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The long-term benefits of bariatric surgery in elderly and super-obese populations

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ABSTRACT

Purpose: to assess the long-term benefits of bariatric surgery in super-obese (body mass index [BMI] ≥ 50) and in elderly obese (age > 60 years) populations.

Methods: one hundred and twenty one patients who underwent laparoscopic Roux-en-Y gastric bypass or laparoscopic sleeve gastrectomy in a university hospital were retrospectively subdivided into the following groups: BMI < 50 *vs* ≥ 50 and age < 60 *vs* ≥ 60 years. Weight loss, body composition and comorbidity outcomes were registered after one and six months and one, two, three and five years with 100%, 93%, 89%, 80%, 75% and 60% successful follow-up.

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Results: the percentage of excess BMI loss (%EBMIL) was comparable between BMI groups and age groups and the difference in the long-term follow up was not statistically significant ($p > 0.05$). Complication rates, comorbidity resolution, reduction in body fat and increase in fat-free mass were comparable between BMI groups and age groups. Gastric bypass resulted in a greater weight loss compared to sleeve gastrectomy. The % EBMIL was 65.2% *vs* 46.7% ($p = 0.002$), 65.8% *vs* 44.9% ($p = 0.004$), 64.4% *vs* 30.5% ($p = 0.001$), 55.6% *vs* 17.6% ($p = 0.016$) at one, two, three and five years postoperative, respectively. Similarly, in the super-obese group, weight loss was more pronounced after gastric bypass *versus* sleeve gastrectomy.

Conclusions: bariatric surgery in super-obese and elderly populations is an effective and safe weight loss measure with a good comorbidity resolution in the long-term. Gastric bypass is superior to sleeve gastrectomy in terms of long-term weight loss and comorbidity resolution in all the groups investigated.

Key words: Bariatric surgery. Super-obesity. Elderly. Weight loss. Comorbidity resolution. Roux-en-Y gastric bypass. Sleeve gastrectomy.

INTRODUCTION

Bariatric surgery has proven to be the most effective long-term treatment for morbid obesity, regardless of the type of procedure used (1-4). There has been a disproportionate increase in the prevalence of super-obesity (SO), i.e., individuals with a body mass index (BMI) ≥ 50 in the USA during the growing obesity pandemic over the last several decades. The SO population has increased nearly tenfold between 1986 and 2005 compared to a twofold increase in obesity (BMI ≥ 30) during this period (5,6). The association between SO and increased perioperative risk due to the greater incidence of comorbidities has been widely debated (7,8). From a surgical point of view, SO is associated with a decreased visualization, the common need for specialized instrumentation and technical challenges which can lead to increased operative times and surgeon fatigue (9).

On the other hand, the proportion of the population older than 60 years is rapidly increasing in the USA and European countries (10). The majority of the aged population suffers from multiple comorbid conditions and these are much more pronounced in patients suffering from morbid obesity. The Cochrane review of weight loss surgery showed that the relative age limit has gradually increased to 60 years of age and above. Nevertheless, as life expectancy increases, more elderly patients fit into the criteria for bariatric procedures (3). In the USA, 37% of males ≥ 60 years old and 42% of women ≥ 60 years old suffer from obesity (11) and the prevalence of obesity within the elderly population is anticipated to grow (12). Therefore, the benefit-risk assessment of elderly patients who undergo bariatric surgery has become an active area of research.

Numerous reports address bariatric outcomes in SO or elderly populations, but data based on long-term follow-up is lacking. Therefore, the distant effects of surgery in this population remain unclear (3). In the current study, we focus our attention on the SO and elderly patient groups who underwent laparoscopic weight loss surgery, either Roux-en-Y gastric bypass (RYGB) or sleeve gastrectomy (SG). The objectives of the study were to compare the long-term results of RYGB and SG in the groups of patients with morbid obesity with a BMI ≥ 50 (SO) *versus* BMI < 50 and patients older than 60 years *versus* those younger than 60 years.

MATERIALS AND METHODS

Two hundred and eighty seven patients underwent laparoscopic bariatric surgery, either RYGB or SG, between January 2009 and December 2014. The academic center is accredited as a European Center of Excellence for Bariatric and Metabolic Surgery. Informed consent was obtained from all participants included in the study. Among them, 121 patients were chosen and analyzed in a retrospective observational study due to the proximity of their area of residence. Table 1 shows the demographic characteristics and preoperative comorbid metabolic conditions of the surgery groups.

Surgery was indicated following the National Institute of Health Consensus Development Statement (13) for patients with a BMI ≥ 35 with obesity-related comorbidities or BMI > 40. The type of surgery was decided after a weekly multidisciplinary team meeting discussion before surgery (MDT). The data collected included demographic characteristics (age, sex, weight, BMI, body fat percentage [BF] and fat-free mass [FFM]) and preoperative comorbid metabolic conditions (type 2 diabetes, hypertension, obstructive sleep apnea and joint disease). Early and late surgical complications, length of stay and reoperations were

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registered. During long term follow-up, a total weight loss, change in BMI, excess BMI loss (%EBMIL), BF, FFM and the resolution of comorbidities was registered at one and six months, and one, two, three and five years after the intervention. BF and FFM were measured by air displacement plethysmography using the BodPod system and impedance (14).

Type 2 diabetes resolution was defined as HbA1c < 6.5%, or fasting basal glucose < 100 mg/dl in the absence of antidiabetic medication; improvement signified a decreased pharmacologic treatment reported by the patient. Obstructive sleep apnea resolution was defined as < 5 events/h of apnea in polysomnography or the absence of continuous positive airway pressure; improvement signified decreased continuous positive airway pressure values and severity of associated symptoms reported by the patient. Resolution of hypertension was defined as normal blood pressure (< 120/80) and no anti-hypertensive medication; improvement signified decreased pharmacologic treatment reported by the patient. Improvement of joint disease was recorded when pain measured by a visual analogue scale decreased after surgery.

Statistical analysis

Descriptive statistics with measures of central tendency and dispersion (mean and standard deviation) were performed for the description of continuous variables and frequency distributions for categorical variables. The level of statistical significance in all the analyses was determined as $p < 0.05$. Patients were subdivided into groups for statistical analysis (Fig. 1): BMI < 50 *vs* BMI ≥ 50 (SO) and age < 60 years *vs* ≥ 60 years. Additional analyses were comparing patients after RYGB *vs* SG. Categorical variables were analyzed using the Chi-square test. Continuous variables were compared using Student's t test; sample normality was assessed using the Kolmogorov-Smirnov, Shapiro-Wilk and Shapiro-Francia tests. Sample homogeneity was evaluated using an analysis of variance. In case of heterogeneous samples, the Welch's t test was performed.

Operative technique

Anesthetic and operative techniques were applied in all cases by the same bariatric team. General anesthesia included ramped head-up intubation avoiding long-acting opioids.

Multimodal analgesia included intravenous paracetamol, diclofenac and metamizol. Patients were placed in a 45° reverse Trendelenburg position to ensure an optimal intra-abdominal space with 10 mm and 45°-view endoscope. Pneumoperitoneum was insufflated at a pressure of 14 mmHg and five laparoscopic trocars were introduced in all cases. RYGB was performed in an antecolic-antegastric fashion (typically 60 cm biliopancreatic limb, 150-190 cm Roux limb length) using a 30 mm end-to-side linear stapled gastrojejunal anastomosis and 45 mm side-to-side jejunojejunal anastomosis technique. SG was sized using a 34F orogastric tube and staple line reinforcement with a 3/0 absorbable running suture. An intraoperative air leak test was performed with methylene blue. Nasogastric tubes, surgical drains and urinary catheters were not routinely used.

Postoperative management

Postoperative interventions were performed according to the hospital bariatric unit protocol based on mobilization within four hours after the end of the surgical procedure, intermittent pneumatic compression boots and hourly use of incentive spirometry. An oral liquid diet was started on the first postoperative day, which advanced to a semisolid diet on day two.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the Declaration of Helsinki of 1964 and its subsequent amendments or comparable ethical standards. For this type of study, formal consent was not required.

RESULTS

Surgeries were successfully completed without any intraoperative complications. The average duration of the surgery was 130 min for RYGB and 100 min for SG. The average length of hospital stay was 2.5 days (range 2-6). The length of stay did not differ significantly among the studied groups. There were five early surgical complications: two surgical site infections and three intraluminal bleedings that required a re-intervention in one case. There were five late surgical complications: two port hernias, two transitory hypoglycemias and one gastrojejunal stenosis that required endoscopic dilatation. No deaths occurred during the perioperative period.

Follow-up success rate was 100% at one month, 93% at six months, 89% at one year, 80% at two years, 75% at three years and 60% at five years after the intervention. The total weight loss in the entire cohort was 28.5% (± 9.5) after one year, 28.9% (± 12.1) after two years, 27.6% (± 12.7) after three years and 24.1% (± 13.5) after five years. The change in BMI was -13.7 (± 5.1) at one year, -14 (± 6.5) at two years, -13.4 (± 6.7) at three years and -11.9 (± 7.2) at five years after surgery. %EBMIL was 61.4% (± 20.8) after one year, 61.8% (± 25.5) after two years, 58.9% (± 26.7) after three years and 50.1% (± 27.7) after five years.

There were no statistically significant differences in weight loss between BMI groups (except for the first postoperative year) or between age groups (Fig. 2) during long-term follow-up. Analysis of surgery types revealed that weight changes after one, two, three and five years were significantly more pronounced for RYGB versus SG patients. The EBMIL percentage was 65.2% *vs* 46.7% (p = 0.002), 65.8% *vs* 44.9% (p = 0.004), 64.4% *vs* 30.5% (p = 0.001) and 55.6% *vs* 17.6% (p = 0.016), respectively.

When comparing BMI < 50 *vs* BMI ≥ 50 groups, there were no significant differences in weight loss, with the exception of the first postoperative year; %EBMIL was 66.1% *vs* 52.6% after one year (p = 0.001), 64.7% *vs* 56.4% after two years (p = 0.1), 61.7% *vs* 53.6% after three years (p = 0.16) and 52.8% *vs* 46.3% after five years (p = 0.39). Further analysis of weight reduction in the SO group showed that the results of the two surgical techniques were similar to those of the whole sample. RYGB was superior to SG in the SO group; %EBMIL was 58.7% *vs* 40.9% after one year (p = 0.015), 62.8% *vs* 43% after two years (p = 0.033), 60.2% *vs* 35.1% after three years (p = 0.031) and 56.7% *vs* 16.9% after five years (p = 0.013). There were no statistically significant differences in weight loss outcomes in the group of patients ≥ 60 years when compared to patients < 60 years old. %EBMIL was 56.4% *vs* 62% after one year (p = 0.33), 52.3% *vs* 62.8% after two years (p = 0.1), 53.3% *vs* 59.5% after three years (p = 0.6) and 35.7% *vs* 51.9% after five years (p = 0.28), respectively. The majority of our elderly patients underwent RYGB.

Apart from considerable weight loss, a significant change in body composition from baseline is obvious in both BMI age groups during the two-year follow-up (Fig. 3). The reduction of BF and the increase in FFM occurred at similar rates among the studied groups. The results of

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comorbidity resolution in age and BMI groups were comparable (Fig. 4). There were no statistically differences in the cumulative rates percentages of resolution/improvement of type 2 diabetes, hypertension, obstructive sleep apnea and joint disease were (70/10, 65/5, 80/5 and 65) between all the subgroups at a median follow-up of three years, with the exception of type 2 diabetes in the age group ($p = 0.059$).

DISCUSSION

Bariatric surgery is an intervention directed at weight loss and significant improvement of comorbidities, thus contributing to a better quality of life. To date, evidence of the outcome of bariatric surgery in SO and elderly populations is contradictory. Therefore, further research in the field is required to assess the impact of older age and/or BMI > 50 on long-term outcome of bariatric surgery. Only few scientific studies have analyzed the long-term effects of age on weight loss in patients undergoing the same bariatric surgery (12). Prospective data from a multi-center study of 4,776 patients undergoing weight loss surgery did not identify advancing age as a perioperative risk factor for the composite endpoint of death and postoperative complications. However, extreme values of BMI were significantly associated with an increased risk of the composite endpoint. Interestingly, the lowest predicted risk was for a BMI of 53 (15).

A multi-hospital study of 48,378 patients demonstrated that older age predicted short-term prolonged length of hospital stay but not major events following bariatric surgery. Older age trended toward predicting mortality but was not statistically significant (16). According to some studies, younger bariatric patients have a better comorbidity and weight loss outcome compared to older patients (17,18). On the other hand, some authors argue that weight loss, reduction in comorbidities and mortality of patients older than 55 years may be comparable to the general bariatric surgical population (19,20). Age alone should not preclude older patients from getting the best bariatric procedure.

Very few studies so far with long-term follow-up have investigated the SO population. Thus, an important part of the current research has been focused on analyzing how this population can better benefit from bariatric surgery, by comparing the advantages of each of the surgical techniques studied. We can conclude that both SG and RYGB are safe and effective for the SO population, although a first-stage SG should be considered in cases of extreme overweight. The staged treatment plan of patients suffering from SO reduces the postoperative complication rate. Furthermore, a considerable proportion of these patients achieves sufficient weight loss after SG, thus eliminating the need for a second-stage surgery (21).

As SO patients with many co-morbidities present a challenge in bariatric surgery, intra-gastric balloons have been used preoperatively in the past to induce weight loss, in an attempt to reduce the risk of surgery. Results in this regard are non-conclusive, even though it seems that, compared with a preoperative low carbohydrate diet and physical activity before surgery, gastric balloons achieve higher weight loss results (22). Other endoscopic procedures such as the Endoscopic Sleeve Gastrosplasty (Apollo®) or Primary Obesity Surgery Endoscopic (POSE®) have been demonstrated to be safe and effective in short term follow-up as co-adjuvant interventionist techniques for the management of obesity (23,24). However, there are no consistent results in long-term follow-up. A three-year follow-up study by Daigle combined both risk factors investigated in the current study, elderly age and SO. The results suggested that successful weight loss and metabolic improvement can be safely achieved in the high-risk population of elderly patients suffering from SO (25).

It is important to highlight that patients with a BMI < 50 have excellent RYGB results, with %EBMIL exceeding 50% throughout the follow-up period of five years, in accordance with previous studies (3,26,27). In the SO group, weight loss effects of RYGB are almost identical to those in the BMI < 50 group. In our study, patients ≥ 60 years old exhibit weight loss outcomes comparable to patients < 60 years old, with %EBMIL exceeding 50% in both age groups five years after RYGB. A maximum weight loss was achieved one year after RYGB and was maintained for more than three years postoperatively in BMI and age groups. After five years of follow-up, minor weight regain was observed. With these data, the importance of maintaining healthy lifestyles was demonstrated, in addition to performing daily physical activity and monitoring dietary recommendations. These factors are of vital importance in order to achieve a sustainable success in the treatment of obesity.

Fewer studies with a long-term follow-up have researched SO patients. As a consequence, an important part of the current work has focused on analyzing how this population can better benefit from bariatric surgery, by comparing the advantages of each of the surgical techniques studied. We can conclude that both SG and GB are safe and effective for SO

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patients. However, a first-stage SG should be considered in cases extreme overweight. The staged treatment plan of SO patients reduces the postoperative complication rate. Furthermore, a considerable proportion of SO patients achieved sufficient weight loss after SG, thus eliminating the need for a second-stage surgery (21).

Information of body composition evolution after bariatric surgery, calculated as BF and FFM, is an important direct indicator of the success of surgery with regard to the implications of fat mass in comorbidities. Weight loss in patients undergoing bariatric surgery should primarily take place on account of the BF, minimizing the FFM loss (28). According to the results of our two-year follow-up, weight loss was mainly related to a significant reduction in BF during the first year after surgery.

With regard to comorbidities, RYGB patients had higher resolution rates for comorbidities examined at five years of follow-up compared to SG patients. Meta-analyses and large cohort studies prove that RYGB is superior to SG in terms of comorbidity resolution (29,30). Elderly age or SO did not have a significant influence on the remission rates of preexisting conditions in our study, except for type 2 diabetes in the elderly patients with lower resolution rates due to disease severity. The results obtained are consistent with other studies published by Thereaux (31) and Basso (32).

Considering the limitations of the study, currently we have a 60% follow-up success rate at five years after surgery, which will be updated as patients treated towards the end of the study attend their last follow-up visits. Another restriction is that there were eleven patients > 60 years of age. Therefore, comparisons of this group have limited strength. Finally, another possible limitation is the relatively lower number of patients included in the study, especially when comparing with other similar mentioned articles.

CONCLUSION

Bariatric surgery in SO and elderly populations is a safe and effective weight loss measure with a good resolution of comorbidities during long-term follow-up, without increasing morbidity and mortality. The current study demonstrates that RYGB is superior to SG in terms of long-term weight loss and comorbidity resolution in all the groups investigated.

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Table 1. Demographic characteristics and preoperative comorbid metabolic conditions

	Gastric bypass (97)	*Sleeve gastrectomy (24)*	*p value*
Age	44.6 *(42.6-46.7)*	42.5 *(38.4-47.6)*	*0.456*
Sex (female/male)	74.2/25.7	62.5/37.5	*0.252*
Initial BMI	47.2 *(45.9-48.1)*	53.5 *(49.2-59.2)*	*0.006*
Initial weight	126.5 *(122.6-130.5)*	147 *(134.9-15.8)*	*0.003*
Initial WHR	0.9 *(0.9-0.9)*	0.9 *(0.9-1)*	*0.472*
Initial FFMI	45.2 *(44.1-46.4)*	434 *(40.1-46.8)*	*0.300*
Hypertension (%)	44.3%	55%	*0.250*
T2DM (%)	36%	41.6%	*0.380*
OSA	55.6%	60.8%	*0.325*
JD	60.8%	62.5%	*0.450*

BMI: body mass index; WHR: waist hip ratio; FFMI: fat free mass index; T2DM: type 2 diabetes mellitus; OSA: obstructive sleep apnea; JD: joint disease.

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Fig. 1. Number of patients in BMI and age groups by type of surgery. BMI: body mass index; RYGB: Roux-en-Y gastric bypass; SG: sleeve gastrectomy.

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Fig. 2. Weight loss expressed as excess BMI loss, according to the BMI and age groups and type of surgery. *Time points with a statistically significant difference ($p < 0.05$). BMI: body mass index; RYGB: Roux-en-Y gastric bypass; SG: Sleeve gastrectomy; %EBMIL: excess BMI loss.

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Fig. 3. Two-year follow-up data of body composition in the studied groups (BMI groups and age groups) and according to the type of surgery. BMI: body mass index; BF: body fat percentage; FFM: fat-free mass; RYGB: Roux-en-Y gastric bypass; SG: Sleeve gastrectomy.

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Fig. 4. Cumulative rates of comorbidity resolution and improvement in BMI and age groups. BMI: body mass index.