Does Age Influence Bariatric Surgery Outcomes?

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Aim: The purpose of this study was to evaluate presurgical comorbidities, perioperative and postoperative complications, and postsurgical outcomes of minimally invasive bariatric surgery in patients aged 55 years and older to determine if age should be used as a selection criteria for bariatric surgery.

Methods: A total of 750 patients underwent sleeve gastrectomy or robotic-assisted Roux-en-Y gastric bypass from January 2008 to June 2014. Patients were divided into three groups according to age: <55 years old; ≥55 to <65 years old; and ≥65 years old. Demographics, presurgical comorbidities, perioperative and postoperative complications (leaks or conversions to open surgery), and postsurgical outcomes were compared across the different groups.

Results: Significant differences in presurgical comorbidities were found across age groups ($p < 0.001$). Results from descriptive statistics revealed that patients younger than 55 years of age had a greater number of complications—defined as leaks ($n = 1$) or conversions to open surgery ($n = 2$)—than did patients older than 55 years of age. There were no significant differences across age groups regarding length of stay. Linear regression analysis failed to reveal significant associations between age and percentage excess weight loss at 6, 12, and 24 months follow-up.

Conclusions: These initial results suggest that patient selection for bariatric surgery should not be based on age alone.

Introduction

LIFE EXPECTANCY IS on the rise, and with that, the prevalence of chronic diseases, including obesity. Obesity causes a significant decrease in quality of life and functional independence, especially in older individuals.¹ In the United States, among those older than 60 years of age, 35.4% are obese, and the prevalence of obesity in this group is rapidly rising.² Such negative health and economic consequences have led the healthcare community to consider bariatric surgery as a treatment for obesity in this population. Weight loss achieved by surgical or nonsurgical interventions has been linked to improved survival in patients.³ Bariatric surgery is also the preferred treatment for severely obese patients.^{4,5}

The use of bariatric surgery as a primary treatment of obesity among older adults (>65 years old) is still under debate due to the perceived risk of perioperative and postoperative complications, as well as poor postsurgical outcomes. As a result of nonspecific guidelines regarding bariatric surgery for older adult patients, surgical decisions are made on a case-by-case basis across the world.^{6–9} In older adults, obesity is associated with sarcopenia, defined as the loss of muscle mass and strength with age.¹⁰ Sarcopenia could also

restrict efficient postoperative weight loss in elderly populations. Although very scarce and somewhat contradictory, data are available about bariatric surgery in older adult patients. Some studies have shown that older patients achieve weight loss comparable to that of younger patients.^{11–15} Due to limited data, weight loss surgery has been underutilized among older patients due to the perceived risk of complications and poor success in postsurgical results.¹⁶

Due to the inconsistencies in prior studies, this study evaluated presurgical comorbidities, perioperative and postoperative complications, and postsurgical outcomes (defined as percentage excess weight loss [%EWL]) of minimally invasive bariatric surgery in patients aged 55 years and older to determine if age should be used as a selection criteria for bariatric surgery. It was hypothesized that older adult patients would not have a significant increase in perioperative and postoperative complications. It was also hypothesized that age does not influence %EWL after bariatric surgery.

Material and Methods

This study is a retrospective review of a prospectively maintained database with 750 patients who underwent either

sleeve gastrectomy (SG) or robotic-assisted Roux-en-Y gastric bypass (RYGB) surgery at the University of Illinois Hospital and Health Sciences System between January 2008 and June 2014. This study was conducted with Institutional Review Board approval.

All patients met the standard eligibility criteria for bariatric surgery. Specifically, these patients followed the National Institutes of Health guidelines on obesity and had a body mass index (BMI) $>35 \text{ kg/m}^2$ with weight loss recalcitrant to nonsurgical measures with two or more presurgical comorbidities, or had a BMI $\geq 40 \text{ kg/m}^2$ without presurgical comorbidities.¹⁶ Because the age of 55 years is commonly used to define the older age group in the literature, 55 years of age was also used to divide the current sample. Patients were divided into three major groups: group 1 (<55 years old), group 2 (≥ 55 to <65 years old), and group 3 (≥ 65 years old). The following variables were obtained from the electronic medical records (EMR): age, sex, BMI, presurgical comorbidities, type of surgery, length of hospitalization, postoperative complications (leaks or conversions to open surgery), and %EWL at 6, 12, and 24 months follow-up.

Preoperative evaluation

All patients completed preoperative bariatric assessments, which included surgical, medical, nutrition, and psychological evaluations. Subsequently, patients were also evaluated by the bariatric surgical team to determine eligibility. The type of bariatric procedure was determined by the patient's BMI, presurgical comorbidities, presence of hiatal hernia, past surgical history, and patient's preferences. If the patient had a hiatal hernia, history of moderate to severe gastroesophageal reflux disease, or history of diabetes, then gastric bypass was recommended. If the patient had a BMI $>60 \text{ kg/m}^2$, chronic renal disease, multiple medical problems, or a history of extensive abdominal surgery, then sleeve gastrectomy was recommended. Age alone did not influence the selection process for any of the surgeries. Age alone was not used as an exclusion criterion. Cardiologists, pulmonologists, and endocrinologists were involved if patients presented with any pertinent risk factors. The preoperative evaluation was the same for all groups of patients. Patients aged 55 years or older did not receive any additional examinations based on their age alone.

Intraoperative and postoperative management

Standard antibiotic and antithrombotic prophylaxis were provided. Laparoscopic/robot-assisted SG or RYGB was performed. Patients ambulated a few hours after the procedure.

On postoperative day 1, an oral tolerance trial was performed, and most of the patients were discharged on postoperative day 2. Patients were seen in the bariatric clinic for follow-up at 1, 6, 12, and 24 months.

Statistical analysis

Data analyses were conducted using SPSS Statistics for Windows v22.0 (IBM Corp., Armonk, NY) and SAS v9.3 (SAS Institute Inc., Cary, NC). Comparisons between three groups (<55 years old, ≥ 55 to <65 years old, and ≥ 65 years old) were performed using a chi-square test for categorical variables and one-way analysis of variance for continuous variables. Confidence intervals were set at 95%, and a two-sided p -value of <0.05 was considered statistically significant. Linear regression analysis of %EWL at 6, 12, and 24 months follow-up were performed using age as a continuous variable. Patients' demographics, presurgical comorbidities, type of surgery, length of hospitalization, postoperative complications (leaks or conversions to open surgery), and %EWL at 6, 12, and 24 months follow-up were evaluated.

Results

A total of 750 consecutive patients underwent a minimally invasive SG or RYGB from January 2008 to June 2014. Patients were divided into three groups according to age. Group 1 included 645 patients younger than 55 years of age. Group 2 included 91 patients aged between 55 and 65 years of age, and group 3 included 14 patients 65 years of age or older. Statistical analyses were performed comparing groups: group 1 had a mean age ($\pm SD$) of 39.1 ± 7.8 years; group 2 had a mean age of 58.7 ± 2.8 years; and group 3 had a mean age of 67.5 ± 2.7 years. The mean preoperative BMI in group 1 was $49.3 \pm 8.5 \text{ kg/m}^2$; group 2 had a mean preoperative BMI of $48.6 \pm 8.3 \text{ kg/m}^2$; and group 3 had a mean preoperative BMI of $47.8 \pm 8.4 \text{ kg/m}^2$. There were therefore no significant preoperative differences between groups ($p=0.133$).

As seen in Table 1, significant differences were found in presurgical comorbidities when comparing patients across all three groups ($p<0.001$). Further analyses revealed that patients in groups 2 and 3 had a higher prevalence of hypertension, diabetes, dyslipidemia, arthritis, and obstructive sleep apnea (OSA) than did patients in group 1 ($p<0.001$). Descriptive statistics revealed that patients in group 1 had a greater number of complications—defined as leaks ($n=1$) or conversions to open surgery ($n=2$)—compared to the number of complications in groups 2 and 3, where no leaks or conversions to open surgery were registered.

TABLE 1. COMORBIDITIES BY AGE GROUP

Comorbidities	Group 1: <55 years old ($n=645$)	Group 2: ≥ 55 and <65 years old ($n=91$)	Group 3: ≥ 65 years old ($n=14$)	p
Hypertension	46.7%	82.4%	100%	<0.0001
Type II diabetes	30.6%	61.5%	42.9%	<0.0001
Dyslipidemia	26.4%	63.7%	57.1%	<0.0001
Arthritis	26.4%	64.8%	71.4%	<0.0001
Obstructive sleep apnea	34.3%	59.3%	64.3%	<0.0001

Comparisons between group 1 and groups 2 and 3 were performed using chi square analyses and were all significant ($p<0.0001$).

TABLE 2. PERCENTAGE EXCESS WEIGHT LOSS BY AGE GROUP

Outcome	Group 1: <55 years old	Group 2: >55 and <65 years old	Group 3: >65 years old	p
Length of hospitalization (days)	2.60 (3.1)	2.66 (1.08)	2.71 (1.2)	0.976
%EWL at 6 months	48.7 (29.8)	43.2 (19.9)	49.9 (30.1)	0.406
%EWL at 12 months	59.8 (22.7)	59.7 (25.4)	57.1 (9.1)	0.980
%EWL at 24 months	58.1 (24.8)	57.2 (31.7)	49.6 (25.5)	0.941

%EWL, percentage excess weight loss.

As seen in Table 2, the mean length of hospitalization was 2.60 ± 3.1 days in group 1, 2.66 ± 1.08 days in group 2, and 2.71 ± 1.2 days in group 3, showing no significant differences between groups ($p=0.976$). The mean %EWL at 6 months follow-up was $48.7 \pm 29.8\%$ in group 1, $43.2 \pm 19.9\%$ in group 2, and $49.9 \pm 30.1\%$ in group 3 ($p=0.406$). The mean %EWL at 12 months follow-up was $59.8 \pm 22.7\%$ in group 1, $59.7 \pm 25.4\%$ in group 2, and $57.1 \pm 9.1\%$ in group 3 ($p=0.980$). The mean %EWL at 24 months follow-up in group 1 was $58.1 \pm 24.8\%$, $57.2 \pm 31.7\%$ in group 2, and $49.6 \pm 25.5\%$ in group 3 ($p=0.941$), showing no statistically significant differences across all groups.

Linear regression analysis was performed with %EWL as an outcome and age as a predictor variable. Results from these analyses showed no significant association between %EWL and age. However, there were significant differences in %EWL using type of surgery and preoperative BMI as predictors, showing a higher %EWL in patients undergoing RYGB ($p<0.05$) and lower %EWL in patients with higher preoperative BMIs ($p<0.001$). Linear regression analysis of %EWL at 6 months is summarized in Table 3. The same analysis was performed at 12 and 24 months follow-up using age as a predictor variable. No significant differences in %EWL using age as a predictor were found at 12 or 24 months follow-up ($p=0.56$ and $p=0.162$, respectively).

Discussion

There have been conflicting data from previous studies regarding the effect of age on bariatric surgery outcomes. Due to the perceived increase of perioperative and postop-

erative complications, insufficient weight loss, and higher mortality rate, some studies have considered older age as a contraindication for bariatric surgery.^{11,17,18} However, recent studies have shown that bariatric surgery in older patients is as safe and effective for weight loss as for younger patients.^{12–15,19} The present study showed no significant differences in %EWL in patients across age groups.

At 6 months postsurgery, Fazylov *et al.* showed no difference in %EWL between two age groups (<55 years old vs. ≥ 55 years old).²⁰ The present study revealed similar results. There were no statistically significant differences in %EWL across age groups at 6 months postsurgery. At 1 year postsurgery, Willkomm *et al.* found there was no significant difference in %EWL between two groups (<55 years old vs. ≥ 55 years old; 77.8% vs. 74.8%).²¹ Papasavas *et al.* also showed no significant difference in %EWL between two age groups at 1 year postsurgery.²² The present study also indicated that there was no significant difference at 1 year follow-up in terms of %EWL across age groups.

At 2 years postsurgery, Papasavas *et al.* showed no statistically significant differences in %EWL between two age groups.²² Giordano *et al.* also showed similar results (<55 years old vs. ≥ 55 years old; 65.1% vs. 64.5%).¹³ The present study builds upon those results by showing that there were no significant differences in %EWL across three age groups at 2 years after surgery. Most previous studies have focused on gastric bypass surgery when investigating the impact of age on bariatric surgery outcomes.²³ Very few publications have included SG in their study.²⁴ There are very scarce data available comparing the differences in outcomes of gastric bypass and SG. In the present study, patients who underwent

TABLE 3. LINEAR REGRESSION ANALYSIS OF PERCENTAGE EXCESS WEIGHT LOSS AT 6 MONTHS

Variable	Model 1 (regression coefficient)	p	Model 2 (regression coefficient)	p	Model 3 (regression coefficient)	p
Age (continuous)	–0.00	0.481	–0.00	0.483	–0.00	0.366
Demographic variable:						
SEX			0.00	0.975	–0.02	0.649
Clinical variable:						
SURGTTYPE					0.07	<0.05
BMI					–0.01	<0.001
HTN					0.02	0.617
T2DM					–0.02	0.608
HYPERCOLESTEROLEMIA					0.00	0.894
ARTHRITIS					–0.03	0.368
OSA					–0.03	0.289

SURGTTYPE, type of bariatric surgery (0=sleeve gastrectomy; 1=Roux-en-Y gastric bypass); BMI, preoperative body mass index; HTN, hypertension; T2DM, type II diabetes mellitus; OSA, obstructive sleep apnea.

RYGB had a greater %EWL at 6, 12, and 24 months follow-up compared to patients who underwent SG. Moreover, results revealed a lower %EWL in patients with higher preoperative BMIs.

Other studies have revealed that patients who are 55 years of age or older have a greater number of presurgical comorbidities when compared to patients who are younger than 55 years of age.^{13,23} This study also revealed similar findings regarding presurgical comorbidities. Patients in groups 2 and 3 had a higher prevalence of hypertension, type II diabetes mellitus, dyslipidemia, arthritis, and OSA than did patients in group 1. Due to such differences in comorbidities, patients who are 55 years of age or older should be evaluated more extensively than patients who are younger than 55 years old before bariatric surgery. Some studies have suggested that preoperative evaluations should include the use of cardiac stress testing and coronary angiography in these patients.^{16,24}

Overall, this study has some potential limitations. Based on the data, the study had 80% power to detect a minimum 6.9% difference in %EWL at 6 months between patients younger than 55 years old and patients older than 55 years of age. In linear regression analysis, the study had 80% power to detect at least a 0.18 partial correlation between %EWL at 6 months and one of the three interested predictors (age, surgery type, and BMI). Although the results indicated that the analysis was appropriate with certain power, more solid conclusions require larger sample sizes, especially when the true difference is very small.

Although no major or recurrent minor complications occurred in older patients, which can alert surgeons of a possibly high risk population, it is acknowledged that the sample size for patients who were 65 years of age or older was relatively small in this study. Therefore, future studies on bariatric surgery complications and outcomes are needed with large sample sizes of patients older than 6 years of age. Multicenter studies may help to increase the number of patients older than 65 years of age, which represents the population in which no major conclusions have been drawn. Moreover, future studies with larger sample sizes are also needed to explore further the reasons for the greater number of complications in patients younger than 55 years old versus patients older than 55 years old. Strengths of this study include its inclusion of patients older than 65 years old and the inclusion of those undergoing SG. Future studies will seek to elucidate further the relationships between age, surgery type, preoperative BMI, and outcomes.

In conclusion, this study provides initial support for the use of bariatric surgery in older adult patients aged 55 years of age and older. The results revealed significant differences in presurgical comorbidities across age groups, with higher comorbidities among patients aged 55 years of age or older versus those younger than 55 years old. The study also failed to find significant associations between age and %EWL at 6, 12, and 24 months follow-up. Taken together, these initial results suggest that patient selection for bariatric surgery should not be based on age alone.

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