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Outcomes of Bariatric Surgery: Patients with Body Mass Index 60 or Greater

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ABSTRACT

Introduction: Perioperative outcomes of bariatric surgery in patients with super super obesity (SSO) (BMI ≥ 60 kg/m^2) merit further investigation.

Methods: A retrospective review was conducted of patients with SSO who underwent surgery from Jun 2005 through Jun 2018 at a Metabolic and Bariatric Surgery Center of Excellence. Quantitative demographic data was summarized using descriptive statistics; categorical variables were compared using Fisher's exact test.

Results: Two hundred fourteen procedures were performed, of which 208 were eligible for inclusion. Majority were female (65.4%). The mean age and BMI was 43 (17–68 years) and 65.9 kg/m^2 (60 95 kg/m^2), respectively. Comorbidities included: obstructive sleep apnea (74%), hypertension (59%), gastro-esophageal reflux disease (43%), osteoarthritis (41%), and diabetes mellitus (30%). Surgical approach: 97 Roux-en-Y gastric bypasses (46%), 88 laparoscopic sleeve gastrectomies (42%), and 23 adjustable gastric bands (11%). Additional subset included: primary (87%), conversion (7.7%), and revision (5.3%); majority being laparoscopic (75%) and robotic (24%). Complications via Clavien-Dindo classification: one Grade I, one Grade II, three Grade IIIa, three Grade IIIb, and three Grade IVa. Thirty-day events: 11 complications (5.3%; one leak [0.5%], one deep vein thrombosis [0.5%]), six re-admissions (3%), four re-operations (2%): repair of staple-line leak, repair of incisional hernia, uterine dilation and curettage, and cholecystectomy. No mortalities occurred. Complications occurred in 14.8% of conversion/revision cases, 3.9% in primary cases ($p = 0.0395$) with no difference observed between laparoscopic (4.5%) and robotic (6.1%) modalities ($p = 0.7051$).

Conclusion: Bariatric surgery is feasible in patients with SSO. Revision procedures may increase risk of operative complications.

Key Words: Bariatric surgery, Bariatric complications, Extreme obesity, MBSAQIP, Morbid obesity, Super-super obesity.

INTRODUCTION

Obesity is a complex medical condition that is rising at an overwhelming rate in the United States, resulting in increasing numbers of bariatric surgeries performed each year. The American Society of Metabolic and Bariatric Surgery (ASMBS) recently reported that in the United States 196,000 bariatric surgeries were performed in 2015, a figure that rose to 228,000 in 2017.[1] Body mass index (BMI) is used to classify body fat based on height and weight and is divided into four broad categories: underweight (< 18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obese (≥ 30 kg/m^2). Obesity is further divided into classes I (30–34.9 kg/m^2), II (35–39.9 kg/m^2), and III (≥ 40 kg/m^2).[2] The International Bariatric Surgery Registry also classified the extremely obese patient population as super obese (50–59.9 kg/m^2) and super super obese (≥ 60 kg/m^2).[3] In general, super obese (SO) and super super obese (SSO) have reportedly higher perioperative morbidity and mortality, with risk of premature death as high as five to 10 times that of overweight and obese patients.[4,5] A multimodal approach with physical rehabilitation, psychological support, lifestyle modification, and dietary planning before bariatric surgery has been shown to produce improved patient outcomes.[6] Surgical procedures for SSO patients include

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laparoscopic sleeve gastrectomy, laparoscopic Roux-en-Y bypass, two-staged biliopancreatic diversion with duodenal switch, gastric banding, and often conversion from one procedure to another. Revisions and conversions have now become a significant part of bariatric surgery. According to the ASMBS, revisional bariatric surgery includes conversion, corrective, and reversal procedures.[7] Conversion is defined as a procedure that changes the index procedure to a different type. Corrective procedures are those that address complications or incomplete treatment effects of a previous bariatric procedure. Reversals are procedures that restore the original anatomy. However, information regarding surgical outcomes of revisional procedures can be inadvertently muddled. Due to the lack of consensus in the literature, we have defined revision as a recreation of the original procedure and conversion as a change from one procedure to another (e.g., gastric band to sleeve). The goal of this study was to evaluate the perioperative outcomes of bariatric surgery in the SSO patient population at a Metabolic and Bariatric Surgery Accreditation Quality Improvement Program Center of Excellence.

METHODS

All patients with BMI $\geq 60\,kg/m^2$ who underwent bariatric surgery from June 1, 2005 through June 30, 2018 by three surgeons at a single institution were retrospectively analyzed on prospectively collected data. Board certified surgeons of the Bariatric Surgery Center of Excellence performed all surgical procedures. All patients were screened by a multidisciplinary team including nutritional and psychological assessment, as well as cardiology, pulmonology, and gastroenterology. They also underwent routine pre-operative tests. The operative technique chosen for the patients was determined by the individual surgeon based upon a plan of care established with each patient. The following procedures, both primary and revisional, included gastric banding (GB), sleeve gastrectomy (SG), and Roux-en-Y gastric bypass (RNY). Notably, gastric banding has not been routinely offered at this institution since 2015.

We studied patient demographics (gender, age, BMI, and weight), duration of postoperative hospital length of stay, 30-day events, postoperative complications, and mortality. Postoperative complications were graded according to the Clavien-Dindo classification[8] with expanded analysis on the complication and treatment of the patient case. Principal medical comorbidities were recorded and included obstructive sleep apnea, hypertension, gastroesophageal reflux disease, osteoarthritis, diabetes mellitus, and inferior vena cava filter (IVCF).

Statistical Methods

Descriptive statistics (mean, standard deviation, minimum, and maximum values for continuous variables; frequencies and percentages for categorical variables) were calculated for the overall sample. Complication rates were calculated separately for conversion/revision versus primary cases, and laparoscopic versus robotic modalities. Complication rates were compared for the two groups using Fisher's exact test. A result was considered statistically significant at the $P < .05$ level of significance. All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

Patient Characteristics

Between June 1, 2005 and June 30, 2018, 208 SSO patients underwent 214 primary and revision bariatric procedures at our institution. **Table 1** shows the patient demographics for all bariatric procedures. Of the 208 patients, the majority were female (n = 136, 65.4%). All patients were SSO, with an average BMI of $65.9\,kg/m^2 \pm 6.0$ with a range of 60.0 to $95.0\,kg/m^2$. Sixty-two patients (29.8%) had diabetes and 106 (51.0%) patients had IVCF in place.

Procedure

Two hundred fourteen procedures were performed and 208 were included in the final analysis after six exclusions: four aborted procedures, one internal hernia repair, and one lap band removal. Roux-en-Y, the most frequently performed procedure, occurred in 97 (46.4%) patients: 78 primaries, nine conversions, and 10 revisions. The second most frequent procedure was the laparoscopic SG performed in 88 (42.3%) patients; 83 were primary procedures, while five were conversions. GB was performed in 23 (11.1%) of the patients with 20 as primary, one for revision, and two for bands over RNY. Most procedures were performed using a minimally invasive technique. There were 156 (75.0%) laparoscopic cases, 49 (23.6%) robotic assisted cases, and three (1.4%) of the open modality. The open cases were performed during the first few years of the study data. **Table 2** includes all procedure details.

Table 1.
Baseline Demographics of Patients Undergoing All Bariatric Procedures (n = 208)

Gender	
Female	136 (65.4%)
Male	72 (34.6%)
Age, years	43.0 ± 11.8* (17 – 68)
Caucasian	160 (76.9%)
Body mass index	65.9 ± 6.0* (60 – 95)
Weight, pounds	411.3 ± 66.1* (265 – 639)
Comorbidities	
Obstructive sleep apnea	153 (73.6%)
Hypertension	123 (59.1%)
Gastro-esophageal reflux disease	90 (43.3%)
Osteoarthritis	86 (41.4%)
Diabetes mellitus	62 (29.8%)
Inferior vena cava filter	106 (51.0%)

Table 2.
Procedure and Outcomes**

Procedure, n (%)	
Band	23 (11.1%)
Primary	20
Revision	1
Band over RNY	2
Sleeve	88 (42.3%)
Primary	83
Conversion	5
From band (4)	
From vertical sleeve (1)	
RNY	97 (46.4%)
Primary	78
Conversion	13
From band (8)	
From sleeve (5)	
Revision	6
Modality	
Laparoscopic	156 (75.0%)
Robot-assisted	49 (23.6%)
Open	3 (1.4%)
LOS, days	2.3 ± 0.9* (1, 7)
30-day events	
Readmission	6 (2.9%)
Reoperation	4 (1.9%)
Mortality	0 (0.0%)
Complications	11 (5.3%)

RNY, Roux-en-Y; LOS, length of stay.
*Data are reported as mean ± standard deviation (range) for continuous and frequency (%) for categorical measures.
**Procedure outcomes are divided by surgical approach and primary or revision operations. Short-term outcomes report morbidity and mortality of all bariatric operations.

Postoperative Complications

Eleven complications occurred and were graded according to the Clavien-Dindo classification system: one Grade I, one Grade II, three Grade IIIa, three Grade IIIb, and three Grade IVa (**Table 2**). The Grade I complication was a wound hematoma that required in office incision and drainage. The Grade II complication was postoperative pneumonia that required antibiotic treatment. Grade IIIa complications involved three patients with ongoing intolerance to postoperative intake and required esophagogastroduodenoscopy for further evaluation. One Grade IIIb complication involved one patient who developed a postoperative deep vein thrombosis and was placed on anticoagulation. This patient subsequently required a dilation and curettage for persistent vaginal bleeding. The second Grade IIIb complication was a patient who experienced biliary colic and underwent a laparoscopic cholecystectomy. The last Grade IIIb complication was a re-operation for the only patient in this study noted to have a staple line leak (00.5%) Three patients did require escalation with re-intubation and transfer to the surgical intensive care unit. There were no mortalities. Having a conversion and revision surgery appeared to increase the risk of complication. Complications occurred in 14.8% of conversion/revision cases and only 3.9% in primary cases ($P = .0395$) with no difference in complications between laparoscopic (4.5%) and robotic (6.1%) modalities ($P = .7051$). Complications were also evaluated based on procedure type and no significant difference was found: GB 4%, SG 3%, RNY 7%, $P = .5013$. The presence of an IVCF was not associated with an increased risk of complication in this study (5.7% vs. 4.9%, $P = .8069$).

DISCUSSION

Obesity is a well-known risk factor for numerous comorbidities, morbidities, and mortality. Weight loss may protect against these conditions as shown by outcomes of the Swedish Obese Subjects study, which found a decreased incidence of diabetes, myocardial infarction, stroke, cancer, and mortality following surgery.[9] Christou et al. also showed that weight-loss surgery significantly

decreases overall mortality as well as the development of new health-related conditions in morbidly obese patients.[10] Patients with SSO constitute a challenge to both medical and surgical management. As bariatric surgery numbers increase secondary to growing prevalence in obesity, the safety of the procedure within each patient population is an important consideration. Previous studies in the literature describe higher morbidity and mortality in patients with a BMI $\geq 60\,kg/m^2$. Concerns with increased operative complications and associated comorbidities in SSO patients herald hesitance in pursuit of surgical management.[11] One study found that higher BMI reportedly increased patient risk after bypass procedures; BMI $> 60\,kg/m^2$ had an odds ratio of 1.95 (97% confidence interval) with $P < .0004$.[12] In addition to increasing BMI, SSO patients also have concomitant comorbidities that increase the risk for perioperative complications. Gupta[13] developed a risk calculator looking at over 11,000 patients through the National Surgical Quality Improvement Program to identify pre-operative risk factors that may assist in predicting postoperative morbidity after various bariatric procedures to aid in surgical decision making and risk reduction. The stepwise multiple logistic regression model selected BMI as one of the major risk factors for postoperative major morbidity. Specifically, it was noted that patients with BMI $> 60\,kg/m^2$ had a significantly higher adjusted odds ratio.

The purpose of our study was to examine the outcome of SSO patients undergoing bariatric surgery. One prior study reported no significant difference between groups (BMI $> 60\,kg/m^2$ and BMI $< 60\,kg/m^2$) regarding complications and 30-day mortality in patients undergoing gastric bypass.[14] In fact, further analysis show patient demographics similar to our study with an average BMI of $64.9 \pm 5.3\,kg/m^2$ and an average age of 42.8 ± 11.8 years with a female predominance (70.5%). Similar results with gastric bypass with safe outcomes in patients with BMI $> 60\,kg/m^2$ was documented in another study by Kushnir in 2010.[15] Interestingly, lower stricture rate were reported in patients with BMI $> 60\,kg/m^2$ when compared to BMI < 60 at one year.

With increased prevalence of bariatric surgeries performed, there is inevitably a corresponding percentage of patients with failed treatment needing revision surgery. Bariatric revisions include conversions, corrections, or reversals and account for 14% of total 228,000 procedures performed in 2018.[1] Of note, to our knowledge, this is the only study that separately analyzes conversion and revision surgical procedures in the setting of SSO patients. In our cohort, there were a total of 15 conversion and 11 revision procedures, the majority being RNY. Complications occurred in 14.8%, with no difference in surgical modality. While this rate is significantly greater than that of primary procedures, it is not entirely unexpected. We previously found that conversion from gastric band to SG is safer than conversion to RNY in both robotic and laparoscopic platforms;[16] however, these findings were not specific to SSO. In this current cohort, the compilation of SSO and higher percentage of RNY conversion support our previous data. While there is no current consensus for the optimal procedure,[7] future studies would need to review optimal nonprimary bariatric procedure for SSO patients, including perioperative and both short and long term outcomes.

In a retrospective study, Moon[17] reported there are equal readmission and re-operation rates in patients with BMI 40–60 kg/m^2 and patients with BMI $> 60\,kg/m^2$, thus proposing that SSO patients are not at increased risk for surgical complications. Stephens[3] previously reported increasing trends in complications with SSO that underwent laparoscopic RNY; however, re-examination of short term outcomes for the original 291 SSO patients found that there was no significant difference in mortality rates when compared with patients with BMI $< 60\,kg/m^2$. Patient characteristics revealed higher percentages of male, black, sleep apnea, and charity care. Moon's study also reported an increased operative time, length of stay, and transfer of patients to chronic care facility at discharge for patients with BMI $> 60\,kg/m^2$. In contrast, Taylor[18] found no difference for the same factors for SSO patients after laparoscopic gastric bypass. A large single center reviewed laparoscopic RNY over the last 20 years and found that patients with BMI $\geq 60\,kg/m^2$ tolerated the procedure with no significant difference in postoperative outcomes or complications.[19] Reasonable factors relating to surgical technical difficulty include increased liver size, thickened meso-colon, trocar positioning, and trocar length.[20] The experience and skill of the operating surgeon may play into the outcomes of the patients.[13]

Few studies compare the effectiveness of one surgical procedure to another in patients with BMI $> 60\,kg/m^2$ and therefore the optimal bariatric procedure has yet to be agreed upon. The overall risk of death and adverse outcome after bariatric surgery is low, but varies considerably based upon different risk groups.[11] Weight loss was reported to be higher in patients who underwent gastric bypass than patients who underwent SG at 12 and 24 months with both groups reporting minimal postoperative complications and no significant complications and mortality rates.[21] Significant weight loss with mini gastric bypass (one anastomosis) when compared to SG was

reported by another study.[22] Mehaffey[19] reported outcomes after laparoscopic RNY in SSO patients with as high as 61.6% excess body mass index lost (EBMIL) and total weight loss (TBWL) 37.6% versus the non-SSO 69.3% EBMIL and 33.6% TBML at 48 month follow up. No significant mortality or major complications were reported at six months, one year, and two years.

Conditions associated with obesity such as hypertension, dyslipidemia, diabetes mellitus, and sleep apnea, may be improved from surgery, with overall improvement in factors affecting heart disease and quality of life.[9] The concomitant prevalence of diabetes has been studied with increasing weight classes.[23] A cross-sectional study found a linear relationship between the prevalence of metabolic abnormalities (diabetes, prediabetes, and metabolic syndrome) substantially increasing with increasing BMI. The entire cohort screen-detected 1,258 patients with 14% for type 2 diabetes, with a range from 6.5% in BMI 30–39.9 kg/m^2 to 20.5% for BMI $\geq 50\,kg/m^2$ (p for trend < 0.001).[24] In our SSO population, 31% of patients were noted to have diabetes, which initially appears high. However, our stratified group of patients was specific to SSO, and follows the expected linear trend reported in literature. Few studies are available that describe the impact and long-term outcome of bariatric surgery on SSO patient comorbidities. Further studies would be needed for long-term impact in assessing improvement or resolution of medical comorbidities within this subpopulation.

High volume bariatric surgery centers have reported better outcomes in managing SSO patients when compared to centers that perform these procedures infrequently.[3] Overall mortality rate of revision operations can be as high as 1.65% and previously contributed to surgeons' reluctance to perform such procedures, especially in SO and SSO patients.[25] The advent of robotics provides comparable or improved clinical outcomes compared to conventional laparoscopy. Factors include superior visualization, improved rotational movement, and ergonomic advantage for the surgeon.[26] The robotic platform may eliminate limitations such as torque from abdominal wall thickness and improve dissection limitations given a heavy liver and excess omental fat in SO and SSO patients.[27] Multiple studies support decreased leak rate post-gastric bypass via robotic performance in re-operation procedures as well.[18,28–30] Gray[31] found that while both laparoscopic and robotic approach can be safely performed, the greatest benefit in use of robotics is with increasingly complex cases; these procedures have acceptable short-term outcome, decreased length of stay, shorter operative time, decreased blood loss, lower stricture rates, and reduction in conversion to open surgery. Our results suggest that revision surgery in the SSO has comparable adverse event profiles, and these patients, given the complexity and technical challenge, may show optimal long-term benefit from robotic surgery.

CONCLUSION

Our results indicate that despite SSO patients historically having increased risk for comorbidities and peri-operative complications, bariatric surgery can be safely performed. These patients have overall comparable risks and complications with no change in postoperative morbidity or mortality in primary bariatric procedures. Revision procedures may increase risk. Future studies are needed to assess selection of the optimal operative procedure for SSO patients, including complication rates with revision robotic bariatric surgery in short and long term follow up.

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