What Is the Impact of Comorbidities on the Risk for Postoperative Body-Contouring Surgery Complications in Postbariatric Patients?

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ORIGINAL CONTRIBUTIONS

What Is the Impact of Comorbidities on the Risk for Postoperative Body-Contouring Surgery Complications in Postbariatric Patients?

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Abstract

Background There is an increasing number of patients presenting after massive weight loss for plastic surgery, and many of these patients have residual diseases that may compromise outcomes. This study aims to evaluate the impact of comorbidities on the development of postoperative complications in postbariatric patients undergoing plastic surgery procedures at the Federal District North Wing Regional Hospital, Brasília, Brazil.

Methods Descriptive, analytical, and prospective study was performed on patients who underwent plastic surgery following RYGB from January 2011 to December 2016. Measures included BMI (body mass index) before RYGB and before plastic surgery, medical complications and comorbidities.

Results One hundred thirty-nine patients (130 female, 9 male) with a mean age of 41 years underwent 233 separate operations. The average BMI at the time of plastic surgery was 27.44 kg/m^2. The average weight loss was 47.02 kg, and the mean pre-weight-loss BMI (max BMI) was 45.17 kg/m^2. The most important pre-plastic comorbidities were arterial hypertension (11.5%), degenerative arthropathy (5.4%), diabetes mellitus (5.0%), and metabolic syndrome (4.3%). Of the 139 patients operated upon, 76.97% underwent abdominoplasty followed by mammoplasty (42.46%). The overall rate of complications was 26.65%. Initially, on univariate regression analyses, comorbidities influenced the development of postoperative complications. However, after multiple logistic regression, the most important comorbidities failed to predict an increased risk of complications.

Conclusion In this group of patients, with these anthropometric and clinical profiles, the most important comorbidities (diabetes, arterial hypertension, and metabolic syndrome) failed to influence the incidence of postoperative complications in postbariatric patients after plastic surgery.

Keywords Bariatric surgery · Plastic surgery · Abdominoplasty · Wound dehiscence · Body-contouring surgery · Postoperative complications

Introduction

Obesity is a disease of epidemic proportion, often associated with increased morbidity and mortality, as well as increased health spending and reduced quality of life and life expectancy [1]. The overall safety of bariatric surgery, represented by low rates of early and late complications (venous thromboembolism, surgical reintervention, prolonged hospitalization) and a mortality rate of 0.3%, together with significant improvement in comorbidities, justify its inclusion as an important strategy in the treatment of severe obesity [2, 3]. However, many patients are not prepared to deal with the excess skin resulting from massive weight loss, which can lead to a decline in quality of life and an increased risk of regaining the weight [4, 5].

Plastic surgery plays an important role in stabilizing the quality of life of patients experiencing massive weight loss after bariatric surgery and in maintaining and improving quality of life over the long term [6]. However, these postbariatric patients often present to plastic surgeon with residual medical comorbidities, nutritional deficiencies, and psychological problems that cause this group of patients to be at risk for

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postoperative complications [7, 8]. Complications in wound healing are common after body-contouring surgery in postbariatric patients, with studies showing rates ranging from 8 to 66%. These complications include seroma, infection, dehiscence, necrosis, lymphorrhea, asymmetry, and thrombosis [9, 10].

This study aims to evaluate the impact of comorbidities on the development of postoperative complications in postbariatric patients undergoing plastic surgery procedures. In addition, this study aims to present the anthropometric and clinical profiles of patients undergoing postbariatric plastic surgery.

Methods

We carried out a prospective study at a public reference hospital for bariatric surgery, with individuals who underwent Roux-en-Y gastric bypass (RYGB) and were subsequently operated on for body contouring from 2011 to 2016, following massive weight loss. The same team performed all operations at the Regional Hospital of Asa Norte, Brasília, DF, Brazil.

Patients with BMI > 40 kg/m^2 or with BMI > 35 kg/m^2 and associated comorbidities who underwent bariatric surgery according to international standards were included. In addition, all patients had previous attempts at weight loss for at least 2 years, absence of serious clinical diseases identified by preoperative exams, absence of severe psychopathologies, absence of illicit drug use and alcoholism, aged between 18 and 65 years, and had the ability to understand the explanations about the implications of the surgical procedure. Following bariatric surgery, the patients were followed up by the multidisciplinary team until weight stabilization and control of comorbidities were achieved, then they were referred to the plastic surgery outpatient clinic.

The percentage of excess weight loss (%EWL) was obtained using the following formula: %EWL = percentage of body weight loss in relation to excess weight. Excess weight was calculated by subtracting the initial weight from ideal weight. The BMI variation (ΔBMI) was calculated as the difference between the maximum BMI before the bariatric surgery and the BMI at the moment of the plastic surgery [2, 11].

Inclusion criteria for postbariatric plastic surgery were as follows: weight stability for at least 6 months after achieving the goal of weight loss for each case; absence of illicit drug use or alcoholism; absence of moderate or severe psychotic features; and an understanding of the need for weight maintenance and postoperative follow-up with a multidisciplinary team throughout life.

Exclusion criteria were smoking, gestational intention, weight instability with no maintenance of weight for 6 months, individuals who did not sign the informed consent form (ICF), patients undergoing other bariatric procedures after RYGB, and patients with postoperative follow-up of < 12 months.

All patients received non-drug thromboprophylaxis, such as early ambulation and lower limb bandaging. We performed bladder catheterization, with catheter removal on the first postoperative day, and prophylactic antibiotic therapy with 2 g of IV cefazolin with anesthetic induction.

For the diagnosis of systemic arterial hypertension, dyslipidemias, type 2 diabetes mellitus, and metabolic syndrome, we used the parameters listed in the respective guidelines of the Brazilian Society of Cardiology and those currently described in the First Brazilian Guideline for Diagnosis and Treatment of Metabolic Syndrome [11, 12]. We diagnosed hepatic steatosis using preoperative abdominal ultrasonography.

The complications evaluated included hematomas, seromas, dehiscence, tissue necrosis, deep venous thrombosis, and pulmonary embolism. According to the Clavien-Dindo classification, postoperative complications were categorized as major whenever they presented a grade equal to or greater than 3 and as minor whenever the grade was lower than 3. Major complications were those requiring a new surgical procedure for hematoma drainage, seroma drainage, suturing of dehiscence areas, or rehospitalization for systemic antibiotic therapy [13].

The variables analyzed prior to plastic surgery included age, gender, weight, height, BMI before bariatric surgery, BMI before plastic surgery, total weight loss, and complication rate. After bariatric surgery, we considered comorbidities resolved when they were controlled without medication and improved when they were controlled by reduced doses of medication.

We performed statistical analyses using SPSS software version 21.0 (Statistical Package for Social Studies, IBM Corp., Armonk, NY). We describe the continuous variables using the mean and standard deviation and categorical variables with relative frequencies. We evaluated the normality of the variables with the Kolmogorov-Smirnov test. We performed the comparisons between groups with the chi-square test for the dichotomous variables, the Student's t test for continuous variables with normal distribution, and the Mann-Whitney U test for continuous variables without normal distribution. The minimum acceptable significance level was 5% ($p < 0.05$).

We conducted this research in accordance with the resolution of the National Health Council number 466, dated December 12, 2012. All individuals involved in this study were informed and signed the ICF for execution of consent. In the present study, there were no conflicts of interest. The project was approved by the Ethics in Research Committee of the Health Department of the Federal District, number CAAE 52738216.5.0000.5553.

Results

There were 154 patients that looked for surgery in the Plastic Surgery Department of North Wing Regional Hospital, Brasília, DF. Fourteen patients were excluded of the study based on the exclusion criteria (4 patients for smoking habits, 2 patients for gestational intention, and 9 patients for instability of the weight). No patient was excluded for uncontrolled medical comorbidities. Therefore, 139 patients were included in this study, following the inclusion criteria.

All 139 patients underwent plastic surgery procedures following RYGB. In relation to RYGB: 57.55% (80 patients) by laparoscopy and 42.45% (59 patients) by laparotomy. The mean age was 41.18 years ± 9.63 (range 22 to 66). As shown in Table 1, women were most frequently operated upon. The majority of patients came from the Federal District. All 139 patients return for the 6-month postplastic surgery follow-up, and there were no missing data points. Only 11 patients needed a telephone call to return, and two patients needed domiciliar visit to complete the follow-up.

The most frequent age group was 40 to 49 years, followed by 30 to 39 years, together representing 71.3% of the patients. Patients who were married or with stable partners were the most observed, followed by singles. Regarding schooling, patients with a median level predominated, followed by the fundamental level, together comprising 86.3% of the sample. The mean time interval between bariatric surgery and the postbariatric plastic surgery was 42.51 ± 28.20 months. Patients underwent plastic surgery more frequently between 25 and 48 months, followed by 18 to 24 months, together representing 74% of the sample (Tables 1 and 2).

The mean maximum BMI before bariatric surgery was 45.17 ± 7.99 kg/m^2. Table 3 shows that patients undergoing bariatric surgery were often morbidly obese, followed by patients classified as grade II obesity, together representing 100% of the sample. Before postbariatric plastic surgery, the mean BMI was 27.44 ± 3.79 kg/m^2.

The mean percentage of excess weight loss (%EWL) was 79.15 ± 13.01. We also observed that patients who underwent postbariatric plastic surgery were more frequently overweight, followed by patients with normal BMI, together comprising 75.6% of the sample.

The difference between the maximum BMI before bariatric surgery and the BMI before plastic surgery was 18.25 ± 8.83. Of the patients, 29.5% (41/139) presented a BMI variation greater than 20. The mean weight loss before repair was 47.02 ± 17.28 kg. The mean maximum weight before bariatric operation was 119.98 ± 23.76 kg (Table 2). The mean weight before plastic surgery was 72.97 ± 12 kg; 33.8% (47/139) of the patients had a weight loss equal to or greater than 50 kg.

Table 4 shows the diseases present before bariatric surgery. We observed that the most frequent comorbidities were

Table 1 Distribution by gender, origin, age groups, marital status, and education level of postbariatric patients undergoing reconstructive plastic surgery in the Asa Norte Regional Hospital, Brasília, DF, from 2011 to 2016

	Variables	*N*	%
Gender			
	Female	130	93.5
	Male	9	6.5
Origin			
	DF	127	91.4
	Out of the DF	12	8.6
Age (years)			
	< 30	15	10.7
	30–39	44	31.7
	40–49	55	39.6
	= 50	25	18.0
Marital status			
	Married	86	61.9
	Single	40	28.8
	Divorced	9	6.4
	Widowed	4	2.9
Schooling			
	College	16	11.5
	High school	72	51.8
	Essential	48	34.5
	Illiterate	3	2.2
Time interval (months)[a]			
	18–24	40	28.7
	25–48	63	45.3
	49–72	25	18
	> 72	11	9

[a] Time interval between bariatric surgery and plastic surgery

Table 2 Profile of the patients before plastic surgery (*N* = 139)

Variable	(mean ± SD)
Age (year)	41.18 ± 9.63
Pre-massive-weight-loss BMI[a]	45.17 ± 7.99
Pre-plastic BMI[a]	27.44 ± 3.79
Weight before massive weight loss (kg)	119.98 ± 23.76
Weight before plastic surgery (kg)	72.97 ± 12.02
Weight loss (kg)	47.02 ± 17.28
ΔBMI[a]	18.25 ± 8.83
%EWL[b]	79.15 ± 13.01
Time interval (months)[c]	42.51 ± 28.20

[a] *BMI*, body mass index (kg/m^2); Δ*BMI*, change in BMI was calculated by subtracting current BMI from Max BMI

[b] *%EWL*, percentage of excess weight loss (%)

[c] Time interval between the gastric bypass and plastic surgery

Table 3 Distribution of patients according to the degree of obesity determined by body mass index before gastric bypass and before plastic surgery

BMI (kg/m^2)*	Before gastric bypass *n* (%)	Before plastic surgery *n* (%)
< 25 (normal)	0	32 (23.1)
25.0–29.9 (overweight)	0	73 (52.5)
30.0–34.9 (grade I)	0	31 (22.3)
35.0–39.9 (grade II)	30 (21.6)	1 (0.7)
≥ 40.0 (grade III)	109 (78.4)	2 (1.4)
Total	139 (100.0)	139 (100.0)

metabolic syndrome and arterial hypertension, followed by arthropathy, depression/anxiety, and diabetes mellitus. Obstructive sleep apnea, esophagitis, and dyslipidemia were the less common comorbidities.

The vast majority of patients reported improvement or complete resolution of the various comorbidities after surgical treatment for obesity. However, as shown in Table 4, some patients still had diseases at the time of the postbariatric plastic surgery, mainly depression/anxiety and hypertension. Other comorbidities presented with low frequency, such as arthropathy, diabetes, metabolic syndrome, esophagitis, obstructive sleep apnea, and dyslipidemia. A third of the patients (33.8%, 47/139) had undergone cholecystectomy prior to plastic surgery.

With regard to the number of daily medications that patients used before bariatric surgery, the mean was 4.17 ± 3.17. After bariatric surgery, the mean decreased to 1.75 ± 1.33 ($p < 0.001$, 95% confidence interval (CI), 3.64–4.69).

Seventy-three (52.5%) patients underwent a single plastic surgery, 49 (35.3%) had two, and 17 (12.2%) had three or more procedures. The mean number of plastic surgery procedures per patient was 1.60 ± 0.74 (ranging from one to four surgical procedures per patient). One hundred twenty-three patients (88.5%) underwent only one surgical procedure per stage; 16 (11.5%) had associated operations in the same surgical procedure, that is, two or more surgical procedures per stage. Table 5 presents the procedures associated with postbariatric plastic surgery. We observed that the majority of patients underwent abdominoplasty, the classic technique being the most used, followed by the anchor technique, and together, these techniques represented 77.0% of the procedures. Six patients had incisional hernias and eight had umbilical hernias, representing 13.1% of the patients undergoing abdominoplasty. We performed the herniorrhaphy along with the abdominoplasty. Table 5 also shows the techniques of mastoplasty. Mastopexy with prosthesis was the most frequently used, followed by reductive mastoplasty, and together, these techniques accounted for 42.5% of the procedures.

As for the other less frequent surgical procedures, we performed facial plastic surgery (rhytidectomy) in 18.0% (25/139) of the patients, arm plastic surgery (brachioplasty) in 14.4% (20/139), and thigh plastic surgery (cruroplasty) in 9.4% (13/139) (Table 5).

The mean weight of the flap of the abdomen removed in the abdominoplasty was 1985.51 g ± 1268.32 (range 350–7880 g). Abdominal flaps weighing 1000 to 1999 g were the most frequent, followed by those from 2000 to 3000 g, together accounting for 70% of the sample. The flaps weighing < 1000 g comprised 17.8% of the samples, and flaps weighing > 3000 g constituted 12.2% of the samples.

As for the volume of the mammary implant used in mastoplasties with prosthesis or augmentation, the mean was 268.62 ml ± 40.33 (range 175–355 ml).

Regarding the complications of the postbariatric plastic surgery, the minor complications were more frequent than the major ones. The overall complication rate was 26.7% (37/139). The major complication rate was 9.4% (13 patients), consisting of five cases of dehiscence with need for resection, three cases of seroma requiring reoperation, three cases of internal hernia with intestinal obstruction, and two cases of

Table 4 Distribution of patients according to the presence of associated diseases before and after gastric bypass

Associated diseases	Before gastric bypass *n* (%)	After gastric bypass *n* (%)	*p* value	x^2
Metabolic syndrome	73 (52.5)	6 (4.3)	0.017	21.02
Hypertension	71 (51.1)	15 (10.8)	< 0.001	53.02
Arthropathy	56 (40.3)	8 (5.8)	< 0.001	46.01
Diabetes mellitus	50 (36.0)	7 (5.0)	< 0.001	41.02
Sleep apnea	31 (22.3)	2 (1.4)	0.008	27.04
Esophagitis	30 (21.6)	4 (2.9)	< 0.001	24.04
Dyslipidemia	29 (20.9)	2 (1.4)	0.006	25.04

Table 5 Distribution of surgical procedures performed in postbariatric patients operated in the North Wing Regional Hospital, Brasília, DF, from 2011 to 2016

Surgical procedures	*N*	%
Abdominoplasty		
Classic	80	57.6
Anchor	27	19.4
Mastoplasty		
With prosthesis	44	31.7
Reductive	15	10.8
Augmentation	11	7.9
Rhytidoplasty	25	18.0
Brachioplasty	20	14.4
Cruroplasty	13	9.4
Total of patients	139	
Total of procedures	235	

wound infection requiring treatment with intravenous antibiotic therapy. The rate of minor complications was 17.3% (24 patients), comprising seven cases of dehiscence without need for resection, seven cases of seroma requiring repeated punctures, six cases of hematoma with drainage or spontaneous resolution, and four cases of wound infection requiring treatment with oral antibiotic therapy alone.

The mean surgical time was 3 h and 10 min and ranged from 160 to 270 min. Vacuum drains were used in all abdominoplasty cases.

General anesthesia was used in 119 patients (85.6%) and epidural was used in 20 (14.4%).

Mean hospitalization time was 2 days in 128 (92.1%) cases, with only 11 (7.9%) patients remaining hospitalized longer. We followed patients for at least 6 months postoperatively. There were no cases of deep venous thrombosis, pulmonary embolism, or deaths in the present study.

Patients with comorbidities prior to plastic surgery, particularly diabetes, arterial hypertension, dyslipidemia, and metabolic syndrome, had more frequent postoperative complications from plastic surgery compared to patients who did not have these diseases. On univariate analysis, these differences were significant, except in the case of arterial hypertension ($p = 0.212$) (Table 6). However, when we combined patients with diabetes and/or arterial hypertension, the difference was significant ($p = 0.004$) (Table 6).

With the multivariate analysis, we observed that the presence of diabetes, arterial hypertension, and metabolic syndrome were not significantly associated with the development of postoperative complications from plastic surgery in postbariatric patients (Table 7).

Discussion

A common sequela of successful weight loss after bariatric surgery that remains stigmatized is excess skin and soft tissues. Body-contouring plastic surgery promotes social and psychological reintegration for these patients. In addition, plastic surgery procedures after gastric bypass aim to optimize the functional results obtained by bariatric surgery by removing excess skin [6, 9].

The present study showed that most of the patients were women, as shown in other studies [9, 14–17]. Likewise, the mean age of 41 years was similar to other studies [15, 16, 18] but was below the age of 48 years old shown in other studies [9, 19]. The mean BMI before plastic surgery of 27.4 kg/m^2 was similar to that found by other authors [9, 14–16] but well below the BMI of 35.6 kg/m^2 verified by Shermak et al. [19] Likewise, the mean ΔBMI of our patients, 18.25 ± 8.83 kg/m^2, was below the 20.7-kg/m^2 and 22.3-kg/m^2 average values verified in other studies [14, 20]. The mean weight loss before the restorative plastic surgery of 47 kg was similar to that verified by Kervilier et al. [9] However, this was below the 51 to 53 kg found in other studies [15, 21].

Overweight individuals undergoing plastic surgery accounted for 52.5% of the sample population, those with a normal BMI accounted for 23.1%, and patients with residual obesity accounted for 24.4%, similar to the data of Orpheu et al. [16], in which overweight individuals represented 56.1% of the cohort and patients with BMI > 30 accounted for 27.5%.

There was a significant reduction in comorbidities after bariatric surgery, and at the time of plastic surgery, 5.7% of the patients persisted with diabetes mellitus and only 11.5% had systemic arterial hypertension, a reduction of 77.5% for all hypertensive patients, similar to that found by other authors [15, 20]. For patients with diabetes, RYGB proved to be very effective in controlling the glycemic levels of diabetic patients with obesity, resulting in complete remission in most patients. In our study, we found a rate of complete diabetes remission of 86.1% of those operated on, similar to other authors who reported rates of remission ranging from 83 to 85% [2, 22]. In an American study, the prevalence of comorbidities was higher, reaching 32.5% of arterial hypertension and 15% of diabetes [19].

Other comorbidities associated with obesity also displayed significant decreases in the study patients, especially dyslipidemia, metabolic syndrome, and sleep apnea syndrome. The remission rates of these diseases were above 90%, similar to those of other studies [14, 20]. This significant improvement in comorbidities directly reflects the drop in the number of pills and medications used by patients after bariatric surgery, as evidenced in our study.

Table 6 Univariate analysis of comorbidities and the development of postoperative complication after plastic surgery following gastric bypass

Variable	Frequency ($N = 139$)	Prevalence of complication after plastic surgery (%)	p value	OR	95%CI
Diabetes					
No	132	25.76	–	–	–
Yes	7	57.14	0.027†	2.22	[1.10; 4.49]
Arterial hypertension					
No	124	25.81	–	–	–
Yes	15	40.00	0.212	1.55	[0.78; 3.08]
Dyslipidemia					
No	137	26.28	< 0.001†	3.81	[2.88; 5.04]
Yes	2	100.00			
Metabolic syndrome					
No	133	25.56	–	–	–
Yes	6	66.67	0.026†	2.07	[1.09; 3.94]
Diabetes/hypertension[a]					
No	117	23.08			
Yes	22	45.45	0.004†	2.23	[1.29; 3.86]

[a] Presence of diabetes and/or hypertension

† $p < 0.05$

The 42-month mean time between bariatric surgery and restorative plastic surgery was similar to the 47 months seen in another national study [16], but higher than the 22 months described in other studies [19, 21].

In patients undergoing abdominoplasty, the technique chosen was determined by the type of abdominal deformity presented by each patient, in consideration of the patient's opinion and preferences. Where there was a transverse excess of

Table 7 Multivariate analysis of comorbidities of the development of postoperative complication after plastic surgery following gastric bypass

Variable	Frequency ($N = 139$)	Prevalence of complication after plastic surgery (%)	p value	OR	95%CI
Diabetes					
No	132	25.76	–	–	–
Yes	7	57.14	0.813	1.07	[0.61; 1.87]
Dyslipidemia					
No	137	26.28			
Yes	2	100.00	0.003†	1.86	[1.24; 2.81]
Metabolic syndrome					
No	133	25.56	–	–	–
Yes	6	66.67	0.917	1.05	[0.43; 2.54]
Diabetes/hypertension[a]					
No	117	23.08	–	–	–
Yes	22	45.45	0.813	1.07	[0.61; 1.87]

[a] Presence of diabetes and/or hypertension

† $p < 0.05$

skin flaccidity, we performed the anchor abdominoplasty. When the abdominal contour deformity was primarily the excess of vertical flaccidity, we performed a conventional abdominoplasty with a suprapubic transversal scar.

Abdominoplasty was frequently associated with other surgical procedures. Studies indicate an association of abdominoplasty with other surgical procedures (brachioplasty and mastoplasty) in up to 40% of patients, without a significant increase in the rate of postoperative complications [14, 19].

The overall postoperative complication rate in postbariatric patients was 27%, similar to the studies by Kervilier et al. [9], but less than other studies with rates ranging from 35 to 50% [14–16, 19, 21]. Suture dehiscence was the main complication, followed by seroma, as observed in other studies [9, 14, 19].

There were no thromboembolic events, but other studies indicate an incidence rate of 0.3 to 1% [16, 23]. The need for preventive measures is a constant concern among the authors, who recommend devices for intermittent compression of the calf intraoperatively, as well as early ambulation and reduction of surgical time. The low rate of major complications in this study, such as thromboembolic events, flap necrosis, and the low number of reoperations may be associated with the low number of associated surgeries. Studies with the highest rates of complications generally had a higher percentage of associated procedures [14, 19]. The association of operations leads to increased surgical time (> 6 h), greater blood loss and need for blood transfusions, factors that may increase the rate of postoperative complications [14, 23].

In the present study, 88.5% of the patients underwent only one surgical procedure per stage, and only 11.5% had associated operations in the same surgical procedure. We usually do not recommend associated surgical procedures, except in selected cases, and then only after careful analysis of clinical, nutritional, emotional, and social conditions. We also advocated and prioritized non-pharmacological preventive management for deep venous thrombosis by reduced surgical time, early ambulation, and good preoperative patient preparation. Another important factor that may have contributed to a lower rate of complications was the low prevalence of comorbidities at the time of postbariatric plastic surgery. Coon et al. [23] studied 449 postbariatric patients with a complication rate of 41.8%; however, the prevalence of systemic arterial hypertension was 44.2% and diabetes was 22.3%. In the same study, more than 50% of patients who sought plastic surgery had residual obesity, whereas in our study, only 24.4% had residual obesity at the time of plastic surgery.

In accordance with other studies, comorbidities in our study were poor predictors of complications in postbariatric patients [14, 17, 24]. Initially, on univariate regression, comorbidities influenced the development of postoperative complications (Table 6). However, after multiple logistic regressions were performed, the most important comorbidities failed to predict an increased risk of complications, with the exception of dyslipidemia (Table 7). One possible reason for this was the decreased necessity of drugs to control the residual disease after bariatric surgery. Following bariatric surgery, the prevalence of residual diseases was low and easily controlled with the use of drugs at a low dosage. Therefore, these comorbidities were easily controlled and did not increase the risk of development of postoperative complications in these patients after plastic surgery.

On the other hand, the impact of comorbidities on outcomes following plastic surgery procedures remains controversial, especially in non-postbariatric patients. In a retrospective analysis of outcomes following 25.478 abdominoplasties, Winocour et al. [25] concluded that diabetes mellitus was not a significant risk factor for major complications in non-postbariatric patients. Similarly, Greco et al. [26] did not find diabetes mellitus alone to be a significant predictor of complications following abdominoplasty and panniculectomy. Interestingly, another studies with non-postbariatric patients showed that patients with metabolic syndrome or diabetes mellitus undergoing abdominoplasty were at a significantly higher risk of developing postoperative complications [27, 28].

AlQataan et al. [29] reported that non-postbariatric grade III obesity patients were at significantly increased risk of adverse outcomes following abdominal contouring. Patients with grade III obesity had higher rates of comorbidities. Postoperatively, patients with grade III obesity were more likely to develop wound complications. On risk-adjusted multivariate regression analysis, it found that non-postbariatric grade III obesity patients were independently associated with greater risk of wound complications, sepsis, medical adverse events, unplanned reoperations, and 30-day readmission [29].

Furthermore, a chart review performed by Zannis et al. [30] evaluating postoperative complications in 563 non-postbariatric patients who underwent a panniculectomy found that wound complications were associated with a significantly higher BMI than non-postbariatric patients without wound complications (43.7 vs. 30.7%; $p < 0{,}0001$). Zannis found that patients with a BMI between 40 and 49 were 3.4 times more likely to develop wound complications compared to the reference group (BMI < 30). In our study, a prospective cohort study on 139 patients who underwent postbariatric plastic surgery procedures, we reported that patients with BMI > 30 had not a greater risk of postoperative complications compared to the reference group (BMI < 30). Thus, patients meeting criteria for bariatric surgery (BMI > 40, BMI 35–39.9 with at least one obesity-related comorbidity and BMI 30–34.9 with uncontrolled diabetes mellitus or metabolic syndrome) can be referred for evaluation to a bariatric surgeon prior to proceeding with plastic surgery procedures, specially panniculectomy or abdominoplasty.

Prior to undergoing any procedures in plastic surgery, thorough preoperative planning and appropriate treatment

selection are fundamental to a successful outcome. A systematic approach is ideal in addressing each area of the patient's body and quantifying the level of deformity in each particular region. In addition, concurrent procedures can be justified in well-selected patients with well-controlled comorbidities.

The limitations of our study include reduced sample size of the postbariatric patients with comorbidities after RYGB and the fact the study was conducted in a single institution. Our results may therefore not be representative of every practice setting. These limitations are commonly reported in the literature for this kind of prospective study. However, studies with larger sample size are crucial to determine the impact of comorbidities on the development of postoperative complications in postbariatric patients undergoing plastic surgery procedures.

In this group of patients with these anthropometric and clinical profiles, the most important comorbidities (diabetes, arterial hypertension, and metabolic syndrome) failed to influence the incidence of postoperative complications in postbariatric patients after plastic surgery.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

References

1. World Health Organization (WHO). Obesity: preventing and managing the global epidemic – report of a WHO consultation on obesity. Geneva: WHO; 2000 [Technical Report Series Number 894].
2. Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systemic review and meta-analysis. JAMA. 2004;292(14):1724–37.
3. Flum DR, Belle SH, King WC, et al. Longitudinal assessment of bariatric surgery consortium. Perioperative safety in the longitudinal assessment of bariatric surgery. N Engl J Med. 2009;361:445–54.
4. Kitzinger HB, Abayev S, Pittermann A, et al. The prevalence of body contouring surgery after gastric bypass surgery. Obes Surg. 2012;22:8–12.
5. Ramalho S, Bastos AP, Silva C, et al. Excessive skin and sexual function: relationship with psychological variables and weight regain in women after bariatric surgery. Obes Surg. 2015;25:1149–54.
6. Beek ESJ, Geenen R, Heer FAG, et al. Quality of life long-term after body contouring surgery following bariatric surgery: sustained improvement after 7 years. Plast Reconstr Surg. 2012;130:1133–9.
7. Michaels VJ, Coon D, Rubin JP. Complications in postbariatric body contouring: strategies for assessment and prevention. Plast Reconstr Surg. 2011;127:1352–7.
8. Pavan C, Marini M, Antoni E, et al. Psychological and psychiatric traits in post-bariatric patients asking for body-contouring surgery. Aesthet Plast Surg. 2017;41:90–7.
9. Kerviler S, Husler R, Banic A, et al. Body contouring surgery following bariatric surgery and dietetically induced massive weight reduction: a risk analysis. Obes Surg. 2009;19:553–9.
10. Naghshineh N, O'Brien Coon D, McTigue K, et al. Nutritional assessment of bariatric surgery patients presenting for plastic surgery: a prospective analysis. Plast Reconstr Surg. 2010;126:602–10.
11. Novais PFS, Rasera Jr I, Leite CVS, et al. Body weight evolution and classification of body weight in relation to the results of bariatric surgery: Roux-en-Y gastric bypass. Arch Endocrinol Metab. 2010;54:303–10.
12. Brazilian Society of Cardiology. Brazilian Society of Hypertension; Brazilian Society of Nefrology. VI Brazilian Guidelines on Hypertension. Arq Bras Cardiol. 2010;95:1–51.
13. Clavien PA, Barkun J, De Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg. 2009;250:187–96.
14. Coon D, Michaels VJ, Gusenoff JA, et al. Multiple procedures and staging in the massive weight loss population. Plast Reconstr Surg. 2010;125:691–8.
15. Arthurs ZM, Cuadrado D, Sohn V. Postbariatric panniculectomy: pre-panniculectomy body mass index impacts the complication profile. Am J Surg. 2007;193:567–70. discussion 570
16. Orpheu SC, Colins PS, Scpel GA, et al. Body contour surgery in the massive weight loss patient: three year-experience in a secondary public hospital. Rev Assoc Med Bras. 2009;55:427–33.
17. Parvizi D, Friedl H, Wurzer P, et al. A multiple regression analysis of postoperative complications after body-contouring surgery: a retrospective analysis of 205 patients. Obes Surg. 2015;25:1482–90.
18. Masoomi H, Rimler J, Wirth GA, et al. Frequency and risk factors of blood transfusion in abdominoplasty in post-bariatric surgery patients: data from the nationwide inpatient sample. Plast Reconstr Surg. 2015;135:861e–8e.
19. Shermak MA, Chang D, Magnuson TH, et al. An outcomes analysis of patients undergoing body contouring surgery after massive weight loss. Plast Reconstr Surg. 2006;118:1026–31.
20. Schmid H, Goelzer Neto CF, Dias LS, et al. Metabolic syndrome resolution by Roux-en-Y gastric bypass in a real world: a case control study. Rev Assoc Med Bras. 2015;61:161–9.
21. Poyatos JV, Castillo JM, Sales BO, et al. Postbariatric surgery body contouring treatment in the public health system: cost study and perception by patients. Plast Reconstr Surg. 2014;134:448–54.
22. Lopes EC, Heineck I, Athaydes G, et al. Is bariatric surgery effective in reducing comorbidities and drug costs? A systematic review and meta-analysis. Obes Surg. 2015;25:1741–9.
23. Coon D, Gusenoff JA, Kannan N, et al. Body mass and surgical complications in the postbariatric reconstructive patient: analysis of 511 cases. Ann Surg. 2009;249:397–401.
24. Bertheuil N, Thienot S, Huguier V, et al. Medial thighplasty after massive weight loss: are there any risk factors for postoperative complications? Aesthet Plast Surg. 2014;38:63–8.
25. Winocour J, Gupta V, Ramirez JR, et al. Abdominoplasty: risk factors, complications rates and safety of combined procedures. Plast Reconstr Surg. 2015;136:597e–606e.
26. Greco JA, Castaldo ET, Nanney LB, et al. The effect of weght loss surgery and body mass index on wound complications after abdominal contouring operations. Ann Plast Surg. 2008;61:235–42.
27. Hensel JM, Lehman Jr JA, Tantri MP, et al. Analysis and satisfaction surgery of 199 consecutive abdominoplasties. Ann Plast Surg. 2001;46:357–63.
28. Bamba R, Gupta V, Shack RB, et al. Evaluation of diabetes mellitus as a risk factor for major complications in patients undergoing aesthetic surgery. Aesthet Surg J. 2016;36:598–608.
29. AlQataan HT, Mundra LS, Rubio GA, et al. Abdominal contouring outcomes in class III obesity: analysis of the ACS-NSQIP database. Aesthet Plast Surg. 2018;42:13–20.
30. Zannis J, Wood BC, Griffin LP, et al. Outcomes study of the surgical management of panniculitis. Ann Plast Surg. 2012;68:194–7.