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ORIGINAL ARTICLE

Weight loss before bariatric surgery and its impact on poor versus excellent outcomes at 2 years

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Abstract

Purpose To identify preoperative factors that influence the outcomes of gastric bypass surgery, in terms of excess weight loss at 24 months.

Methods This retrospective study included two groups of patients who underwent laparoscopic gastric bypass surgery. Group A (poor outcomes) had ≤ 50%EWL or BMI ≥ 30 kg/m^2; group B (excellent outcomes) had ≥ 80%EWL at 24 months. A comparative analysis of demography, anthropometry, comorbidities, and metabolic status was performed. A linear regression model was used to evaluate %EWL association; the number of preoperative and postoperative consultations were also compared.

Results A total of 202 patients completed follow-up; 71 (35.1%) and 78 (38%) had poor and excellent outcomes (%EWL 44.1 ± 9.4% vs. 92 ± 10.9%), respectively. Mean age was 40.4 ± 8.9 years. Patients with poor outcomes had higher weight and BMI, lesser preoperative %EWL, higher dyslipidemia and diabetes rates with longer periods of evolution, and increased HbA1c% levels. In the linear regression analysis, preoperative %EWL and initial and preoperative BMI were statistically significant determinants of %EWL at 24 months Diabetes remission was 46.2% (group A) vs. 66.6% (group B). Group A had higher non-attendance rates after surgery.

Conclusion The factors independently associated with greater %EWL at 24 months between groups were higher preoperative %EWL, and lower initial and preoperative BMI.

Keywords Bariatric surgery · Weight regain · Insufficient weight loss · Laparoscopic gastric bypass · Excess weight loss · Obesity surgery

Introduction

Obesity is a major health problem worldwide. In Mexico, the latest National Health and Nutrition Survey (ENSANUT 2018) reported that the prevalence of overweight and obesity in adults was 75.2% [1]. Obesity is associated with higher rates of comorbidities such as type 2 diabetes mellitus (T2DM), hypertension, and dyslipidemia. Bariatric surgery is considered the optimal treatment with good results for weight loss [2], and is considered successful when the loss is greater than 50% of the excess weight. Other ways of measuring success are the following: the resolution of comorbidities, a body mass index (BMI) < 30 kg/m^2, and an improved quality of life [3, 4]. The results observed in terms of percentage of excess weight loss (% EWL) range from 60–75% at 18–24 months after surgery [3, 5]; however, these values are not maintained in all patients in the long term. The fail to achieve a EWL > 50% can vary between 15 and 35% [6–9]. This variability may be associated with the lack of standardization in the literature when reporting insufficient weight loss, fail, or weight regain [10, 11]. Other associated factors include behavioral problems, sociodemographic factors, surgical techniques, and even genetic and hormonal/metabolic polymorphisms [4, 12]. Based on the above, multidisciplinary support is imperative before and after surgery to maintain results, and to establish a timely diagnosis of weight regain or insufficient weight loss that may require additional therapeutics [13].

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In this study, we analyzed two groups (poor versus excellent outcomes) following laparoscopic gastric bypass (LGBP) at 24 months to identify preoperative factors related to such results.

Material and methods

A retrospective study (with prospective data collection) was performed by analyzing medical records of every patient who underwent LGBP between 2013 and 2017 at a single institution. Only patients who completed 24 months follow-up with complete data on demographics, and pre- and post-postoperative biometric and biochemical parameters were included. Patients with BMI ≥ 50 kg/m^2 and < 35 kg/m^2, those who underwent sleeve gastrectomy or revisional surgeries, and those of age < 18 or > 65 years were excluded. Patients were divided into two groups based on their %EWL at 24 months. Group A (poor outcomes) had ≤ 50% EWL or BMI ≥ 30 kg/m^2; group B (excellent outcomes) had ≥ 80% EWL. The main objective was to identify preoperative factors and compare the results of patients who had poor (failure/regain) versus excellent outcomes, in terms of weight loss at 24 months.

A baseline analysis was performed comparing demographic, anthropometric, comorbidities, and metabolic data (glucose, HbA1c%, antidiabetic treatment, triglycerides, total cholesterol, high density lipoprotein, and low density lipoprotein) between the two groups, with laboratory tests and clinical parameters being compared at baseline and at 24 months. The %EWL variable was calculated with the formula: [(initial weight − current weight) / (initial weight − ideal weight)] × 100. Patients required to lose at least 10% EWL before surgery (preoperative) without a specific time to accomplish it. A comparison of the %EWL at 6, 12, and 24 months was performed. T2DM remission rates (complete, partial, or improvement) were determined based on the American Diabetes Association (ADA) criteria [14]. A linear regression analysis was used to assess the effects of multiple factors on postoperative %EWL at 24 months. Variables included in the univariate analysis were age, sex, initial BMI, preoperative BMI, and preoperative %EWL. P < 0.05 was considered statistically significant. Finally, the number of preoperative and postoperative appointments with the multidisciplinary team (nutrition, psychology, and endocrinology) was compared.

Definitions

Poor outcomes (group A) were defined as failure (% EWL < 50%, and/or a BMI ≥ 30 kg/m^2) and/or regain (unable to maintain a % EWL of 50%) at 24 months. Excellent outcome (group B) was defined as % EWL ≥ 80% at 24 months [6, 15]. Complete T2DM remission was defined as the return of indicators to normal (HbA1c < 6% and fasting glucose < 100 mg/dL) for 1 year in the absence of active drug therapy. Partial remission was defined as hyperglycemia (HbA1c > 6% or fasting glucose 100–125 mg/dL) for 1 year in the absence of active drug therapy. Improvement was defined as the improvement of the metabolic profile, together with a reduction in the dose/number of drugs.

Surgical technique

LGBP (classic Roux-en-Y) was performed with a gastric pouch of 30–50 mL constructed with an antecolic/antegastric gastro-jejunal anastomosis. The biliary and alimentary limbs were made at 70 cm and 150 cm, respectively. The jejuno-jejunal anastomosis was also performed mechanically in a latero-lateral fashion. The mesenteric defects were closed with running non-absorbable sutures [16].

Statistical analysis

Data was expressed as mean ± standard deviation (SD), values or percentages. Categorical variables were compared using the Fisher's exact test. Groups with continuous variables were compared using the Mann Whitney *U* test for independent variables. A linear regression analysis was also performed. A *p*-value < 0.05 and a 95% confidence interval were defined as statistically significant. All statistical analyses were performed using IBM SPSS version 25 (Armonk, NY) and GraphPadPrism 8th version for Windows (GraphPad Software, La Jolla, CA).

Results

In a 4-year period, a total of 298 patients were eligible, but only 202 (67.7%) had complete follow-up information at 24 months. Based on definitions, 71 (35.1%) and 78 (38.6%) patients had poor and excellent outcomes, respectively. Average outcomes were observed in the other 53 patients (26.2%). Female sex represented 74.5% of cases. The mean age was 40.4 ± 8.9 years. The preoperative %EWL for both groups were 18.4 ± 8.2 vs. 22.1 ± 10.1 ($p = 0.006$), and at 24 months 44.1 ± 9.4 vs. 92 ± 10.9 ($p < 0.001$), respectively. The comparative baseline analysis showed that patients with poor outcomes had higher weight and BMI (baseline and preoperative), a lower percentage of preoperative %EWL, higher T2DM prevalence with more years of evolution, higher HbA1c% levels, and dyslipidemia. The detailed analysis is presented in Tables 1 and 2.

The metabolic profile analysis performed between the two groups at 24 months showed homogeneous improvement in most parameters, except for the lipid panel, as shown in

Table 2. For weight loss, there were significant differences in %EWL between groups from preoperative to 24 months (Fig. 1). In the linear regression analysis, preoperative %EWL, and initial and preoperative BMI were statistically significant determinants of %EWL at 24 months (Table 3). Complete T2DM remission rates in the poor and excellent

Table 1 Demographic, anthropometric, and comorbidity analysis

	Group A ($n=71$)	Group B ($n=78$)	p
Female sex, n (%)	64 (90.1)	69 (88.5)	0.742
Age (years), mean ± SD	41.9 ± 9.7	39.1 ± 7.9	0.062
Weight (kg), mean ± SD	117.1 ± 18	108.1 ± 15.9	0.002
BMI (kg/m^2), mean ± SD	46.1 ± 5.6	41.2 ± 4.6	< 0.001
Preoperative %EWL, mean ± SD	18.4 ± 8.2	22.1 ± 10.1	0.006
Preoperative weight (kg), mean ± SD	106.4 ± 14.7	97.8 ± 13	< 0.001
Preoperative BMI (kg/m^2), mean ± SD	41.8 ± 4.4	37.3 ± 3.6	< 0.001
T2DM, n (%)	26 (36.7)	18 (23.1)	0.048
T2DM evolution (years), mean ± SD	4.6 ± 4.8	1.8 ± 2.3	0.039
SAH, n (%)	31 (43.7)	29 (37.2)	0.422
Dyslipidemia, n (%)	36 (50.7)	26 (33.3)	0.032
BMI at 24 months (kg/m^2), mean ± SD	33.8 ± 2.4	25.1 ± 1.5	< 0.001
%EWL at 24 months, mean ± SD	44.1 ± 9.38	92.0 ± 10.9	< 0.001
%TWL at 24 months, mean ± SD	18.7 ± 5.5	32.3 ± 5.8	< 0.001

Table 2 Metabolic and lipid analysis

	Initial			**24 m**		
	Group A ($n=71$)	Group B ($n=78$)	p	Group A ($n=71$)	Group B ($n=78$)	p
Glucose, mean ± SD	108.5 ± 23.8	101.9 ± 21.2	0.052	87.5 ± 7.7	86 ± 9	0.153
HbA1c%, mean ± SD	6.4 ± 1.2	5.9 ± 1	0.001	5.5 ± 0.48	5.5 ± 0.47	0.529
Total cholesterol, mean ± SD	181.1 ± 38.2	181.6 ± 33.3	0.701	167.9 ± 30.2	163.5 ± 28.7	0.601
Triglyceride, mean ± SD	142.6 ± 89.1	140.4 ± 55.5	0.832	114.4 ± 47.2	90.5 ± 31.8	0.001
HDL, mean ± SD	54.5 ± 34.6	43 ± 20.5	0.279	51.3 ± 13.6	57.4 ± 12.3	0.002
LDL, mean ± SD	132 ± 68.2	117.3 ± 34.5	0.800	97.1 ± 31.7	89 ± 21.9	0.002

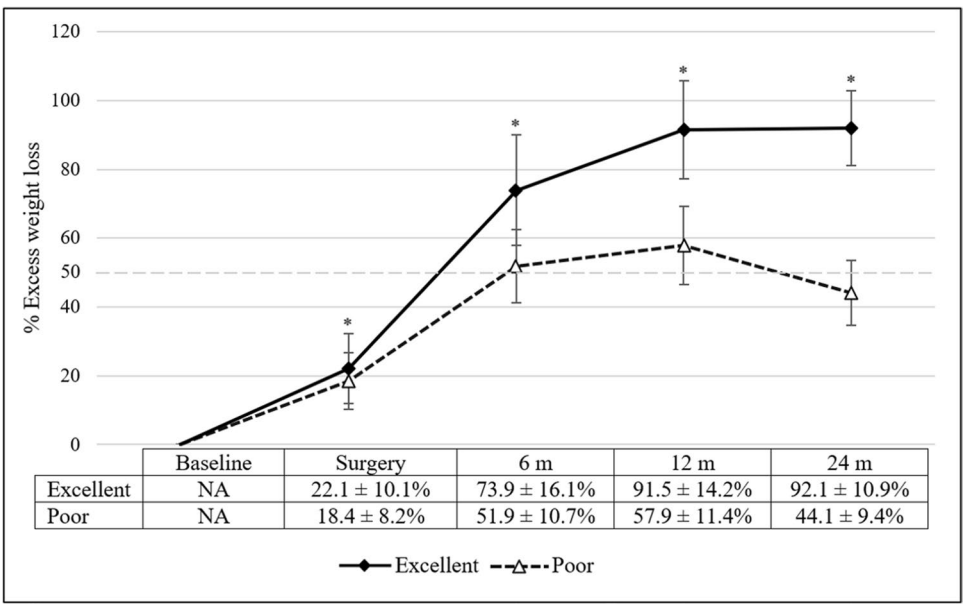

Fig. 1 *$p = < 0.05$ after Mann Whitney U test. The dotted line represents 50%EWL

Table 3 Linear regression model of predictors of %EWL at 24 months

Dependent variables	Independent variables	β (95% CI)	p
% EWL after 24 months between groups	Preoperative %EWL	0.19 (0.09 to 0.98)	0.019
	Age	−0.43 (−0.89 to 0.06)	0.087
	Gender	−0.12 (−13.8 to 13.6)	0.987
	Initial BMI	−0.37 (−2.43 to −1.02)	<0.001
	Preoperative BMI	−0.43 (−3.32 to −1.64)	<0.001

Table 4 Comparative analysis of appointments

	Group A ($n=71$)	Group B ($n=78$)	p
Preoperative			
Nutrition	5.7 ± 2.1	4.9 ± 2.2	0.003
Psychology	5.3 ± 2	5 ± 2	0.261
Endocrinology	2.7 ± 1.1	2.6 ± 1.2	0.185
Postoperative			
Nutrition	9.3 ± 3.9	9.7 ± 3.6	0.471
Psychology	7.3 ± 3.6	7.7 ± 3.3	0.431
Endocrinology	4.5 ± 2.5	3.5 ± 2.4	0.010
Non-assistance			
Nutrition	3.4 ± 3	1.1 ± 1.6	<0.001
Psychology	3.2 ± 2.8	1.4 ± 2	<0.001
Endocrinology	1.3 ± 1.2	0.8 ± 1.2	0.050

outcome groups were 46.2% vs. 66.6%, partial remission 19.2% vs. 5.6%, and improvement 34.6% vs. 27.8%, respectively. The appointments with the multidisciplinary team showed that patients with poor outcomes had better attendance with nutrition (preoperative) and endocrinology (at follow-up). However, the number of non-attendees (all specialists) was higher in this group, as shown in Table 4.

Discussion

This retrospective study analyzed two types of results following LGBP: poor versus excellent outcomes in terms of % EWL at 24 months post-surgery. Different preoperative factors found to determine postoperative outcomes were preoperative weight and BMI, prevalence of T2DM and dyslipidemia, time of evolution, and HbA1c% levels. Bariatric surgery leads to sustained weight loss and a decrease in overall mortality, compared to diet and lifestyle interventions [17]. Among the most frequently performed procedures, LGBP has demonstrated significant control of comorbidities. Remission of T2DM (in 81% of cases), hypertension (60.9%), dyslipidemia (70.7%), and gastroesophageal reflux disease (74.1%) have been associated with a mean % EWL of 68.2% [18, 19]. A meta-analysis with ≥ 10 years of follow-up reported an average of 55.4% of EWL, so weight regain is important in longer follow-up periods [20]. Maintaining weight loss is an important factor in prolonging the beneficial effects, since weight regain can influence comorbidities and decrease the quality of life [3, 21].

Between 15 and 35% of patients who undergo surgery will not lose more than 50% of their EWL. In a systematic review of 16 studies, the rates of weight regain ranged from 19 to 87%; this considerable variation arises mainly from the lack of consensus between definitions [3, 4, 22]. In our study, we obtained failure and regain rates of 4.4% and 31.1%, respectively. It is important to note that when reporting success or failure, the main limitations are the definitions used. The American Society for Metabolic and Bariatric Surgery (ASMBS) and the International Federation for the Surgery of Obesity (IFSO) published a series of recommendations to ensure consistency and standardization of outcomes in the field of bariatric and metabolic surgery. Accordingly, reports of weight loss outcomes should include the percent total weight loss (% TWL), % EWL, BMI reduction, and percent excess BMI loss (% EBMIL) [23]. In our study, we reported a significant difference between both groups with respect to % EWL from baseline to 24 months. To assess success, several authors have used various parameters. For example, the Adelaide study group proposed the use of % EWL > 50%, as described by Reinhold and cols [7, 24–26]. Although this measure is most widely used, its accuracy has been questioned, a less explored issue is excellent success, which some authors have defined as an % EWL of ≥ 80%. This % EWL is derived by exceeding the average expected weight loss by LGBP at 2 years, but the literature on this subject is scarce [15, 27]. Lechner et al. reported that 52% (40/77) of the patients presented excellent results two years after surgery, which was obtained by 38% (78/202) of patients in our study; however, it is important to emphasize that our series was nearly three times larger.

There are several weight loss predictors, such as advanced age, high baseline BMI, and the presence of T2DM [7, 28]. Varban et al. used logistic analysis to identify predictors for a BMI < 30 at 1 year after surgery and reported that patients with a preoperative BMI ≤ 40 kg/m^2 tended to have greater weight loss and a greater probability of remission of comorbidities; whereas, in BMI ≥ 50 kg/m^2, less than 9% of patients achieved this goal [29]. In the Swedish national bariatric registry data set, weight loss before gastric bypass was associated with sustained postoperative weight reduction [30]. In

our study, we concluded that factors independently associated with greater %EWL at 24 months were preoperative %EWL (positive association), and initial and preoperative BMI (negative association) on linear regression analysis. The presence of T2DM and the time of its evolution were factors that affected the results, despite the fact that patients with super-obesity were not included. Patients with excellent results had similar rates of resolution of pre-existing comorbidities compared with those with failure, suggesting that at least some extent of disease resolution may occur independent of weight loss [31]. In our results, a considerable remission of T2DM was observed, along with an improvement in laboratory tests at 24 months in both groups. Buchwald et al. determined the impact of bariatric surgery on T2DM, reporting that 82% of patients had resolution of clinical and laboratory manifestations of obesity in the first 2 years after surgery, and 62% remained diabetes-free more than 2 years after surgery [32]. Patients with longer duration of T2DM, insulin use, and poor glycemic control prior to surgery have been identified to be most likely to experience non-remission [33]. We observed complete T2DM remission in both groups, but as expected, those with excellent weight loss had better metabolic results.

The multidisciplinary team has a fundamental and integral role in the evaluation, follow-up, and support of patients before and after bariatric surgery. It has been shown that skipping preoperative consultations correlates with failure to follow-up and worse results [34, 35]. Riele et al. reported that 60% of patients who did not attend follow-up had a % EWL < 25% at 8 years after surgery [36]. In our study, we evaluated patient compliance with a multidisciplinary team. We identified that patients with poor outcomes required more preoperative appointments with nutrition, probably due to higher BMI; it was also demonstrated that non-attendance was more common in the same group. During follow-up, it is important to recognize the possible factors that may contribute to failure or weight regain, and establish a more effective strategy for early diagnosis and therapy.

The limitations of our study include its retrospective nature, relatively small number of patients, and the lack of objective tools to measure eating behaviors, physical activity, or quality of life. Despite the above, we clearly identify factors associated with excellent outcomes of bariatric surgery, a subject that has been scarcely analyzed in the literature. The clinical implications of these findings can aid in appropriate patient selection during surgery, help monitor a select few patients closely during the post-op period, or aid in patient counselling.

Conclusions

Patients with excellent postoperative outcomes (≥ 80% EWL at 24 months) following LGBP tend to have lower preoperative weight and BMI, higher preoperative %EWL, and a better baseline metabolic profile. Factors independently associated with greater %EWL at 24 months are preoperative %EWL, and initial and preoperative BMI on linear regression analysis. These outcomes are also related to a significantly higher postoperative adherence to nutrition, psychology, and endocrinology consultations.

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Authors' contributions All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Louis A. Hernández, Luis F. Peñuñuri, and Antonio Herrera. The first draft of the manuscript was written by Fernando Rodriguez and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Code availability Not applicable.

Declarations

Ethics approval All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments. This retrospective analysis was approved by the local research and ethics committee (Institutional Register 212–110-04–20) and registered at the national committee (CONBIOÉTICA-09-CEI-001–20160404).

Consent to participate (include appropriate statements) Formal consent was not required based on the retrospective study design. Every patient signed an informed consent for the surgery.

Consent for publication Not applicable.

Conflict of interest The authors declare no competing interests.

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