population was obese or overweight, a percentage that is increasing.[3,4]

This public health issue is associated to the double of mortality as well as to a high number of comorbidities, namely type-2 diabetes mellitus, psychological or psychiatric pathology (including depression, anxiety or eating disorders), cardiovascular pathology and cancer. Comorbidities related to morbid obesity are largely responsible for its poor outcome, as well as for the increasing health-related costs.[1,5,6]

Bariatric surgery has become the most efficient way to obtain satisfying results in terms of weight loss, comorbidity improvement and survival increase and patients with morbid obesity (BMI > 40 kg/m^2) or with BMI over 35 kg/m^2 when associated to major comorbidities have an indication for bariatric surgery.[5-10] A global improvement in quality of life has also been described in patients who underwent this procedure.[11,12] However, heterogeneous outcomes have been obtained with this type of intervention and patients with poor weight loss were described, leading to study which factors are associated, in some patients, to a poorer weight reduction.[13,17]

Either surgical option in bariatric surgery produce two major effects: malabsorptive and restrictive. Malabsorptive surgery (such as gastric bypass) limit the absorption of food bypassing parts of the gastrointestinal tract, leading to a negative energy balance and to weight loss. Restrictive procedures (including gastric banding and partly gastric sleeve) reduce stomach's storage capacity, leading to a lower caloric intake. There are also mixed procedures, such as the Roux-en-Y gastric bypass.[6,7]

As described above, patients with an indication for bariatric surgery frequently present with metabolic disorders such as type-2 diabetes, having been shown significant improvements upon bariatric surgery.[6,11,18,19]

Literature also supports the hypothesis that obese patients, namely those with an indication for bariatric surgery, more frequently present with psychological/psychiatric disorders, when compared to normal-weight patients; 20 to 60% of the patients present with axis-1 psychiatric disorders,[20] with depression, anxiety and binge eating disorder as the most common pathologies.[8,12,16,21] There is also an association between psychological and psycho-social factors, dysfunctional eating behaviour and obesity.[13,14,21,22]

As regards the outcomes of bariatric surgery, studies are not consensual significant improvements in terms of mental health were not always found;[10] other studies found improvements in terms of depression and anxiety disorders, with better results for depression.[12,18,19,23]

Type-2 diabetes and psychological/psychiatric disorders simultaneously emerge and may relate with each other; understanding the progression upon bariatric surgery as well as the influence on outcomes is therefore very relevant.[12,24,25] Post-surgical eating behaviour[14,22] as well as depression[9,13] were found to be associated to lower weight loss.[8] A recent study has shown the association between post-surgical weight gain and episodes of compulsive food intake, concerns regarding body image and depressive symptoms.[26] The presence of type-2 diabetes has also been associated to worst outcomes. However, medical and psychological variables are traditionally assessed in an independent way and few studies have analysed the impact of psychological and social factors along with medical variables within the same model aimed to understand its possible relationship with weight loss.[21,27,28]

Our study aimed to assess the progression of type-2 diabetes and psychopathological variables (depression and eating disorders) before and after bariatric surgery, as well as to analyse the importance of the different variables in weight loss outcomes, testing an integrated model that includes medical and psychological variables.

MATERIAL AND METHODS

This was a retrospective observational and cross-sectional study involving clinical data regarding 75 patients before and upon bariatric surgery (47 – Gastric banding; 19 – Gastric bypass – Roux-en-Y gastric bypass [RYGB]; 9 – Gastric sleeve) performed at the *Centro Hospitalar de São João - Porto*, (n = 56; 74.7 %) and at the *Hospital de Braga* (n = 19; 25.3%). Data were obtained between January 2009 and June 2013. Patients included in the study had to meet the following inclusion criteria: having an indication for bariatric surgery; having completed the self-report questionnaires detailed below; having been followed-up for at least 18 months. The patients having been submitted to subsequent surgery or getting pregnant during follow-up were excluded from the study. Approval by the ethics committees of the involved institutions was requested and all participants were asked to complete a written informed consent.

A semi-structured interview and self-report questionnaires (Beck Depression Inventory – BDI and Eating Disorder Examination questionnaire – EDE-Q) were used in the assessment and the interview was carried out by a psychologist with experience in this type of assessment. The participants were assessed before and upon surgery and follow-up varied between 18 and 46 months.

Instruments

Clinical interview according to DSM-IV[20]

It includes data that allows for the identification of patient's social and demographic characteristics, type or surgery, time after surgery and any relevant clinical history. Diagnosis and metabolic clinical data were obtained from patient's hospital clinical records.

Eating Disorder Examination questionnaire (EDE-Q)[29,30]

This is a 36-item self-report survey aimed to estimate the frequency and severity of pathological eating behaviours over a 28-day time period. Reliability and consistency of this method have been recognized and the validity of using the questionnaires in Portuguese population has also been established. These surveys aimed to identify the presence of any eating disorder.

Beck Depression Inventory (BDI)[31,32]

This is a survey aimed to estimate the presence of depressive symptoms over the last seven days. The questionnaire includes 21 multiple-choice questions, each one ranking 0 to 3, up to a maximum total score of 63. This has also been shown as a reliable and applicable method for the Portuguese population.

Diagnosis of type-2 diabetes

The diagnosis of type-2 diabetes was confirmed by an endocrinologist, according to the criteria issued by the Portuguese *Direção Geral de Saúde*.[33]

Statistical analysis

A chi-square test was initially used in order to assess the progression of the dichotomous variable 'type-2 diabetes', before and after bariatric surgery. Analysis of variance (ANOVA) was also used to test for repeated measures, in order to analyse any differences between the two assessment moments regarding the selected psychiatric variables. Analyses were controlled for the type of surgical procedure.

A multiple linear regression analysis was carried out in order to understand the effect of variables (type-2 diabetes, depression and eating disorders) on weight loss and pre and post-operative tests were carried out. The variable 'weight loss' was defined as the percentage of excess weight loss from surgery to the moment of assessment.

IBM's SPSS, Version 20 software was used. Statistical significance was set at 0.05. Differences regarding the size of sample occurred due to the presence of missing values.

RESULTS

Our study involved 75 participants, aged between 23 and 64 (85.3% female). In total, 47 patients (62.7%) underwent the implantation of gastric banding, 19 (25.3%) a RYGB and nine (12%) patients underwent a gastric sleeve. The social and demographic characteristics of the participants in our study are shown in Table 1. Information regarding the progression of BMI after surgery, as well as the percentages of excess weight loss are shown in Table 2.

As regards the progression of type-2 diabetes, 50.7% (n =34) of the patients had no diabetes before surgery and 61.2% (n = 41) had no diabetes upon surgery. A significant difference was found between both stages, χ^2 (1) = 26.132, $p < 0.001$. A statistically significant percentage of diabetic patients improved upon surgery. The progression of diabetes in our group of participants is shown in Table 3.

As regards the progression of psychiatric disorders, a statistically significant improvement was found in terms of depression (Wilk's Lambda = 0.89, F = 1.38, $p = 0.006$). The variable 'eating disorders' also showed an improvement upon surgery (Wilk's Lambda = 0.806, F = 1.797, $p = 0.008$), even though the analysis did not find statistically significant differences when controlled for the type of surgical procedure.

Two multiple linear regression tests were carried out in order to understand the effect of variables (type-2 diabetes, depression – BDI and eating disorders – EDE-Q), using pre (first test) and post-operative variables (second test).

As regards the first test, pre-operative variables were found not significantly have contributed to weight loss (F (3.39) = 0.55, $p = 0.65$), unlike post-operative variables that showed a significant association to weight loss. According to multiple linear regression test using weight loss as dependent variable and type-2 diabetes, eating disorders (EDE-Q) and depression (BDI) as independent variables,

Table 1 - Social and demographic characteristics of our group of patients

Gender	
Female	64 (85.3%)
Male	11 (14.7%)
Age	
Minimum	23 years
Maximum	64 years
Time of follow-up	
Minimum	18 months
Maximum	46 months
Type of procedure	
Gastric banding	47 (62.7%)
Roux-en-Y gastric bypass	19 (25.3%)
Gastric sleeve	9 (12.0%)
	n = 75

Table 2 - BMI progression and percentage of excess weight loss

Pre-operative BMI	
Minimum	34.53 kg/m^2
Maximum	59.82 kg/m^2
Average	44.75 kg/m^2
Post-operative BMI	
Minimum	21.45 kg/m^2
Maximum	57.26 kg/m^2
Average	32.79 kg/m^2
% of excess weight loss	
Minimum	-2.44% (weight gain)
Maximum	105.44%
Average	55.56%

a significant association between these factors and weight loss was found. This model explains for 27% of the variation of body weight upon surgery (R^2= 0.265) and showing a significant value F (3.33) = 2.981, p = 0.038. Type-2 diabetes was shown as the most relevantly associated variable to weight loss (β = -0.484, t = -2.373, p = 0.024). Eating disorders (β = -0.1, t = -0.38, p = 0.341) and depression (β = -0.249, t = -0.967, p = 0.341) also have contributed, even though marginally, to weight loss.

DISCUSSION

A statistically significant improvement was found in our study as regards type-2 diabetes after bariatric surgery, in line with literature.[6,11,18,19] However, follow-up of these patients is still short (minimum of 18 months, maximum of 46 months) and longer follow-up would be crucial in order to analyse outcomes –a study described that remission of type-2 diabetes mellitus is three times more frequent at 10 years when compared to non-surgical methods.[34]

Psychopathological variables used in our study had a favourable progression upon surgery, but only when the analysis was not controlled to the type of procedure. This is possibly related to the fact that symptom improvement is mainly associated to gastric bypass, possibly due to the fact that it leads to higher weight loss, less collateral effects, higher level of satisfaction with the procedure or due to other constraints.

Previous studies suggested improvements in terms of psychiatric pathology in obese patients who underwent bariatric surgery.[12,18,19,23] However, this needs further research as results from different studies were not consistent.[11]

The presence of post-operative type-2 diabetes (the variable with greatest impact on weight loss) was associated to a lower percentage of weight loss. As described above, type-2 diabetes does not influence weight loss when observed pre-operatively. In fact, there is in literature some evidence that remission of type-2 diabetes is related to post-operative weight loss and therefore non-remission of diabetes may have a contribution to a lower weight loss.[35]

The relationship of psychiatric pathology with weight loss is controversial. According to our study, depression was one of the variables included in the model associated to weight loss. Literature shows that the impact of psychiatric status in weight loss is not clear.[21] In fact, post-operative psychosocial functioning and psychiatric disorders may influence and, at the same time, may be influenced by weight loss.[12,16] We were not able to clarify whether the fact that patients in poorer psychological state had a lower weight loss or the fact that they did not obtain the expected result did contribute to a poorer state in terms of mental health.

The presence of post-operative eating disorders was found to be related with the percentage of weight loss, in line with literature. In fact, different studies found that the presence of post-operative, unlike pre-operative eating disorders predicted a poorer outcome (lower weight loss), in line with what was found in our study.[12,17]

The fact that this was a cross-sectional study confers solidity to our results. However, some limitations should be mentioned. A higher uniformity as regards the type of surgical procedure would be desirable in order to better sustain our results, as well as using a larger sample and a longer follow-up. The study was based on self-report questionnaires, which may have biased the results (such as memory or classification biases as regards psychopathological assessment).

CONCLUSION

Improvement in type-2 diabetes upon bariatric surgery was found in our study. We also found that factors such as type-2 diabetes, depression and eating disorders have an influence on weight loss postoperatively.

The results support the importance of a continuous psychiatric follow-up of patients submitted to bariatric surgery. Therefore, the need for tailored strategies in terms of psychological and psychiatric follow-up is crucial in order to improve the outcomes of bariatric surgery.

The assessment of depression and mainly eating

Table 3 - Progression of type-2 diabetes

Pre-operative	**50.7% (n = 34) non-diabetic**	**49.3% (n = 33) diabetic**
Post-operative	61.2% (n = 41) non-diabetic	38.8% (n = 26) diabetic

disorders in patients who underwent bariatric surgery should be related to the type of surgical procedure.

Further studies are important in order to prevent the limitations described in our study, as well as to search for new variables that may have a major role in weight loss, therefore influencing the outcome of these procedures.

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HUMAN AND ANIMAL PROTECTION

The authors declare that the followed procedures were according to regulations established by the Ethics and Clinical Research Committee and according to the Helsinki Declaration of the World Medical Association.

DATA CONFIDENTIALITY

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

CONFLICTS OF INTEREST

The authors declare that there were no conflicts of interest in writing this manuscript.

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