



Abdominoplasty in gastric bypass patients: anthropometric profile, comorbidities, and complications

Abdominoplastia em pacientes pós-bariátricos: perfil antropométrico, comorbidades e complicações

SIMONE CORRÊA ROSA^{1,2,3}
JEFFERSON LESSA SOARES DE
MACEDO^{1,4*}
LUIZ AUGUSTO CASULARI^{2,3,5}
FLÁVIO GONDIM FREITAS^{1,6}
JOÃO LUIZ DARQUES FERREIRA^{1,6}
LUCAS RIBEIRO CANEDO⁴

■ ABSTRACT

Introduction: Patients who undergo vertical-banded gastroplasty-Roux-en-Y gastric bypass (VBG-RYGB) have significant weight loss, and abdominoplasty (AP) is an effective corrective surgery for removing excess skin. **Methods:** A prospective study conducted from January 2011 to December 2016 in a public hospital evaluated patients who underwent AP after VBG-RYGB. The analyzed variables were body mass index (BMI) before VBG-RYGB, BMI before AP, weight loss, weight of the excised abdominal flap, comorbidities, and complications. **Results:** For this study, 107 patients who underwent AP were included. The patients' mean age was 41 years; BMI before AP, 27.6 ± 3.7 kg/m²; and mean weight loss, 47.7 ± 17.3 kg. The maximum BMI before bariatric surgery was 45.5 ± 7.5 kg/m², and the difference between the maximum BMI before VBG-RYGB and before corrective surgery was 18.6 ± 9.3 kg/m². The comorbidities observed before VBG-RYGB were arterial hypertension (11.1%), arthropathy (4.6%), diabetes mellitus (5.6%), and metabolic syndrome (5.6%). Fourteen patients (13.1%) underwent herniorrhaphy during AP. The overall complication rate was 31.5%. Weight before VBG-RYGB, BMI before VBG-RYGB, mean weight loss, comorbidities, abdominal flap weight, and BMI of >20 kg/m² were significantly associated with postoperative complications. **Conclusions:** VBG-RYGB was an effective approach to reduce comorbidities in obese patients. Comorbidities, weight before VBG-RYGB, mean weight loss, amount of tissue removed from the abdomen, and BMI of >20 kg/m² significantly increased the complication rate in the gastric bypass patients who underwent AP. Furthermore, AP is fundamental for the comprehensive care of obese patients and has optimized the results achieved with VBG-RYGB.

Keywords: Bariatric surgery; Postoperative care; Abdominoplasty; Reconstructive surgical procedures; Vertical-banded gastroplasty-Roux-en-Y gastric bypass.

Institution: Hospital Regional da Asa Norte,
Brasília, DF, Brazil.

Article received: January 18, 2018.
Article accepted: May 17, 2018.

Conflicts of interest: none.

DOI: 10.5935/2177-1235.2018RBCP0000

¹ Hospital Regional da Asa Norte, Brasília, DF, Brazil.

² Universidade de Brasília, Brasília, DF, Brazil.

³ Curso de Pós-Graduação em Ciências da Saúde, Brasília, DF, Brazil.

⁴ Escola Superior de Ciências da Saúde, Curso de Medicina, Brasília, DF, Brazil.

⁵ Hospital Universitário de Brasília, Brasília, DF, Brazil.

⁶ Secretaria de Estado de Saúde, Brasília, DF, Brazil.

■ RESUMO

Introdução: Os pacientes submetidos à gastroplastia apresentam importante perda de peso e a cirurgia plástica representa um importante meio de tratamento do excesso de pele. **Método:** Estudo prospectivo foi realizado em pacientes submetidos à abdominoplastia pós-gastroplastia no período de janeiro de 2011 a dezembro de 2016 em hospital público. As variáveis analisadas foram: IMC (Índice de Massa Corporal) antes da gastroplastia e antes da cirurgia plástica, perda de peso, peso do retalho retirado, comorbidades e complicações. **Resultados:** 107 pacientes que realizaram abdominoplastia foram incluídos. Média de idade foi 41 anos. O IMC médio antes da cirurgia plástica foi $27,6 \pm 3,7$ Kg/m². Perda de peso médio foi $47,7 \pm 17,3$ Kg. O IMC máximo antes da gastroplastia foi $45,5 \pm 7,5$ Kg/m² e o IMC foi $18,6 \pm 9,3$ Kg/m². Comorbidades presentes antes da plástica foram: hipertensão arterial (11,1%), artropatia (4,6%), diabetes melito (5,6%) e síndrome metabólica (5,6%). Catorze (13,1%) pacientes realizaram herniorrafia durante a abdominoplastia. A taxa de complicações foi 31,5%. O peso antes da gastroplastia, IMC antes da gastroplastia, perda de peso médio, comorbidades, peso do retalho do abdome e IMC > 20Kg/m² foram fatores associados significativamente a complicações pós-operatórias. **Conclusões:** A gastroplastia em Y de Roux foi uma terapêutica efetiva na resolução de comorbidades em obesos. Comorbidades, peso antes da gastroplastia, perda de peso médio, quantidade de tecido retirado do abdome e IMC > 20Kg/m² levaram significativamente a mais complicações em pacientes pós-bariátricos submetidos à abdominoplastia. A cirurgia plástica é importante no cuidado integral ao paciente obeso e otimizou os resultados alcançados com a cirurgia bariátrica.

Descritores: Cirurgia bariátrica; Cuidados pós-operatórios; Abdominoplastia; Procedimentos cirúrgicos reconstrutivos; Gastroplastia.

INTRODUCTION

Obesity is a serious disease usually associated with increased morbidity and mortality, increased healthcare costs, reduced quality of life, and reduced life expectancy¹.

The clinical management of obesity is challenging because most individuals with morbid obesity cannot lose or maintain the lost weight².

In recent years, the surgical treatment of morbid obesity has gained popularity. The effectiveness of surgical treatment in weight loss has been confirmed by well-controlled studies, especially in the United States and Sweden^{3,4}. In the United States, the number of surgical procedures for weight loss increased from 28,800 in 1999 to 220,000 in 2009⁴.

Safety in the execution of bariatric surgery, represented by low rates of early and late complications (venous thromboembolism, surgical reintervention, and prolonged hospitalization) and a mortality rate of 0.3%, together with a significant decrease in comorbidities,

justify the inclusion of bariatric surgery as an essential strategy for treating morbid obesity^{1,5}.

Patients who undergo gastric bypass surgery usually complain of excess skin and loss of soft tissues, which affect the practice of exercises and suitability of clothes, and may lead to aesthetic, posture, and mobility problems. In addition, weight loss may result in pain due to mechanical friction, limit hygiene procedures, and cause fungal infections and intertriginous dermatitis⁶.

Post-bariatric surgery patients who intend to undergo abdominoplasty (AP) should be carefully monitored for the risk of postoperative complications because these patients usually present with residual comorbidities, nutritional deficiencies, and psychological problems⁷.

OBJECTIVE

The objective of this study was to assess the anthropometric profile, and the prevalence of comorbidities and complications in patients who underwent AP

after vertical-banded gastroplasty-Roux-en-Y gastric bypass (VBG-RYGB).

MATERIALS AND METHODS

This prospective study was conducted in a public referral hospital for bariatric surgery. The sample included individuals who underwent vertical-banded gastroplasty-Roux-en-Y gastric bypass surgery (VBG-RYGB) followed by AP from 2011 to 2016 after massive weight loss.

This study was performed in accordance with the National Health Council Resolution No. 466 of 12/12/2012. All the participants were informed about the scope of the study and signed a free and informed consent form. The authors of the present study no conflicts of interest to declare. The study was approved by the research ethics committee of the Health Department of the Federal District under Certificate for Ethics Assessment (Certificado de Apresentação para Apreciação Ética-CAAE) No. 52738216.5.0000.5553 (Opinion No. 1,504,199).

All the surgeries were performed by the same team of assistants at the Regional Hospital of Asa Norte, Brasília, Federal District, Brazil.

Inclusion criteria

The inclusion criteria for AP after VBG-RYGB were weight stability for at least 6 months after achieving the weight loss goal in each case, absence of drug and alcohol abuse, absence of moderate or severe psychotic or dementia, and acknowledgment of the need for weight maintenance and postoperative follow-up by a multidisciplinary team^{1,8}.

Exclusion criteria

The exclusion criteria were smoking, gestational intention, weight instability and absence of maintenance of weight for 6 months, not signing the consent form, patients who underwent other bariatric procedures after VBG-RYGB, patients followed up for <12 months, and patients belonging to vulnerable groups (mentally ill, institutionalized, or aged <18 years)⁸.

Analyzed variables

The analyzed variables were age, sex, weight, height, body mass index (BMI) before VBG-RYGB (kg/m^2), BMI before AP (kg/m^2), total weight loss (%), percentage of excess weight loss (%EWL), time interval between VBG-RYGB and AP (months), presence of comorbidities before VBG-RYGB, presence of comorbidities before AP, number of medications

used before and after VBG-RYGB, and postoperative complication rate.

Anthropometric variables

Weight was measured on a digital scale with a maximum capacity of 300 kg. Height was determined using a Personal Caprice Sanny[®] stadiometer. %EWL was obtained using the following formula: weight loss after AP/excess weight \times 100. Excess weight was calculated by subtracting the weight at the beginning of the VBG-RYGB follow-up from the ideal weight (BMI of $25 \text{ kg}/\text{m}^2$)⁹.

The BMI variation (Δ BMI) was calculated as the difference between the maximum BMI before VBG-RYGB and the BMI at the time of AP.

Clinical variables and comorbidities

The diagnoses of systemic arterial hypertension, dyslipidemia, type 2 diabetes mellitus, and metabolic syndrome were based on parameters established in the respective guidelines of the Brazilian Society of Cardiology and currently described in the First Brazilian Guideline for the Diagnosis and Treatment of Metabolic Syndrome¹⁰. Hepatic steatosis was diagnosed using preoperative abdominal ultrasonography.

The preoperative diagnosis of obstructive sleep apnea was based on the apnea-hypopnea index (AHI). An apnea event was defined as cessation of oronasal airflow for ≥ 10 seconds. A hypopnea event was defined as a reduction in nasal pressure signal of $\geq 30\%$ accompanied by desaturation of $\geq 4\%$ for > 10 seconds.

The AHI was defined as the sum of apnea and hypopnea events per hour of sleep. The diagnosis of obstructive sleep apnea was based on an AHI of ≥ 5.0 events per hour, and the severity of obstructive sleep apnea was based on the following AHI scores: mild (5.0 to 14.9 events/hour), moderate (15.0 to 29.9 events/hour), or severe (≥ 30.0 events/hour)¹¹.

Patients with arthropathy were defined as those who underwent surgical treatment for joint pain or received conventional anti-inflammatory drugs as treatment for joint pain⁹.

Number of medications for treatment of comorbidities

After VBG-RYGB, comorbidities were considered resolved in cases in which they were controlled without medications and considered improved when they were controlled using smaller doses. The number of medications taken by the patient before VBG-RYGB and the number of drugs the patient continued taking

after the surgery were calculated. The drugs were categorized by classes as follows: antihypertensive, hypoglycemic, anti-inflammatory, cholesterol reducers, bronchodilators, multivitamins, anxiolytics, and antidepressants¹².

Abdominoplasty

AP involved the removal of excess skin and abdominal fat combined with an extensive detachment of the upper abdominal flap, correction of the diastasis of the rectus abdominis, and umbilical transposition. Anchor-line AP included a vertical midline resection and was usually required in patients with previous midline scars and incisional hernias, and patients with excess vertical and horizontal abdominal dermis and panniculus^{13,14}.

Postoperative complications

The evaluated complications were hematomas, seromas, dehiscence, tissue necrosis, internal hernias, deep venous thromboembolism, and pulmonary embolism. The complications were divided into major and minor. Major complications were considered as those requiring a new surgical procedure for hematoma drainage, seroma drainage, dehiscence suture, or rehospitalization for systemic antibiotic therapy.

The epidemiological, anthropometric, clinical, and surgical variables were compared between the patients with and without postoperative complications. This strategy allowed determining the factors associated with complications in VBG-RYGB patients undergoing AP¹⁵⁻¹⁸.

Postoperative care

All the patients received non-drug thromboembolic prophylaxis, including early ambulation and lower limb compression. Cystoscopic surveillance was performed, the bladder catheter was removed on the first postoperative day, and prophylactic antibiotic therapy was initiated. Anesthetic induction was performed using 2 g of intravenous cefazolin.

Elastic compression stockings were routinely used for 3 months. The vacuum drains used in AP were removed on the seventh day regardless of the flow rate.

The patients were hospitalized until the following day and maintained a semi-Fowler position, with an indwelling urinary catheter and stimulation of the active movements of the feet and knees.

The basic guidelines were maintaining the elastic compressive stockings, increasing water intake, walking, and avoiding physical exertion. The postoperative visits

were weekly in the first month and then monthly for a minimum of 12 months.

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) statistical package 20.0 for Windows (SPSS Inc. Chicago, IL, USA). Continuous variables were described using means and standard deviations, and categorical variables were described using relative frequencies. The normality of the variables was evaluated using the Kolmogorov-Smirnov test. All analyses were performed at a level of significance of 5%.

The groups were compared using the chi-square test for dichotomous variables, the Student *t*-test for continuous variables with a normal distribution, and the Mann-Whitney *U*-test for continuous variables with a non-normal distribution. The correlations between continuous variables were assessed using the Spearman correlation coefficient (r_s).

RESULTS

A total of 107 patients underwent operation after VBG-RYGB using videolaparoscopy (60; 55.8%) or laparotomy (47; 44.2%). The mean age was 40.89 ± 9.76 years, and most surgeries (91.6%, 98/107) were performed on women.

Anthropometric variables

The anthropometric profile of the VBG-RYGB patients before undergoing AP are shown in Table 1.

The patients who underwent VBG-RYGB usually had morbid obesity or grade II obesity, and these two groups represented 100% of the sample (Table 2). The patients who underwent AP after VBG-RYGB usually presented overweight or normal BMI, and both groups represented 75.6% of the sample.

The difference between the maximum BMI before VBG-RYGB and before AP (Δ BMI) was 18.60 ± 9.34 kg. Moreover, 33.6% (36/107) of the patients presented a BMI variation of >20 kg/m², and 36.4% (39/107) had a weight loss of ≥ 50 kg.

Clinical variables and comorbidities

The diseases diagnosed before VBG-RYGB are shown in Table 3. The most common comorbidities were metabolic syndrome, arterial hypertension, arthropathy, depression/anxiety, and diabetes mellitus. The least common comorbidities were obstructive sleep apnea syndrome, esophagitis, and dyslipidemia.

Table 1. Anthropometric profile of the post-bariatric surgery patients before abdominoplasty at the Asa Norte Regional Hospital, Brasília, Federal District, Brazil, from 2011 to 2016.

Characteristics	Mean	SD***
Age (years)	40.89	9.76
Maximum weight (kg)	120.79	24.19
Maximum BMI* (kg/m ²)	45.52	7.55
Final BMI before abdominoplasty (kg/m ²)	27.63	3.70
Total weight loss (kg)	47.70	17.32
%EWL**	78.79	12.61

* BMI: Body Mass Index. ** %EWL: Excess Weight Loss. *** Data are expressed as mean \pm standard deviation.

Table 2. Distribution of patients according to the degree of obesity (BMI before bariatric surgery and abdominoplasty) after undergoing bariatric surgery at the Regional Hospital of Asa Norte, Brasília, Federal District, Brazil, from 2011 to 2016.

BMI (kg/m ²)	Before bariatric surgery, number of patients (%)	Before abdominoplasty, number of patients (%)
<25 (normal)	0	21 (19.6%)
25.0–29.9 (overweight)	0	60 (56.1%)
30.0–4.9 (grade I)	0	24 (22.4%)
35.0–39.9 (grade II)	22 (20.6%)	1 (0.9%)
>40.0 (grade III)	85 (79.9%)	1 (0.9%)

* BMI, body mass index.

Most patients reported improvement or complete resolution of many of these comorbidities after surgical treatment of obesity. However, some patients had preexisting diseases before undergoing AP, with depression and anxiety and hypertension being the most frequent (Table 3). In addition, 35.2% (38/107) of the patients had undergone cholecystectomy before AP.

Number of medications for treatment of comorbidities

The mean daily number of medications taken by the patients before VBG-RYGB was 4.24 ± 3.25 , which decreased to 1.74 ± 1.31 after VBG-RYGB. This difference was significant ($p < 0.001$, 95% confidence interval [CI], 3.62–4.86).

AP: time interval after VBG-RYGB, combined surgeries, and complication rates

The mean time between VBG-RYGB and AP was 43.47 ± 29.82 months. The patients underwent AP more frequently at 25–48 months and 18–24 months after VBG-RYGB, and these time intervals represented 70.6% of the sample.

Table 3. Distribution of patients according to the presence of comorbidities before and after bariatric surgery performed at the Regional Hospital of Asa Norte, Brasília, Federal District, Brazil, from 2011 to 2016.

Comorbidities	Before bariatric surgery, number of patients (%)	Before abdominoplasty, number of patients (%)	Valor <i>p</i>
Metabolic syndrome	61 (56.5%)	6 (5.6%)	0.027
Hypertension	59 (54.6%)	12 (11.1%)	0.001
Arthropathy	42 (38.9%)	5 (4.6%)	0.004
Diabetes mellitus	41 (38.0%)	6 (5.6%)	0.002
Depression/anxiety	40 (37.0%)	27 (25.0%)	0.001
Dyslipidemia	26 (24.1%)	2 (1.9%)	0.010
Sleep apnea syndrome	22 (20.4%)	2 (1.9%)	0.005
Esophagitis	22 (20.4%)	4 (3.8%)	0.005

* Chi-square test.

The adopted techniques were classical (80; 74.8%) and anchor-line (27; 25.2%). Incisional hernias occurred in six patients; and umbilical hernia, in eight patients, representing 13.1% of patients undergoing AP. Herniorrhaphy was performed during AP (Figure 1).

Ninety-one patients (85.0%) underwent only one surgical procedure per stage, and 16 (14.9%) underwent combined surgeries in the same surgical procedure. The other associated surgical procedures were mastoplasty (12 patients) and brachioplasty (four patients).

The overall complication rate was 31.5% (34/107). The rate of major complications was 11.1% (12 patients), including wound dehiscence requiring resuturing (four cases), hematoma/seroma requiring reoperation (three cases), internal hernia with intestinal obstruction (three cases), and wound infection requiring treatment with intravenous antibiotics (two cases).

The rate of minor complications was 20.4% (22 patients), including seroma requiring repeated punctures (nine cases), hematoma with drainage or spontaneous resolution (five cases), dehiscence not requiring resuturing (five cases), and wound infection requiring treatment with oral antibiotics (three cases).

The mean surgical time was 170.00 ± 55.33 min. Vacuum drains were used in all the AP procedures.

General anesthesia was used in 95 patients (88.8%), and epidural anesthesia was used in 12 patients (11.2%).

The mean length of hospital stay was 2.0 ± 1.2 days, and a period of hospitalization of 2 days was necessary in 98 hospitalizations (91.6%). Only nine patients (8.4%) required hospitalization for >2 days.

The patients were followed up for at least 12 months. No case of deep venous thrombosis, pulmonary embolism, or death was found in our sample.

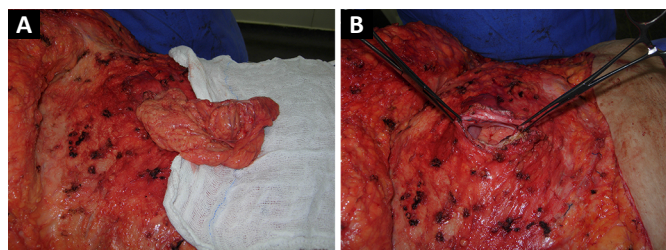


Figure 1. A post-bariatric surgery patient who underwent incisional herniorrhaphy during abdominoplasty. **A:** Incisional hernia diagnosed during abdominoplasty; **B:** Treatment of an incisional hernia during abdominoplasty.

Factors associated with complications in AP in the VBG-RYGB patients

The age-related and anthropometric factors associated with complications in AP in the VBG-RYGB patients are shown in Table 4. The factors more strongly associated with postoperative complications in these patients were age of >40 years, pre-VBG-RYGB maximum weight, pre-VBG-RYGB BMI, ΔBMI, total weight loss, and BMI variation (ΔBMI) of >20 kg/m². Pre-AP BMI and weight loss of >50 kg were not significantly higher in the VBG-RYGB patients who presented complications after AP (*p* < 0.08).

The factors associated with complications after AP related to comorbidities and weight of the abdominal flap removed during AP are shown in Table 5. The factors significantly associated with postoperative complications in these patients were the presence of comorbidities (dyslipidemia, diabetes, and arterial hypertension), weight of the excised flap, especially when weight was >2,000 g (Figure 2).

The incidence of diabetes and systemic arterial hypertension in isolation was not significantly higher

in the patients who presented complications after abdominoplasty (*p* < 0.09). However, the combined presence of diabetes and arterial hypertension significantly correlated with a higher number of complications after AP.

DISCUSSION

After substantial weight loss, complaints of tissue flaccidity and cutaneous changes, especially in the breasts, abdomen, back, arms, thighs, and face, were common. In addition to the psychosocial impact of generalized excess skin, there were clinical implications, including intertrigo and functional limitations in ambulation, urination, and sexual activity¹⁹.

Plastic surgery of the body contour helps promote the social and psychological reintegration of obese patients, who have prolonged suffering. Moreover, the objective of these corrective surgeries is to optimize the functional results obtained with bariatric surgery by removing excess skin^{2,8}.

The results of this study indicated that most of the VBG-RYGB patients who underwent AP were women with a mean age of 41 years, maximum BMI of 45 kg/m², mean maximum weight of 119 kg, and mean weight loss of 47 kg. These results agree with those of studies conducted in Brazil^{9,14,19}, Italy²⁰, Austria^{4,17}, France¹⁸, Switzerland², and the United States¹⁶.

However, other studies reported a higher mean age, especially in the United States^{13,21} and Spain²². Furthermore, a maximum BMI of >50 kg/m² has been reported, especially in the United States²³⁻²⁵.

A statistically significant association was found among discomfort, excess skin after bariatric surgery,

Table 4. Age and anthropometric factors that potentially led to the complications in the post-bariatric surgery patients who underwent abdominoplasty.

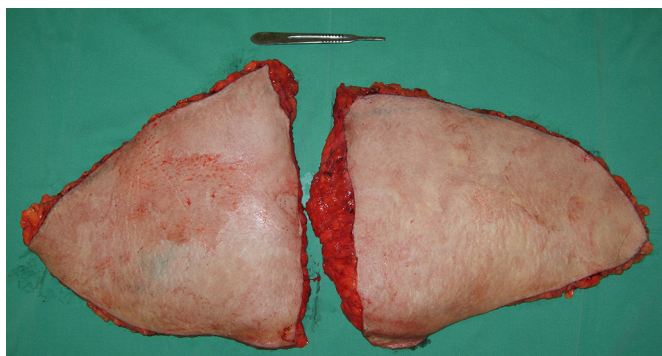
Variables	Presence of complications	Absence of complications	<i>p</i> -value	OR	95% CI
Patients (N)	34	73	-	-	-
Age (years) ^a	43.09 ± 12.1	39.9 ± 8.4	0.058	-	-
Age >40 years	73.5%	47.3	0.011***	2.22	[1.15-4.30]
Mean maximum weight before bariatric surgery (kg) ^a	129.4 ± 30.6	116.5 ± 19.5	0.010***	-	-
Maximum BMI before bariatric surgery (kg/m ²) ^a	48.5 ± 9.6	44.1 ± 5.9	0.004***	-	-
Mean BMI before abdominoplasty (kg/m ²) ^a	28.5 ± 4.4	27.2 ± 3.3	0.094	-	-
Mean ΔBMI (kg/m ²) ^a	19.7 ± 7.5	16.9 ± 4.9	0.022***	-	-
Total weight loss (kg) ^a	54.5 ± 23.1	44.3 ± 12.9	0.004***	-	-
Lost weight ≥50 kg	50.1%	31.0%	0.059	1.70	[0.98;2.94]
ΔBMI > 20 kg/m ²	47.0%	27.0%	0.040***	1.78	[1.03;3.06]
BMI before abdominoplasty > 30 kg/m ²	24.32%	21.57%	0.818	-	-

^a Data are presented as means and standard deviations. *BMI: Body mass index. ** ΔBMI: BMI before bariatric surgery - BMI before abdominoplasty. *** *p* < 0.05.

Table 5. Other factors that potentially led to the complications in the post-bariatric surgery patients who underwent abdominoplasty.

Variables	Presence of complications	Absence of complications	p-value	OR	95% CI
Weight of the flap removed from the abdomen (g) ^a	2743 ± 1601	1630.1 ± 846	<0.001***	-	-
Weight of the removed flap of ≥2,000 g*	61.8%	25.7%	0.004***	3.41	[2.11; 5.56]
Diabetes	11.8%	2.7%	0.056	2.27	[1.19;4.30]
Hypertension	17.7%	8.1%	0.143	1.71	[0.90;3.27]
Dyslipidemia	5.9%	0.0%	0.035***	3.31	[2.48;4.42]
Metabolic syndrome	11.8%	2.7%	0.056	2.27	[1.19-4.30]
Diabetes/hypertension**	26.5%	8.1%	0.011***	2.23	[1.31-3.80]

^a Data are presented as means and standard deviations. *Weight of the abdominal flap removed during abdominoplasty. **Presence of diabetes and/or hypertension. *** $p < 0.05$.

**Figure 2.** Abdominal flap of >2,000 g removed during abdominoplasty.

and female sex, that is, women were more uncomfortable with excess skin after bariatric surgery than men²⁶.

The mean BMI before AP was 27.4 kg/m², which is similar to the results of other studies in populations from Brazil¹⁴, Italy²⁰, Austria^{4,17}, France¹⁸, Switzerland², and the United States^{13,16}. However, the mean BMI values reported in the studies performed in the United States^{6,24,25}, Turkey²⁷, and Greece²⁸ were <27.4 kg/m².

Residual obesity is a persistent problem in these patients after massive weight loss. Coon et al.²³ reported that 45% and 20% of patients who sought abdominoplasty after VBG-RYGB had BMI values of >30 and >35 kg/m², respectively. Orpheu et al.¹⁹ reported that the percentage of residual obesity (BMI > 30 kg/m²) was 27.55%, which agrees with the results of our study.

A significant reduction in comorbidities was observed after VBG-RYGB, and at the time of AP, only 11.5% of the patients had systemic arterial hypertension and 5.7% had diabetes mellitus. In the United States, the incidence rates of arterial hypertension, diabetes mellitus, and sleep apnea syndrome in VBG-RYGB patients before AP were 32.5%, 15%, and 5%, respectively⁶.

This significant improvement in comorbidity rates is a direct result of the decreased number of medications used by the patients after bariatric surgery. Our results also indicated a significant difference between the mean

number of medications before and after VBG-RYGB ($p < 0.001$; 95% CI, 3.64-4.69).

Similarly, Lopes et al.¹² found that the mean number of medications per patient decreased from 3.9 ± 1.67 before surgery to 1.64 ± 1.68 after surgery, corresponding to two drugs per patient (95% CI, 2.38-1.69, $p = 0.71$), indicating a reduction of >50% in the number of medications used after surgery¹².

The mean duration between bariatric surgery and AP was 43 months. This period is similar to that reported in one Brazilian study (47 months)¹⁴ but higher than that (32 months) reported in another Brazilian study²⁹ and much higher (22 to 26 months) than that reported in studies on other countries, including Spain²² and the United States^{6,25}.

The overall complication rate after AP in the VBG-RYGB patients was 31%. This result is similar to those in the study of de Kerviler et al.² and Espinosa-de-los-Monteros et al.²⁵ but lower than those in other studies, wherein the rates ranged from 35% to 50% of the operated patients^{13,22-24,29}.

The observed low rate of major complications, including thromboembolic events, flap necrosis, and low number of reoperations, may be due to the small number of combined surgeries observed in this study. Studies that reported higher complication rates usually involved a higher percentage of combined surgeries^{13,23}. Combined surgeries lead to longer surgical time (>6 hours), greater blood loss, and a greater need for blood transfusions, and these factors may increase the rate of postoperative complications^{6,23,29}.

The rates of dehiscence, seroma, infection, and necrosis correlated with the number of surgical procedures²³. The comparison of the patients subjected to one surgical procedure and those subjected to multiple procedures after bariatric surgery revealed a significant increase in the rate of postoperative complications in the latter group²³.

The execution of combined surgeries is usually discouraged to avoid a longer surgical time and higher

skin damage and deterioration. However, in selected cases, after careful analysis of clinical, nutritional, emotional, and social factors, more than one plastic surgery, as was the case in 16 patients (14.8%) in this study, or other surgical procedures (e.g., herniorrhaphy) may be performed without the occurrence of serious complications. The combination of plastic surgery procedures is common in other treatment centers for gastric bypass patients; however, this strategy should be used only in selected cases^{6,13,30}.

Another important factor that may have contributed to the lower complication rate was the low prevalence of comorbidities during AP. A study in the United States involving 449 gastric bypass patients found a complication rate of 41.8%; however, the prevalence rates of systemic arterial hypertension and diabetes mellitus in bariatric surgery patients who underwent plastic surgery were 44.2% and 22.3%, respectively¹³.

That same study reported that >50% of patients who sought plastic surgery had residual obesity. In our study, only 22.3% of the operated patients had grade I obesity at the time of corrective surgery.

The presence of obesity at the time of AP may have strongly affected the complication rate related to wound dehiscence¹⁶⁻¹⁸.

Some studies reported that the rate of smoking in AP patients was up to 48%. Smoking is known to increase the risk of wound complications by threefold^{20,31}. The non-inclusion of smokers in the present study may have contributed to the lower complication rates.

In the present study, the primary clinical and anthropometric factors that were strongly associated with the postoperative complications in the VBG-RYGB patients were pre-VBG-RYGB maximum weight, pre-VBG-RYGB BMI, total weight loss, Δ BMI, and presence of comorbidities. In our study, comorbidities were predictors of complications. Nonetheless, some studies indicated that comorbidities were poor predictors of complications^{13,18}.

Δ BMI, especially Δ BMI of >20 kg/m² (difference in BMI before and after bariatric surgery), was significantly associated with post-AP complications in gastric bypass patients, and these results were confirmed by other studies^{13,32}. Furthermore, the mean weight loss was higher in the patients with complications, which agrees with the results of another study¹⁶.

Maximum BMI of >50 kg/m² increases the risk of infections by 2.6-fold higher than does the maximum BMI of <50 kg/m^{2,13}.

The total weight of the resected abdominal tissue during AP significantly affected the occurrence of postoperative complications, including seroma and wound dehiscence, especially when the abdominal flap weight was >2,000 g. Similarly, other studies reported that

the rate of postoperative complications was increased as the weight of resected tissues was increased in plastic surgeries performed after bariatric surgery^{2,17,25,31}.

The advent of bariatric surgery has brought lasting and satisfactory results in the fight against obesity. The patient's desire after massive weight loss is to undergo corrective procedures to improve body contouring. The careful and differentiated approach of the surgeon in each case, together with a multidisciplinary follow-up, is essential for adequately managing these patients to improve aesthetic results and prevent complications^{8,19}.

The plastic surgeon should consider the anthropometric, clinical, and surgical factors that significantly increase the risk of postoperative complications in bariatric surgery patients. Despite significant weight loss after gastric bypass surgery, weight loss cannot completely reverse the increased risk of complications. This fact needs to be evaluated in future studies to identify strategies to reduce the complication rate in these patients and evaluate clinical protocols to better prepare these patients for new surgical procedures.

CONCLUSION

The profile of bariatric surgery patients who underwent AP was represented by women with a mean age of 41 years, maximum BMI of 46 kg/m², mean maximum weight of 120 kg, and mean weight loss of 48 kg. The mean BMI of these patients before VBG-RYGB was 27.6 kg/m², and their %EWL was 78.8%. A significant reduction in comorbidities was observed after VBG-RYGB, including the complete remission of diabetes mellitus, dyslipidemia, sleep apnea syndrome, and metabolic syndrome.

The mean time between VBG-RYGB and AP was 43 months. The overall complication rate in the VBG-RYGB patients after AP was 31.5%, and the factors significantly associated with complications were age of >40 years, presence of comorbidities, removed abdominal flap weight of >2,000 g, and Δ BMI of >20 kg/m².

COLLABORATIONS

- SCR** Analysis and/or interpretation of data; final approval of the manuscript; conception and design of the study.
- JLSM** Final approval of the manuscript; conception and design of the study; completion of surgeries and/or experiments.
- LAC** Analysis and/or interpretation of data; final approval of the manuscript.
- FGF** Analysis and/or interpretation of data; final approval of the manuscript.

JLDF Analysis and/or interpretation of data; final approval of the manuscript.

LRC Statistical analyses; writing the manuscript or critical review of its contents.

REFERENCES

- Karlsson J, Taft C, Rydén A, Sjöström L, Sullivan M. Ten-year trends in health-related quality of life after surgical and conventional treatment for severe obesity: the SOS intervention study. *Int J Obes (Lond)*. 2007;31(8):1248-61. DOI: <http://dx.doi.org/10.1038/sj.ijo.0803573>
- de Kerviler S, Hüsler R, Banic A, Constantinescu MA. Body contouring surgery following bariatric surgery and dietetically induced massive weight reduction: a risk analysis. *Obes Surg*. 2009;19(5):553-9. DOI: <http://dx.doi.org/10.1007/s11695-008-9659-8>
- Sjöström L, Peltonen M, Jacobson P, Sjöström CD, Karason K, Wedel H, et al. Bariatric surgery and long-term cardiovascular event. *JAMA*. 2012;307(1):56-65. DOI: <http://dx.doi.org/10.1001/jama.2011.1914>
- Felberbauer FX, Shakeri-Leidenmühler S, Langer FB, Kitzinger H, Bohdjalian A, Kefurt R, et al. Post-Bariatric Body-Contouring Surgery: Fewer Procedures, Less Demand, and Lower Costs. *Obes Surg*. 2015;25(7):1198-202. DOI: <http://dx.doi.org/10.1007/s11695-014-1493-6>
- Poirier P, Cornier MA, Mazzone T, Stiles S, Cummings S, Klein S, et al.; American Heart Association Obesity Committee of the Council on Nutrition, Physical Activity, and Metabolism. Bariatric surgery and cardiovascular risk factors: a scientific statement from the American Heart Association. *Circulation*. 2011;123(15):1683-701. PMID: 21403092 DOI: <http://dx.doi.org/10.1161/CIR.0b013e3182149099>
- Shermak MA, Chang D, Magnuson TH, Schweitzer MA. An outcomes analysis of patients undergoing body contouring surgery after massive weight loss. *Plast Reconstr Surg*. 2006;118(4):1026-31. PMID: 16980866 DOI: <http://dx.doi.org/10.1097/01.prs.0000232417.05081.db>
- Michaels J 5th, Coon D, Rubin JP. Complications in postbariatric body contouring: strategies for assessment and prevention. *Plast Reconstr Surg*. 2011;127(3):1352-7. PMID: 21364438 DOI: <http://dx.doi.org/10.1097/PRS.0b013e3182063144>
- van der Beek ES, Geenen R, de Heer FA, van der Molen AB, van Ramshorst B. Quality of life long-term after body contouring surgery following bariatric surgery: sustained improvement after 7 years. *Plast Reconstr Surg*. 2012;130(5):1133-9. PMID: 22777040 DOI: <http://dx.doi.org/10.1097/PRS.0b013e318267d51d>
- Silva CF, Cohen L, Sarmiento LA, Rosa FMM, Rosado EL, Carneiro JRI, et al. Efeitos no longo prazo da gastroplastia redutora em Y-de-Roux sobre o peso corporal e comorbidades clínicas metabólicas em serviço de cirurgia bariátrica de um hospital universitário. *ABCD Arq Bras Cir Dig*. 2016;29(Supl.1):20-3.
- Projeto Diretrizes. Associação Médica Brasileira e Conselho Federal de Medicina. *Sobrepeso e Obesidade: Diagnóstico*. Brasília: Sociedade Brasileira de Endocrinologia e Metabologia; 2004.
- Duarte RLM, Magalhães-da-Silveira FJ. Fatores preditivos para apnéia obstrutiva do sono em pacientes em avaliação pré-operatória de cirurgia bariátrica e encaminhados para polissonografia em um laboratório do sono. *J Bras Pneumol*. 2015;41(5):440-8. DOI: <http://dx.doi.org/10.1590/S1806-37132015000000027>
- Lopes EC, Heineck I, Athaydes G, Minhardt NG, Souto KEP, Stein AT. Is Bariatric Surgery Effective in Reducing Comorbidities and Drug Costs? A Systematic Review and Meta-Analysis. *Obes Surg*. 2015;25(9):1741-9. DOI: <http://dx.doi.org/10.1007/s11695-015-1777-5>
- Coon D, Gusenoff JA, Kannan N, El Khoudary SR, Naghshineh N, Rubin JP. Body mass and surgical complications in the post-bariatric reconstructive patient: analysis of 511 cases. *Ann Surg*. 2009;249(3):397-401. DOI: <http://dx.doi.org/10.1097/SLA.0b013e318196d0c6>
- Donnabella A, Neffa L, Barros BB, Santos FP. Abdominoplastia pós cirurgia bariátrica: experiência de 315 casos. *Rev Bras Cir Plást*. 2016;31(4):510-5.
- Cintra Junior W, Modolin MLA, Rocha RI, Gemperli R. Mastopexia de aumento após cirurgia bariátrica: avaliação da satisfação das pacientes e resultados cirúrgicos. *Rev Col Bras Cir*. 2016;43(3):160-4.
- Arthurs ZM, Cuadrado D, Sohn V, Wolcott K, Lesperance K, Carter P, et al. Post-bariatric panniculectomy: pre-panniculectomy body mass index impacts the complication profile. *Am J Surg*. 2007;193(5):567-70. DOI: <http://dx.doi.org/10.1016/j.amjsurg.2007.01.006>
- Parvizi D, Friedl H, Wurzer P, Kamolz L, Lebo P, Tuca A, et al. A Multiple Regression Analysis of Postoperative Complications After Body-Contouring Surgery: a Retrospective Analysis of 205 Patients: Regression Analysis of Complications. *Obes Surg*. 2015;25(8):1482-90. DOI: <http://dx.doi.org/10.1007/s11695-014-1559-5>
- Bertheuil N, Thienot S, Huguier V, Ménard C, Waltier E. Medial thighplasty after massive weight loss: are there any risk factors for postoperative complications? *Aesth Plast Surg*. 2014;38(1):63-8. DOI: <http://dx.doi.org/10.1007/s00266-013-0245-7>
- Orpheu SC, Coltro PS, Scopel GA, Saito FL, Ferreira MC. Cirurgia do contorno corporal no paciente após perda ponderal maciça: experiência de três anos em hospital público secundário. *Rev Assoc Med Bras*. 2009;55(4):427-33. DOI: <http://dx.doi.org/10.1590/S0104-42302009000400018>
- Fraccalvieri M, Datta G, Bogetti P, Verna G, Pedrale R, Bocchiotti MA, et al. Abdominoplasty after weight loss in morbidly obese patients: a 4-year clinical experience. *Obes Surg*. 2007;17(10):1319-24. DOI: <http://dx.doi.org/10.1007/s11695-007-9235-7>
- Sanger C, David LR. Impact of significant weight loss on outcome of body-contouring surgery. *Ann Plast Surg*. 2006;56(1):9-13. DOI: <http://dx.doi.org/10.1097/01.sap.0000186512.98072.07>
- Vilà J, Balibrea JM, Oller B, Alastrué A. Post-bariatric surgery body contouring treatment in the public health system: cost study and perception by patients. *Plast Reconstr Surg*. 2014;134(4):448-54.
- Coon D, Michaels J 5th, Gusenoff JA, Purnell C, Friedman T, Rubin JP. Multiple procedures and staging in the massive weight loss population. *Plast Reconstr Surg*. 2010;125(2):691-8. PMID: 20124854 DOI: <http://dx.doi.org/10.1097/PRS.0b013e3181c87b3c>
- Taylor J, Shermak M. Body contouring following massive weight loss. *Obes Surg*. 2004;14(8):1080-5. DOI: <http://dx.doi.org/10.1381/0960892041975578>
- Espinosa-de-los-Monteros A, de la Torre JI, Rosenberg LZ, Ahumada LA, Stoff A, Williams EH, et al. Abdominoplasty with total abdominal liposuction for patients with massive weight loss. *Aesth Plast Surg*. 2006;30(1):42-6. DOI: <http://dx.doi.org/10.1007/s00266-005-0126-9>
- Giordano S, Victorzon M, Koskivuo I, Suominen E. Physical discomfort due to redundant skin in post-bariatric surgery patients. *J Plast Reconstr Aesthet Surg*. 2013;66(7):950-5. DOI: <http://dx.doi.org/10.1016/j.bjps.2013.03.016>
- Menderes A, Baytekin C, Hacıyanlı M, Yılmaz M. Dermalipectomy for body contouring after bariatric surgery in Aegean region of Turkey. *Obes Surg*. 2003;13(4):637-41. DOI: <http://dx.doi.org/10.1381/096089203322190880>
- Fotopoulos L, Kehagias I, Kalfarentzos F. Dermalipectomy following weight loss after surgery for morbid obesity. *Obes Surg*. 2000;10(5):451-9. DOI: <http://dx.doi.org/10.1381/096089200321593959>
- Canan Junior LW. Abdominoplastia após grandes perdas ponderais: análise crítica de complicações em 130 casos consecutivos. *Rev Bras Cir Plást*. 2013;28(3):381-8.
- Gmür RU, Banic A, Erni D. Is it safe to combine abdominoplasty with other dermalipectomy procedures to correct skin excess after weight loss? *Ann Plast Surg*. 2003;51(4):353-7. PMID: 14520060

31. Manassa EH, Hertl CH, Olbrisch RR. Wound healing problems in smokers and nonsmokers after 132 abdominoplasties. *Plast Reconstr Surg*. 2003;111(6):2082-7. DOI: <http://dx.doi.org/10.1097/01.PRS.0000057144.62727.C8>
32. Nemerofisky RB, Oliak DA, Capella JF. Body lift: an account of 200 consecutive cases in the massive weight loss patient. *Plast Reconstr Surg*. 2006;117(2):414-30. DOI: <http://dx.doi.org/10.1097/01.prs.0000197524.18233.bb>

***Corresponding author:**

Jefferson Lessa Soares de Macedo

SQS 213, Bloco H, Apto 303 - Asa Sul, Brasília, DF, Brazil

Zip Code 70292-080

E-mail: jls Macedo@yahoo.com.br