Roux-en-y gastric bypass improves in short term the clinical-anthropometric parameters and reduces risk for obesity-related cardiometabolic diseases

Bypass gástrico roux-en-y melhora a curto prazo os parâmetros clínico-antropométricos e reduz o risco de doenças cardiometabólicas relacionadas à obesidade

DOI:10.34117/bjdv7n7-503

Recebimento dos originais: 07/06/2021
Aceitação para publicação: 23/07/2021

Thiago da Rosa Lima Ph.D
Federal University of Mato Grosso. Cuiabá. Mato Grosso. Brazil; Graduation Program in Health Sciences. Faculty of Medicine. Brazil.
University Center of Várzea Grande. Várzea Grande. Mato Grosso, Brazil. Federal University of Mato Grosso - Fernando Correa da Costa Avenue, nº 2367 - District: Boa Esperança Postal Code: 78060-900- Cuiabá – Mato Grosso, Brazil; Phone number: (+55) 65 98157-773 https://orcid.org/0000-0001-8544-6797
E-mail: limars.thiago@gmail.com

Paula Caroline de Almeida M.Sc
Federal University of Mato Grosso. Cuiabá. Mato Grosso. Brazil; Graduation Program in Health Sciences. Faculty of Medicine. Brazil.
Federal University of Mato Grosso - Fernando Correa da Costa Avenue, nº 2367 District: Boa Esperança - Postal Code: 78060-900 - Cuiabá – Mato Grosso, Brazil;
E-mail: limars.thiago@gmail.com

Fabrício Azevedo Voltarelli Ph.D
Federal University of Mato Grosso. Cuiabá. Mato Grosso. Brazil; Graduation Program in Health Sciences. Faculty of Medicine. Brazil.
Federal University of Mato Grosso - Fernando Correa da Costa Avenue, nº 2367 District: Boa Esperança - Postal Code: 78060-900 - Cuiabá – Mato Grosso, Brazil;
E-mail: limars.thiago@gmail.com

Lilian Culturato B.Sc
University Center of Várzea Grande. Várzea Grande. Mato Grosso, Brazil.
Federal University of Mato Grosso - Fernando Correa da Costa Avenue, nº 2367 District: Boa Esperança - Postal Code: 78060-900 - Cuiabá – Mato Grosso, Brazil;
E-mail: limars.thiago@gmail.com

Eudes Thiago Pereira Ávila M.Sc
Federal University of Mato Grosso. Cuiabá. Mato Grosso. Brazil; Graduation Program in Health Sciences. Faculty of Medicine. Brazil.
Federal University of Mato Grosso - Fernando Correa da Costa Avenue, nº 2367 District: Boa Esperança - Postal Code: 78060-900 - Cuiabá – Mato Grosso, Brazil;
E-mail: limars.thiago@gmail.com

Wender Junior de Deus Silva B.Sc[2],
University Center of Várzea Grande. Várzea Grande. Mato Grosso, Brazil.
Federal University of Mato Grosso - Fernando Correa da Costa Avenue, nº 2367
District: Boa Esperança - Postal Code: 78060-900 - Cuiabá – Mato Grosso, Brazil;
E-mail: limars.thiago@gmail.com

James Wilfred Navalta Ph.D[3],
University of Nevada-Las Vegas, Las Vegas, Nevada, USA.
Federal University of Mato Grosso - Fernando Correa da Costa Avenue, nº 2367
District: Boa Esperança - Postal Code: 78060-900 - Cuiabá – Mato Grosso, Brazil;
E-mail: limars.thiago@gmail.com

Amilcar Sabino Damazo Ph.D
Federal University of Mato Grosso. Cuiabá. Mato Grosso. Brazil; Graduation Program in Health Sciences. Faculty of Medicine. Brazil.
Federal University of Mato Grosso - Fernando Correa da Costa Avenue, nº 2367
District: Boa Esperança - Postal Code: 78060-900 - Cuiabá – Mato Grosso, Brazil;
E-mail: limars.thiago@gmail.com

ABSTRACT

BACKGROUND: Roux-en-Y gastric bypass surgery (RYGB) is the most applied technique in the treatment of severe obesity worldwide. However, its impact on anthropometric parameters and the risk for cardiometabolic diseases in obese patients is uncertain. **OBJECTIVE:** To evaluate anthropometric clinical parameters and the evolution of risk factors for obesity-related diseases in individuals of both sexes undergoing RYGB. **METHODOLOGY:** Sixty-nine adults subjects from both sexes submitted to RYGB surgery treatment were divided into 3 groups: G1(<13 months, n=24); G2 (>13 and <25 months, n=21), and G3 (>25 and <37 months, n=24). Sociodemographic and anthropometric information before and after surgery were collected. The abdominal perimeter was used in the classification of cardiometabolic risk and the BMI was used for the risk of obesity-related diseases. Hypotheses were tested by Student's t-test and ANOVA, and the significance level adopted was 5%. **RESULTS:** The average age was 36.0±10.0 years, with 69.6% being male and 30.4% female. Anthropometric parameters (weight, BMI, and abdominal circumference) were higher among women, except for weight loss and percentage of weight loss. There was a difference in weight loss between the sexes in the moments before and after RYGB. There was a decrease in the risk of disease due to obesity and cardiovascular diseases after RYGB. Weight loss and %WL were greater years by year in the short term of 3 years after surgery. **CONCLUSION:** RYGB proved to be an effective strategy for both sexes in combating obesity, providing in the short term a significant improvement in clinical-anthropometric parameters and reduction of risk factors for obesity-related cardiometabolic diseases.

keywords: Bariatric Surgery, Severe obesity, Nutritional and metabolic diseases.

RESUMO

INTRODUÇÃO: cirurgia de bypass gástrico em Y-de-Roux (BGYR) é a técnica mais aplicada no tratamento da obesidade grave em todo o mundo. No entanto, seu impacto sobre os parâmetros antropométricos e o risco de doenças cardiometabólicas em pacientes

obesos é incerto. **OBJETIVO:** Avaliar os parâmetros clínicos antropométricos e a evolução dos fatores de risco para doenças relacionadas à obesidade em indivíduos de ambos os sexos submetidos ao BGYR. **METODOLOGIA:** Sessenta e nove indivíduos adultos de ambos os sexos submetidos ao tratamento cirúrgico com BGYR foram divididos em 3 grupos: G1 (<13 meses, n = 24); G2 (> 13 e <25 meses, n = 21) e G3 (> 25 e <37 meses, n = 24). Foram coletadas informações sociodemográficas e antropométricas antes e após a cirurgia. O perímetro abdominal foi utilizado para a classificação do risco cardiometabólico e o IMC para o risco de doenças relacionadas à obesidade. As hipóteses foram testadas pelo teste t de Student e ANOVA, e o nível de significância adotado foi de 5%. **RESULTADOS:** A média de idade foi de 36,0±10,0 anos, sendo 69,6% do sexo masculino e 30,4% do feminino. Os parâmetros antropométricos (peso, IMC e circunferência abdominal) foram maiores entre as mulheres, exceto para perda de peso e %PP. Houve diferença na perda de peso entre os sexos nos momentos antes e depois do BGYR. Houve diminuição do risco de doenças por obesidade e doenças cardiovasculares após o BGYR. A perda de peso e %PP foram maiores ano a ano no curto prazo (3 anos após a cirurgia). **CONCLUSÃO:** O BGYR demonstrou ser uma estratégia eficaz para ambos os sexos no combate à obesidade, proporcionando em curto prazo uma melhora significativa dos parâmetros clínico-antropométricos e redução dos fatores de risco para doenças cardiometabólicas relacionadas à obesidade.

Palavras-chave: Cirurgia bariátrica, Obesidade severa, Doenças metabólicas e nutricionais.

1 INTRODUCTION

The increasing prevalence of obesity at all stages of life has a serious impact on public health worldwide (1). Besides, not just excess body mass by subcutaneous and intra-abdominal fat (visceral) accumulation but countless other diseases are triggered in association with obesity such as diabetes mellitus, cardiovascular diseases, osteoporosis, and cancer (2).

Body mass index (BMI) is a clinical tool widely used in the identification of obesity (2). Individuals with a BMI of 25.0 to 29.9 kg/m^2 are considered overweight; obese when they have a BMI of 30 kg/m^2 or higher being BMI of 40 kg/m^2 or more is considered as severe obesity (3). It is widely recognized that the increase in BMI is directly associated with the onset of chronic diseases and mortality from various causes (4). It is estimated that with each increase of 5 kg/m^2 from the eutrophic state (i.e., 25 kg/m^2) there is an increase of 29% in general mortality 41% in vascular mortality, and 210% in mortality related to diabetes (5).

Epidemiological data indicate that in low-income countries obesity is prevalent among middle-aged adults. whereas in high-income countries this predominance occurs among individuals of both sexes and varied ages (6). In Brazil, on account of being a

developing country (i.e., low income) recent data collected in the Surveillance of Risk and Protection Factors for Chronic Diseases by Telephone Survey (VIGITEL) revealed a higher incidence of obesity in young adults aged between 25 and 34 years old (84.2%) and middle-aged adults between 35 and 44 years old (81.1%). When considering sex, women with 20.7% stand out showing a higher prevalence of obesity than men with 18.7% (7).

Guidelines for the treatment of obesity in several countries, including Brazil, recommend multidisciplinary clinical treatment through behavioral therapy, regular physical exercise, and low-calorie diets to mitigate negative psychological effects reduce body fat, increase lean mass. in addition to attenuating the comorbidities generated by excess fat composing to the treatment, if necessary, the use of specific drugs (8-10).

However, the vast majority of cases of severe obesity do not present sufficient outcomes with conventional clinical treatment. requiring the adoption of surgical alternatives (11). In this context. the Roux-en-Y gastric by-pass (RYGB) technique is considered one of the most efficient methods and incurs a lower morbidity and mortality rate (12, 13). Among the various bariatric and metabolic surgery techniques, RYGB has been considered the gold standard is the most popular and the most adopted considered a well-tolerated procedure in the control of obesity (14).

Based on the above, the present study aimed to evaluate clinical parameters and the evolution of risk factors for obesity-related diseases in individuals of both sexes who underwent Roux-en-Y gastric bypass surgery in the city of Cuiabá/MT between January 2015 and January 2018.

2 MATERIALS AND METHODS

This is a cross-sectional study through a retrospective analysis of the database of patients undergoing RYGB surgery. The study was previously approved by the Research Ethics Committee of the Academic Center of Várzea Grande-MT (CEP/Univag) with protocol n° 2.959.596.

The study consisted of data collection from 69 adult patients, of both sexes, aged between 18 and 65 years who were followed up in a particular establishment specialized in the clinical and surgical treatment of obesity, metabolic and digestive diseases located in the county of Cuiabá/MT throughout January 2015 and January 2018.

The inclusion criteria adopted were bariatric and metabolic surgery using the RYGB technique, and the premise of having undergone regular multi-professional

clinical follow-up to assess surgical viability was adopted in addition to maintaining the follow-up for at least 3 years after surgery.

The information collected through medical records, medical history, anamnesis, anthropometric measurements, and nutritional assessment were: sex, age, professional occupation, education level, race, presence or absence of comorbidities, the time elapsed after surgery, body weight before of surgery (Usual weight - UW), bodyweight after surgery (current weight - CW) as well as the usual and current abdominal perimeters.

The level of education was classified according to that proposed by the Ministry of Education (15). Race /color was self-reported and followed the proposal in the color and race classification system described by the Brazilian Institute of Geography and Statistics (IBGE) (16). For the evaluation of metabolic and cardiovascular risk, obtained due to the excessive accumulation of visceral fat, the measurement of the abdominal perimeter (waist region) was adopted and classified as proposed by the WHO (3). The body mass index (BMI) obtained using the formula $\text{BMI}\ (\text{kg/m}^2) = \text{Bodyweight}/\ \text{height}^2$, was used to evaluate the risk of diseases associated with obesity (i.e.. comorbidities caused by excess weight and body fat) were classified as proposed by the Brazilian Obesity Guidelines (2016) (8). The percentage of body weight loss (%WL) was obtained using the formula $\%\text{WL} = ([\text{Usual weight} - \text{current weight}]/\ \text{Usual weight})\ \text{x}\ 100$ (17). Regarding the time elapsed after surgery the participants were divided into 3 groups: G1 (<13 months; n=24); G2 (> 13 and <25 months; n=21), and G3 (> 25 and <37 months; n=24) for comparisons between weight loss (kg) % WL and BMI.

Descriptive analysis of qualitative data was expressed as a percentage, and the associations between these variables the χ^2-square test were used. Quantitative variables were analyzed for normality using the Kolmogorov-Smirnov method. Student's t-test for independent samples was used for analysis between genders. Parameters such as body weight, % WL and BMI were analyzed by Student's t-test for dependent samples (before and after surgery). Data regarding the time elapsed after surgery were tested by analysis of variance (one-way ANOVA) and when necessary Tukey's post-hoc was applied. The results are expressed as mean ± standard deviation (SD), and the significance level adopted was 5%. All analyzes were performed using software the Statistical Package for Social Sciences (SPSS®) version 25.

3 RESULTS

3.1 SOCIODEMOGRAPHIC PROFILE

The data regarding the sociodemographic profile are presented in table 1. In a total of 69 participants with a mean age (36.0±10.0 years) previously submitted to RYGB surgery, it was observed that 48 (69.6 %) were male and 21 female (30.4%). Regarding race 37 participants reported being brown (53.6%), 22 white (31.9%), 8 participants (11.6%) considered themselves black, and 2 yellow (2.9%). Education level was 4 (5.8%) participants with incomplete elementary school, 8 (11.6%) complete elementary school, 25 (36.2%) complete high school, and 32 individuals (46.4%) with complete undergraduate degree. The professional occupation of the participants portrayed that 42 of them (60.9%) were employed, 17 (24.6%) were unemployed, 9 were self-employed (13.0%) and only 1 (1.4%) was retired.

Table 1 Sociodemographic profile of the studied population.

Sex	**Frequency**	**Percentage**
	n	**%**
Male	48	69.6
Female	21	30.4
Race/color	**n**	**%**
White	22	31.9
Black	8	11.6
Yellow	2	2.9
Brown	37	53.6
Education levels	**n**	**%**
Incomplete elementary school	4	5.8
Complete elementary school	8	11.6
Complete high school	25	36.2
Complete undergraduate degree	32	46.4
Professional occupation	**n**	**%**
Employed	42	60.9
Unemployed	17	24.6
Self-employed	9	13.0
Retired	1	1.4

Data presented as relative frequency (n) and percentage (%).

3.2 ANTHROPOMETRIC CLINICAL PARAMETERS

Anthropometric clinical parameters are shown in table 2. The usual weight ($p<0.001$) and the current weight ($p<0.001$) were higher in females. However, there was no difference for the usual BMI between genders ($p=0.06$). The current BMI was lower for males ($p=0.03$). There was no difference in the usual abdominal perimeter ($p=0.06$). However, the current abdominal perimeter was lower among males ($p=0.02$). Weight loss (kg) ($p=0.11$) and weight loss percentage ($p=0.67$) were similar between genders

Table 2 Anthropometric clinical parameters

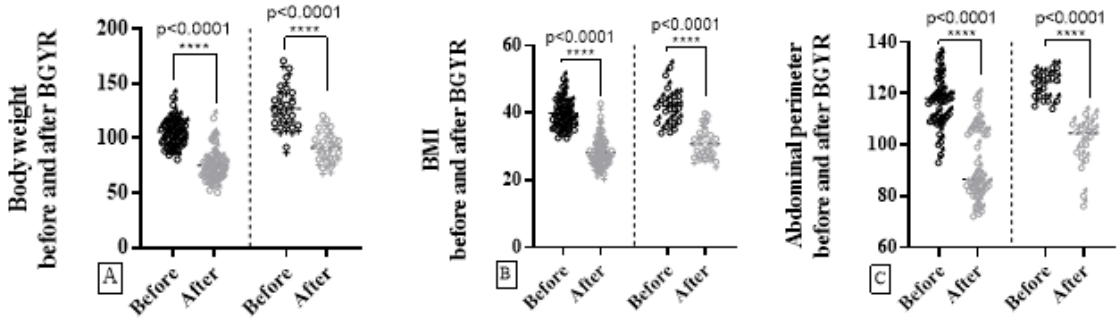
Variables		□±DP	Minimum	Maximum	*p-value*
Usual weight (kg^{-1})	Male	105.6±12.1	83.0	140.0	<0.001
	Female	127.1±19.7	89.0	168.0	
Current weight (kg^{-1})	Male	75.2±13.6	53.0	121.0	<0.001
	Female	91.3±13.7	70.0	118.0	
Usual BMI (kg/m^2)	Male	39.8±4.2	33.1	50.8	0.06
	Female	42.0±5.2	34.7	54.2	
Current BMI (kg/m^2)	Male	28.1±4.3	20.9	41.9	0.03
	Female	30.6±4.3	24.5	39.0	
Usual abdominal perimeter (cm)	Male	117.0±9.7	94.0	136.0	0.06
	Female	124.0±5.2	115.0	131.0	
Current abdominal perimeter (cm)	Male	92.4±13.6	73.0	120.0	0.02
	Female	101.0±9.9	77.0	113.0	
Weight loss (kg)	Male	30.4±11.6	6.0	49.0	0.11
	Female	35.8±15.3	9.0	67.0	
Weight loss (%)	Male	28.7±10.2	7.2	43.7	0.67
	Female	27.5±9.6	7.3	41.6	

Student t-test for independent samples and a 5% significance level. Data presented as mean±standard devia1tion ($\overline{X}$±DP).

3.3 ANALYSIS OF ANTHROPOMETRIC PARAMETERS IN THE BEFORE AND AFTER RYGB

There was a reduction between before and after surgery moments of RYGB for both men and women on anthropometric parameters of body weight (differences of mean: men = -30.4 kg; women = -35.8 kg) (figure 1A); BMI (differences of mean: men = -11.7 kg/m2; women = -11.4 kg/m2) (figure 1B); and abdominal perimeter (differences of mean: men = -24.3 cm; women = -22.4 cm) (figure 1C).

Figure 1 Anthropometric parameters in the before and after RYGB moments. The data were evaluated by Student's t-test for dependent (paired) samples. and a significance level of 5% was adopted. The results are presented as mean ± standard deviation ($\overline{X}$±DP). The differences between the means are presented as the mean of the post-surgery moment - mean of the pre-surgical moment (B - A).



3.4 ASSOCIATION OF RISKS FOR OBESITY-RELATED DISEASES AND THE TIME ELAPSED FROM RYGB

The association of risks for diseases caused by excess body weight and accumulation of abdominal fat before surgery and between the after-surgery period is shown in figure 3. There was an association between the risk of diseases due to obesity before surgery (p=0.02). In a total of 69 participants, it was observed that 7 (10.1%) were at high risk, 28 (40.6%) at very high risk, and 34 (49.3%) at extremely high risk for comorbidities associated with obesity. There was no association between the risk of diseases associated with obesity and the time after surgery (p=0.23). Similarly. there was no association between cardiovascular risk in the before surgery period (p=0.31). There was an association between cardiovascular risk and after surgery time (p=0.01), where, in a total of 60 participants, 23 (38.3%) had normal risk, 6 (10.0%) high risk, and 31 (51.7%) extremely high risk for cardiovascular diseases

Table 3 Association of risk for diseases caused by excess body weight and cardiovascular diseases (CVD) due to the accumulation of abdominal fat in the before and after RYGB.

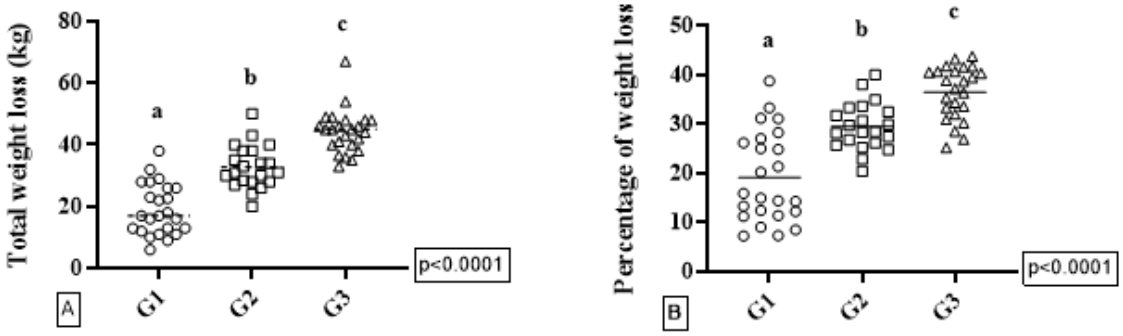
Comorbidities	Classification	Groups (%)			Total (%)	χ^2 *p-value*
		G1	G2	G3		
Risk of disease due to before surgery obesity	High	5 (71.4)	2 (28.6)	0 (0.0)	**7 (10.1)**	**0.02**
	Very high	13 (46.4)	8 (28.6)	7 (25.0)	**28 (40.6)**	
	Extremely high	6 (17.6)	11(32.4)	17 (50.0)	**34 (49.3)**	
Risk of disease due to after surgery obesity	Normal	2 (15.4)	3 (23.1)	8 (61.5)	**13 (18.8)**	**0.23**
	Little high	9 (29.0)	11 (35.5)	11 (35.5)	**31 (44.9)**	
	High	9 (50.0)	6 (33.3)	3 (16.7)	**18 (26.1)**	
	Very high	3 (50.0)	1 (16.7)	2 (33.3)	**6 (8.7)**	
	Extremely high	1 (100)	0 (0.0)	0 (0.0)	**1 (1.4)**	
CD risk before surgery	Very high	0 (0.0)	2 (66.7)	1 (33.3)	**3 (4.9)**	**0.31**
	Extremely high	20 (34.5)	17 (29.3)	21(36.2)	**58 (95.1)**	
CD risk after surgery	Normal	13 (56.5)	6 (26.1)	4 (17.4)	**23 (38.3)**	**0.01**
	High	1 (16.7)	4 (66.7)	1 (16.7)	**6 (10.0)**	
	Very high	6 (19.4)	10 (32.3)	15 (48.4)	**31 (51.7)**	

Groups indicating the time elapsed post-surgery G1 (<13 months. n = 24). G2 (> 13 and <25 months. n=21). G3 (> 25 and <37 months. n=24). The classification of risk factors (comorbidities) was performed according to the Brazilian Obesity Guidelines (2016) [18]. The data were submitted to association analysis by chi-square ($\chi 2$) with a significance level of 5%. The results are presented as relative frequency (n) and Percentage (%)

3.5 TOTAL WEIGHT LOSS AND PERCENTAGE OF WEIGHT LOSS CONCERNING THE ELAPSED TIME OF RYGB

Weight loss (kg) was higher in G3 (44.4±7.0) compared to G1 (19.0±8.3) and G2 (32.8±7.0) as well as G2 was higher than G1 ($p<0.0001$) (figure 2A). The percentage of weight loss was higher in the G3 group (36.5±5.4) compared to G1 and G2 (19.1±9.2; 29.5±4.8), respectively; and the G2 was greater than G1 ($p<0.0001$) (figure 2B).

Figure 2 (A) Total weight loss (kg); and (B) percentage of weight loss. Groups indicating the time elapsed after surgery G1 (<13 months. n=24), G2 (> 13 and <25 months; n=21), G3 (> 25 and <37 months. n=24). The data were evaluated by analysis of variance (Anova one-way) and when necessary Tukey HSD's post-hoc presented in superscript letters, was applied significance level of 5%.



4 DISCUSSION

The present study aimed to evaluate anthropometric clinical parameters and the evolution of risk factors for obesity-related diseases in adult individuals of both sexes who underwent bariatric and metabolic surgery using the RYGB technique. The main findings show that RYGB induced, in both sexes, an improvement in the nutritional profile and a reduction in risk factors for cardiovascular and metabolic diseases associated with obesity. The study portrayed a greater number of male patients who underwent bariatric and metabolic surgery for RYGB, which at least for this technique contradicts the overall frequency of predominance of bariatric and metabolic surgery by women as reported in the literature (19).

Notably, the positive outcomes observed were similar between men and women undergoing RYGB bariatric and metabolic surgery when we consider the classic anthropometric parameters expected after the procedure such as rapid weight loss, reduced BMI and morbidities related to the degree of obesity, reduction cardiovascular risk is seen by the smaller abdominal perimeter and an increase in the %WL (19-21). Although widely studied, there is still no consensus on which metrics should be adopted to confirm a good or bad response to short and long-term weight loss and recovery. Even so, the surgical treatment of severe obesity and super obesity is considered effective, especially when it provides sustained reductions in excess body weight and BMI (11).

The purposes of bariatric and metabolic surgery, especially RYGB, are based on the improvement of clinical parameters such as weight loss, reduced risk of morbidities, remission and/or control of metabolic diseases, and improved quality of life (22, 23). In general, the sustained loss of excess body weight is understood as one of the main parameters to determine the success and/or failure of a strategy, surgical or not, in the treatment of obesity, and this outcome is considered essential to improve clinical conditions of the individual (21, 24). At this point, even though the present study evaluated patients with a maximum time of up to 3 years after RYGB, the observed results indicate significant clinical benefits, at least concerning anthropometric clinical parameters.

Among the different techniques of surgical approach, RYGB is considered the gold standard in the treatment of severe obesity and super obesity, since its outcome provides a rapid and considerable reduction in excess body weight, which favors the control of metabolic morbidities, attenuating the risk of deleterious cardiovascular events and overlapping perioperative risk (25). In the present study, we observed a positive

change in the classification of risk factors for diseases caused by excess body weight and for cardiovascular diseases (CD) due to the accumulation of abdominal fat concerning the time of surgery, which corroborates the recent findings in the literature (26-28).

The risk of developing catastrophic cardiovascular events is greatly increased according to the degree of obesity (4). An interesting study sought to evaluate the cardiovascular risk estimated in 10 years of obese patients considering the moments before and 2 years after the treatment of obesity with RYGB. The study involved 42 patients; of these, the majority were female, 85.7% with a mean age of 43.5±8.6 years. The results registered a significant reduction in cardiovascular risk associated, mainly, with the reduction of body weight and improvement of obesity-related morbidities such as diabetes mellitus and arterial hypertension. According to the authors, super-obese patients benefited from the effects of RYGB surgery, especially over the first 2 years that followed, this outcome is related to the accelerated weight loss that occurs in this period (29).

Throughout the treatment of severe obesity, rapid weight loss becomes a key measure in preventing metabolic and cardiovascular risk in the short term, and long term if sustained. There are reports in the literature that in the immediate post-surgical period of RYGB, patients have excellent responses on clinical parameters (14, 30). In a clinical trial conducted with 4047 obese individuals, divided between those undergoing bariatric and metabolic surgery and those who were treated conventionally, the results showed that after 2 years, there was an increase in body weight by 0.1% for the control group and a reduction of 23.4% for the surgical group. However, after 10 years, weight increased by 1.6% for the control and decreased by 16.1% for the surgery group. In summary, the group undergoing surgery had lower incidence rates for diabetes, dyslipidemia, and hyperuricemia after 2 and 10 years (28). However, it is still contradictory to say that the benefits remain over time or whether the disease will tend to return, and the serious risks for morbidities may still reappear (31).

Sociodemographic, socio-cultural and psychosocial aspects have a strong impact on eating behavior, energy intake, and physical activity level (30). Therefore, so far, there is no known single factor that can be attributed to sustained weight change, but rather a set of interdisciplinary elements that stimulate positive physiological, genetic, behavioral, and motivational responses. In this sense, we understand that special care should be implemented over time after a surgical follow-up of Roux-en-Y gastric bypass, since the

effects of the technique lead to energy restriction and malabsorption of nutrients, among other events that can cause damage to short and/or long term.

In the present study, it was evidenced that the individuals participating in the research presented satisfactory results, even though the short time after surgery is a bias factor to confirm this information. The main limitations of the study are in the cross-sectional design, which prevents the monitoring and makes it impossible to obtain new data for further analyzes even more robust. Certainly, some additional clinical data such as blood pressure, blood glucose, lipid profile, body composition could be included for a better analysis of the outcome. However, concerning the central proposal of the study, the results described manage in one way or another to contribute to the understanding of the clinical course of patients with a high degree of obesity and who underwent surgical treatment of obesity using the RYGB technique.

5 CONCLUSION

The data described here support the assumption that bariatric and metabolic surgery using the Roux-en-Y gastric bypass technique proved to be an effective strategy for both sexes in combating obesity, providing, in the short term, a significant improvement in the anthropometric clinical parameters as fast weight loss, increased %WL, reduced BMI and risk factors for cardiometabolic and obesity-related diseases. Future research is important to provide new knowledge aimed at assisting the clinical follow-up of obese individuals on the way to surgical treatment or those who have already been treated surgically aiming mainly at health and quality of life.

ACKNOWLEDGEMENTS

This research did not receive any specific grant from funding agencies in the public or not-for-profit sectors. The authors acknowledge CAPES, FAPEMAT, CNPq, and Academic Center of Várzea Grande/MT (UNIVAG).

REFERENCES

1. Engin A. The Definition and Prevalence of Obesity and Metabolic Syndrome. Advances in experimental medicine and biology. 2017;960:1-17. doi:10.1007/978-3-319-48382-5_1

2. Apovian CMJAJMC. Obesity: definition, comorbidities, causes, and burden. 2016;22(7 Suppl):s176-85.

3. WHO. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organization technical report series. 1995;854:1-452.

4. Global BMIMC, Di Angelantonio E, Bhupathiraju Sh N, et al. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. Lancet (London, England). Aug 20 2016;388(10046):776-86. doi:10.1016/s0140-6736(16)30175-1

5. Whitlock G, Lewington S, Sherliker P, et al. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. Lancet (London, England). Mar 28 2009;373(9669):1083-96. doi:10.1016/s0140-6736(09)60318-4

6. Swinburn BA, Sacks G, Hall KD, et al. The global obesity pandemic: shaped by global drivers and local environments. Lancet (London, England). Aug 27 2011;378(9793):804-14. doi:10.1016/s0140-6736(11)60813-1

7. Brasil. VIGITEL Brasil 2018: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2018. In: Saúde Md, editor.: SVS/MS Brasília; 2019.

8. ABESO. Diretrizes Brasileiras de Obesidade. 4ª ed. São Paulo, SP: ABESO 2016.

9. Ryan DH, Kahan S. Guideline Recommendations for Obesity Management. The Medical clinics of North America. Jan 2018;102(1):49-63. doi:10.1016/j.mcna.2017.08.006

10. Yumuk V, Tsigos C, Fried M, et al. European Guidelines for Obesity Management in Adults. Obesity facts. 2015;8(6):402-24. doi:10.1159/000442721

11. Jastrzębska-Mierzyńska M, Ostrowska L, Hady HR, Dadan J, Konarzewska-Duchnowska E. The impact of bariatric surgery on nutritional status of

patients. Wideochirurgia i inne techniki maloinwazyjne = Videosurgery and other miniinvasive techniques. Apr 2015;10(1):115-24. doi:10.5114/wiitm.2014.47764

12. Kahan S. Overweight and obesity management strategies. Am J Manag Care. Jun 2016;22(7 Suppl):s186-96.

13. Lim CH, Jahansouz C, Abraham AA, Leslie DB, Ikramuddin S. The future of the Roux-en-Y gastric bypass. Expert review of gastroenterology & hepatology. Jul 2016;10(7):777-84. doi:10.1586/17474124.2016.1169921

14. Navarrete S, Leyba JL, Ll SN, Borjas G, Tapia JL, Alcázar R. Results of The Comparative Study of 200 Cases: One Anastomosis Gastric Bypass vs Roux-en-Y Gastric Bypass. Obesity surgery. Sep 2018;28(9):2597-2602. doi:10.1007/s11695-018-3224-x

15. Brasil. Lei de Diretrizes e Bases da Educação Nacional. In: Federal S, editor.: Brasília; 2005.

16. Osório RG. O sistema classificatório de cor ou raça do IBGE. 2003;

17. Blackburn GL, Harvey KB. Nutritional assessment as a routine in clinical medicine. Postgraduate medicine. May 1982;71(5):46-63. doi:10.1080/00325481.1982.11716062

18. Mancini M. Diretrizes Brasileiras de Obesidade 2016. Associação Brasileira para o Estudo da Obesidade e da Síndrome Metabólica 4ª ed São Paulo. 2016;

19. Kennedy-Dalby A, Adam S, Ammori BJ, Syed AA. Weight loss and metabolic outcomes of bariatric surgery in men versus women - A matched comparative observational cohort study. European journal of internal medicine. Dec 2014;25(10):922-5. doi:10.1016/j.ejim.2014.10.020

20. Sherf Dagan S, Goldenshluger A, Globus I, et al. Nutritional Recommendations for Adult Bariatric Surgery Patients: Clinical Practice. Adv Nutr. 2017;8(2):382-394. doi:10.3945/an.116.014258

21. Wolfe BM, Kvach E, Eckel RH. Treatment of Obesity: Weight Loss and Bariatric Surgery. Circulation research. May 27 2016;118(11):1844-55. doi:10.1161/circresaha.116.307591

22. Brethauer SA, Kim J, el Chaar M, et al. Standardized outcomes reporting in metabolic and bariatric surgery. Surgery for obesity and related diseases :

official journal of the American Society for Bariatric Surgery. May-Jun 2015;11(3):489-506. doi:10.1016/j.soard.2015.02.003

23. de Mattos LC, Costa ACC. Clinical and laboratory review of the reversion of metabolic syndrome in patients submitted to bariatric surgery after one year of the procedure. Brazilian Journal of Development. 2021;7(2):18278-95.

24. Grover BT, Morell MC, Kothari SN, Borgert AJ, Kallies KJ, Baker MT. Defining Weight Loss After Bariatric Surgery: a Call for Standardization. Obesity surgery. Nov 2019;29(11):3493-3499. doi:10.1007/s11695-019-04022-z

25. Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systematic review and meta-analysis. Jama. Oct 13 2004;292(14):1724-37. doi:10.1001/jama.292.14.1724

26. Schiavon CA, Bersch-Ferreira AC, Santucci EV, et al. Effects of Bariatric Surgery in Obese Patients With Hypertension: The GATEWAY Randomized Trial (Gastric Bypass to Treat Obese Patients With Steady Hypertension). Circulation. Mar 13 2018;137(11):1132-1142. doi:10.1161/circulationaha.117.032130

27. Mundbjerg LH, Stolberg CR, Cecere S, et al. Supervised Physical Training Improves Weight Loss After Roux-en-Y Gastric Bypass Surgery: A Randomized Controlled Trial. Obesity (Silver Spring, Md). May 2018;26(5):828-837. doi:10.1002/oby.2214328.

28. Sjöström L, Lindroos AK, Peltonen M, et al. Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. The New England journal of medicine. Dec 23 2004;351(26):2683-93. doi:10.1056/NEJMoa035622

29. Donadelli SP, Salgado W, Jr., Marchini JS, et al. Change in predicted 10-year cardiovascular risk following Roux-en-Y gastric bypass surgery: who benefits? Obesity surgery. May 2011;21(5):569-73. doi:10.1007/s11695-010-0348-z

30. Christensen BJ, Schmidt JB, Nielsen MS, et al. Patient profiling for success after weight loss surgery (GO Bypass study): An interdisciplinary study protocol. Contemporary clinical trials communications. Jun 2018;10:121-130. doi:10.1016/j.conctc.2018.02.002

31. Dayan D, Kuriansky J, Abu-Abeid S. Weight Regain Following Roux-en-Y Gastric Bypass: Etiology and Surgical Treatment. The Israel Medical Association journal : IMAJ. Dec 2019;12(21):823-828.