Evaluation of outcome and safety of bariatric surgery in super-obese elderly patients

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Background
Super obesity and old age are risk factors for bariatric complications. However, super-obese elderly (SOE) patients are the most vulnerable for obesity-related complications and the most in-need candidates for bariatric surgery. This study evaluates the safety and outcome of bariatric surgery in SOE patients.
Patients and methods
A retrospective cohort study of patients older than 60 years who underwent bariatric surgery was conducted between January 2015 and June 2018. The study group included patients older than 60 years with BMI more than or equal to 50 kg/m^2, whereas the control group [morbidly obese elderly (MOE) group] included patients older than 60 years with BMI less than 50 kg/m^2. Included bariatric procedures were sleeve gastrectomy, one-anastomosis gastric bypass (OAGB), Roux-en-Y gastric bypass, and revisional bariatric surgeries. Outcomes of both groups after bariatric surgery were compared in terms of in-hospital morbidities and mortalities.
Results
Of 99 elderly patients, the SOE group included 60 (60.6%) patients with a mean age of 63.05±2.7 years and mean BMI of 57.97±6.1 kg/m^2. MOE group included 39 (39.4%) patients with mean BMI of 44.32±4.1 kg/m^2. A total of 51 (85%) patients underwent laparoscopic sleeve gastrectomy and nine (15%) patients underwent laparoscopic OAGB. Major postoperative complications occurred in six (10.1%) patients with SOE and in two (5.1%, P=0.39) patients of the MOE group. There was no hospital mortality among SOE patients, whereas one patient of the MOE group died out of septic shock secondary to anastomotic leak after OAGB. Regarding excess weight loss, there was no significant difference between both groups.
Conclusion
The safety of bariatric surgery in SOE patients is comparable to MOE patients. Judicious perioperative management is important for safety and better outcome.

Keywords:
bariatric surgery, elderly population, high risk, older age, super obesity

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Introduction

Super obesity (SO) in elderly patients is a double-folded problem. SO is associated with higher rate of medical comorbidities, less mobility, and less compliance to medical instructions and behavioral changes [1,2]. Moreover, elderly population has a higher prevalence of chronic comorbidities, lower physical activity, and less response to weight-reduction therapies [3]. Sarcopenia, a reduction in skeletal muscle mass related to aging, aggravates the pathological and metabolic sequalae of obesity in the elderly [4]. In addition, the effect of aging-related changes in fat distribution and body composition on general health and survival is not fully understood [5].

Although bariatric surgery is recognized as the most effective treatment for morbid obesity, the choice of the proper management plan for super-obese elderly (SOE) patients is a clinical dilemma. The rationale for managing one condition is, to a great extent, contradictory to the approach to the other one. Simple procedures with rapid recovery and less anesthetic exposure are more suitable for elderly patients [6]. On the contrary, staged-approach ending into complex malabsorptive procedures is better for SO to achieve maximum weight loss [7]. SO poses a technical challenge owing to left lobe hypertrophy, heavy abdominal wall, increased visceral fat, thick omentum, short mesentery, and difficult exposure of the angle of His [1,7]. Bridging procedures and conversion to open approach are suggested to overcome technical difficulties in SO [1]. However, these solutions are not suitable in

elderly patients as the least invasive procedures and minimal exposure to anesthesia are recommended.

Approximately 17% of the population is expected to be more than or equal to 65 years in 2050 on the global scale [8,9]. Moreover, the prevalence of SO in candidates for bariatric surgery is increasing [2]. Bariatric surgery increased by three folds in elderly population compromising 10% of annual bariatric procedures over the past decade [10,11]. So, the health care providers are expected to manage a substantial increase in SOE patients. Nevertheless, there is scarce research that exclusively deals with bariatric surgery in SOE patients [11–13]. The aim of the present study is to evaluate the safety and outcome of laparoscopic bariatric surgery in SOE patients.

Patients and methods

This is a retrospective cohort study of all patients who underwent laparoscopic bariatric surgery in the period between January 2015 and June 2018. This study was performed in Gastrointestinal Surgery Center of Mansoura University. The study group included patients older than 60 years with BMI more than or equal to 50 kg/m^2, whereas the control group [morbidly obese elderly (MOE) group] included patients older than 60 years with BMI less than 50 kg/m^2. Included bariatric procedures were sleeve gastrectomy (SG), one-anastomosis gastric bypass (OAGB), Roux-en-Y gastric bypass (RYGB), and revisional bariatric surgeries. Bypass surgery was recommended for patients with uncontrolled diabetes mellitus with special emphasis on the need for long-term follow-up and lifelong supplementations. All patients signed a written informed consent before surgery.

The primary outcomes were in-hospital morbidities and mortalities within 30 days of surgery. Secondary outcomes included rate of conversion to open approach, length of hospital stay, resolution of comorbidities, percentage of excess weight loss (%EWL), percentage of total body weight loss, and long-term complications. Diagnosis and cure of diabetes were defined according to the recommendations of the American Diabetes Association [14,15]. Resolution or improvement of medical comorbidities was defined by cessation or reduction of dosage of medical treatment respectively, as determined by the specialized physician. Postoperative complications are defined and classified according to the standardized outcome reporting of bariatric surgery [16].

Regarding preoperative data recorded, all patients were evaluated by multidisciplinary team including bariatric surgeons, dieticians, pulmonologist, cardiologist, endocrinologist, and psychiatrist. All patients were enrolled in a 2 months low-carbohydrate dietary program before surgery and a very-low-calorie diet 5 days before surgery. Our routine preoperative investigations included an upper endoscopy and pulmonary function testing.

All patients received proper thromboembolic prophylaxis [17].

This has been considered a clinical retrospective cohort study, and no ethical approval was requested. Patients' data were collected from a prospectively maintained bariatric database. Preoperative variables included demographic characteristics, previous weight-reducing therapies, medical comorbidities, imaging studies, and laboratory investigations. Operative data included type of procedure, specific procedural details, operative time, blood transfusion, and intraoperative complications. Postoperative complications, need for reoperation, hospital stay, and time of starting oral intake were recorded. The follow-up visits were scheduled every 3 months in the first year and then every 6 months. The minimum duration of postoperative follow-up was 18 months.

Data distribution was tested for normality using the Kolmogorov–Smirnov test and Shapiro–Wilk test. Categorical variables are expressed as group percentages, and continuous data are presented as medians with range. Categorical variables were compared for independent samples using χ^2 test, and continuous data were compared for independent samples using t test or Mann–Whitney test according to the data distribution. Statistical analyses were performed using SPSS, version 17 (SPSS Inc., Chicago, Illinois, USA).

Results

In the duration between January 2015 and June 2018, 99 elderly patients (>60 years) underwent bariatric surgery with a mean age of 63.08±2.74 years and mean BMI of 52.6±8.6 kg/m^2. None of the patients were older than 70 years. A total of 60 (60.6%) patients were super obese (BMI ≥50 kg/m^2), and of those, 18 (18.2%) patients were super-super obese (BMI ≥60 kg/m^2). Baseline characteristics of the super obese and morbidly obese patients are summarized in Table 1. There were no revisional surgeries in this series.

Operative and postoperative details are summarized in Table 2. There were no primary RYGB or revisional procedures in this series as whenever possible, complex malabsorptive procedures were avoided in SOE patients owing to technical difficulty, long anesthetic exposure, and demanding follow-up. Two patients had chronic calculous cholecystitis on routine preoperative ultrasound, but they were informed that concomitant cholecystectomy would not be performed for the sake of saving time. Laparoscopic approach was employed in all patients with no conversion to open surgery. Stapler failure occurred in two patients and was managed by inward restapling with reinforcement by interrupted sutures, and the postoperative course of both cases was uneventful.

Two cases of thromboembolic complications occurred in the SOE patients. One case of pulmonary embolism presented on the eighth day and had been successfully managed with anticoagulant therapy. The other case presented 6 weeks after surgery with mesenteric vascular occlusive disease that was managed by resection anastomosis of ~50 cm from the jejunum. There was one case of staple line leakage after SG in the SOE group and was managed by laparoscopic exploration, drainage, and endoscopic stenting on the seventh postoperative day. Hospital mortality occurred in one patient from the MOE group who presented with anastomotic leakage 1 week after OAGB, who was managed by surgical exploration, drainage, and feeding jejunostomy but died 10 days later of septic shock and multiorgan failure.

The mean duration of follow-up was 33 months after surgery ranging from 12 to 60 months. Three patients died during the first year after surgery. One patient from the MOE group presented with protein-energy malnutrition 8 months after OAGB and died 2 weeks after reversal surgery from liver cell failure. Another patient from the SOE group presented with protein-energy malnutrition 10 months after OAGB, who was admitted twice and was discharged after good response to nutritional support, but 2 weeks later, he died owing to severe soft tissue infection in the upper limb. The third deceased patient, from the SOE group, died 8 months after OAGB owing to pulmonary embolism. The progress of weight loss and resolution of comorbidities in SOE and MOE groups are summarized in Table 3.

Discussion

SO and older age are identified as risk factors for morbidity and unsatisfactory outcome after bariatric

Table 1 Baseline characteristics of the study population

Variables	Super-obese group (*N*=60) [*n* (%)]	Morbidly obese group (*N*=39) [*n* (%)]	*P* value
Age (years)	63.05±2.7	63.13±2.8	0.89
≥65	16 (26.7)	12 (30.8)	
Sex (female : male)	48 : 12	26 : 13	0.14
BMI (kg/m^2)	57.97±6.1	44.32±4.1	0.0001
Weight loss attempts			
None	7 (11.7)	13 (33.3)	0.94
Dietary regimen	52 (86.7)	23 (59)	
Intragastric balloon	1 (1.7)	3 (7.7)	
Comorbidities			
Type II DM	29 (48)	15 (38.5)	NS
Hypertension	40 (66.7)	26 (66.7)	NS
OSAS	37 (61.7)	9 (23.1)	NS
Osteoarthritis	59 (99.3)	39 (100)	NS
Hypercholesterolemia	31 (51.7)	11 (28.2)	NS
Patients with 1 comorbidities	7 (11.7)	9 (23.1)	
Patients with 2 comorbidities	12 (25)	12 (30.8)	
Patients with 3 comorbidities	11 (18.3)	8 (20.5)	
Patients with 4 comorbidities	9 (15)	7 (17.9)	
Patients with 5 comorbidities	18 (30)	3 (7.7)	
Previous surgery			
Cholecystectomy	20 (33.3)	21 (53.8)	
Cholecystectomy and appendectomy	1 (1.7)	0	
Lower abdominal surgery	0	1 (2.6)	
Left lower limb BKA	1 (1.7)	0	
Spine surgery	1 (1.7)	0	

BKA, below-knee amputation; DM, diabetes mellitus; OSAS, obstructive sleep apnea syndrome.

Table 2 Operative and postoperative data

	Super-obese group (*N*=60) [*n* (%)]	Morbidly obese group (*N*=39) [*n* (%)]	*P* value
Type of procedure			
SG	51 (85)	31 (79.5)	0.48
OAGB	9 (15)	8 (20.5)	
Sleeve gastrectomy			
Staple line reinforcement	37 (61.7)	24 (61.5)	0.62
Operative time	87.5±40.3	69.1±15.5	0.008
Blood transfusion			
None	59 (98.3)	39 (100)	0.1
One unit	1 (1.7)		
Intraoperative difficulties			
Large left lobe	15 (25)	3 (7.7)	0.029
Adhesions	11 (18.3)	1 (2.6)	
Anesthetic problems	4 (6.7)	2 (5.1)	
Intraoperative complications	8 (13.3)	4 (10.3)	0.65
Staple line bleeding (sutured)	7 (11.7)	3 (7.7)	
Stapler failure	1 (1.7)	1 (2.6)	
Hospital stay (days)	1.13±0.4	1.18±0.4	0.57
Time to start oral intake (h)	15.6±9.5	14.6±9.5	0.62
Postoperative complications	6 (10)	2 (5.1)	0.39
Internal hemorrhage	None	None	
Staple line leakage	1 (1.7) (SG)	1 (2.6) (OAGB)	
MVO	1 (1.7) (SG)	None	
Pulmonary embolism	1 (1.7)	None	
Wound infection	2 (3.3)	1 (2.7)	
Chest infection	1 (1.6)	None	
Major complications	4 (6.7)	1 (2.6)	
Hospital mortality	None	1 (2.6)	0.21

MVO, mesenteric vascular occlusion; OAGB, one-anastomosis gastric bypass; SG, sleeve gastrectomy.

surgery [2,18–20]. Combined with male sex, hypertension, and history of thromboembolic disease, the 90-day mortality rate increases substantially to 7.6% [21]. However, SOE patients are the most vulnerable for obesity-related complications and the neediest candidates for bariatric surgery. This can be coined as a bariatric surgery paradox 'the higher the risk, the greater the need.' Few studies have exclusively presented the experience with SOE patients (Table 4). This study demonstrates the safety and outcome of bariatric surgery in SOE, and it is the first study to include OAGB as a surgical option for this subgroup of patients.

The rate of major early and late postoperative complications in the studies limited to SOE patients is 10–16%. In a study by Aminian *et al*. [19] on limited to extremely high-risk morbidly obese patients, the rate of major complications was 13.6%. The morbidity rate in SOE patient lies within the reported range of postoperative morbidity in elderly patients, including all classes of morbid obesity, which is 1–23% [10,22,23]. This also copes with a reported rate of 2.5–32.2% for postoperative morbidity in SO patients including all age groups [11,20,24]. In this series, there was no significant difference in postoperative complications between SOE and MOE groups [six (10%) vs. two (5.1%), *P*=0.39]. So, despite being comparable to high-risk groups, bariatric surgery in SOE patients results in no substantial increase in postoperative morbidity rate compared with outcome in SO or elderly patients alone.

Early detection of postoperative complications in SOE patients is a clinical challenge. Symptoms of pre-existing comorbidities, such as shortness of breath owing to restrictive lung diseases, may mask symptoms of newly developed postoperative pulmonary complications. Abdominal examination is usually deceiving owing to capacious peritoneal cavity, thick abdominal wall, and high pain threshold caused by diabetic neuropathy [25]. Vital signs are usually affected by preoperative cardiac comorbidities and medications such as β-blockers-induced bradycardia. Abdominal imaging carries a high fallacy rate owing to low sensitivity of ultrasound, weight-limit and width-limit for computed tomography scanner tables and gantry apertures, difficult patient mobility, and image artifacts [26]. Moreover, diagnostic laparoscopy is not an easy-to-take decision and must be weighed against unnecessary exposure to anesthetic and surgical insult.

Table 3 Weight loss and resolution of comorbidities on follow-up

	Super obese group (*N*=60) (mean±SD)	Morbidly obese group (*N*=39) (mean±SD)	*P* value
1-year weight loss progress			
WT (kg)	105.96±14.5	82.57±9.1	0.0001
BMI (kg/m^2)	41.7±5.9	31.3±2.7	0.0001
%EWL	47.7±10.1	62.8±10.7	0.0001
SG	47.5±10.1	62.8±10.5	
OAGB	49.6±10.9	62.7±12.6	
%TBWL	28.2±5.5	28.8±5.3	0.65
SG	28.1±5.2	28.5±4.7	
OAGB	29.2±7.4	30.3±8	
1-year diabetic state			
Basal (*n*)	29 (2 deceased)	15 (2 deceased)	0.85
Improved [*n* (%)]	6 (20.7)	2 (15.4)	
Resolved [*n* (%)]	18 (66.7)	10 (76.9)	
1-year HTN			
Basal (*n*)	40 (2 deceased)	26 (2 deceased)	0.9
Improved [*n* (%)]	19 (50)	11 (45.8)	
Resolved [*n* (%)]	17 (44.7)	12 (50)	
1-year OSAS			
Basal (*n*)	37 (2 deceased)	9 (1 deceased)	0.14
Improved [*n* (%)]	7 (20)	8 (100)	
Resolved [*n* (%)]	28 (80)		
Completed 2-year follow up	49 (84.5)	35 (94.6)	
2-year weight loss progress			
WT (kg)	103.6±13.1	80.3±8.5	0.0001
BMI (kg/m^2)	40.6±4.9	30.6±2.5	0.0001
%EWL	50.8±10.3	66.2±9.9	0.0001
SG	49.5±9.7	65.6±8.97	
OAGB	59.6±11.5	69±14.4	
%TBWL	30.2±5.98	30.5±5.6	0.83
SG	29.5±5.7	29.9±4.7	
OAGB	35.1±5.8	33.3±8.5	
2-year diabetic state			
Completed follow up (*n*)	20	13	0.74
Improved [*n* (%)]	4 (20)	2 (15.4)	
Resolved [*n* (%)]	16 (80)	11 (84.6)	
2-year HTN			
Completed follow up (*n*)	30	23	0.45
Improved [*n* (%)]	13 (43.3)	8 (34.8)	
Resolved [*n* (%)]	17 (56.7)	14 (60.9)	
2-year OSAS			
Completed follow up (*n*)	28	8	0.26
Improved [*n* (%)]	4 (14.3)		
Resolved [*n* (%)]	24 (85.7)	8 (100)	

%EWL, percentage of excess weight loss; %TBWL, percentage of total body weight loss; HTN, hypertension; OAGB, one-anastomosis gastric bypass; OSAS, obstructive sleep apnea syndrome; SG, sleeve gastrectomy.

Several precautions can be applied to reduce the risk and achieve early detection of complications in SOE patients. Preoperative risk stratification in bariatric clinics according to a unified protocol to detect high risk patients is essential [19,27]. The second factor is limitation of bariatric surgery in high-risk groups, including SOE patients, to high-volume bariatric centers. High-volume centers provide multidisciplinary preoperative risk optimization, suitable operative and imaging equipment, trained nursery staff, and surgical expertise [10,19]. Risk optimization includes achievement of preoperative weight loss, correction of metabolic profile, and setting realistic expectations for postoperative complications and long-term outcome. In a study by Lee *et al.* [7] on University Health System Consortium (UHC) Clinical Database, the outcome of elderly patients undergoing bariatric surgery in 2009–2013 was better compared with elderly patients from 1999 to 2005 regarding hospital stay (2.60±3.2 vs. 4.9±4.0

Table 4 Summary of preoperative, operative, postoperative, and follow-up data of available studies on super obese elderly patients (data presentation was limited to the super obese group even if the study presented a control group)

	Elbahrawy *et al*. (2017)	Daigle *et al*. (2016)	McGlone *et al*. (2015)	Current study
Definition of elderly	> 60 years	> 65 years	> 60 years	> 60 years
Total number	66	30	26	59
Age (years)	63.3±2.6	67.1±2.7	NR	63.05±2.7
BMI (kg/m^2)	56.4±6.4	55.9±3.9	54.4±3.4	57.97±6.1
Comorbidities [*n* (%)]				
Type II DM	39 (59)	15 (50)	16 (61.5)	29 (48)
Hypertension	48 (72.7)	27 (90)	22 (84.6)	40 (66.7)
OSAS	18 (27.3)	14 (46.7)	7 (26.9)	37 (61.7)
Osteoarthritis	NR	NR	9 (34.6)	59 (99.3)
Hypercholesterolemia	24 (36.4)	16 (53.3)	10 (38.5)	31 (51.7)
Procedures [*n* (%)]				
SG	85 (74)	6 (20)	17 (65)	51 (85)
LAGB	Not performed	8 (26.7)	Zero	Not performed
OAGB	Not performed	Not performed	Not performed	9 (15)
RYGB	18 (16)	16 (53.3)	9 (35)	Not performed
BPD/DS	8 (7)	Not performed	Not performed	Not performed
Revision	4 (3)	Not performed	Not performed	Not performed
Hospital stay (days)	NR	3 (1–17)	2±0.25	1.13±0.4
Major postoperative complications	7 (10.6)	5 (16)	3 (12)	6 (10.1)
Mean follow up time (m)	42 (24–120)	37 (6–95)	33 (19-50)	33 (12–60)
2-year retention rate	79%	60%	NR	84.5%
Outcome				
2-year %EWL	48.8±20.8	44.5±20.5)	56.7±22.0	50.8±10.3
DM remission	17 (44)	5 (33.3)	9 (53)	18 (66.7)
DM improvement	31 (79)	6 (40)	NR	6 (20.7)
HTN remission	11 (23)	NR	10 (59)	17 (44.7)
HTN improvement	31 (65)	NR	NR	19 (50)
Hospital mortality (*n*)	None	None	1 (RYGB)	None
Cause of hospital mortality			Incarcerated abdominal wall hernia	
Long term mortality (*n*)	None	None	NR	2 (both OAGB)
Cause of late mortality				PEM and PE

%EWL, percentage of excess weight loss; BPD/DS, biliopancreatic diversion with duodenal switch; DM, diabetes mellitus; HTN, hypertension; LAGB, laparoscopic adjustable gastric band; NR, not reported; OAGB, one-anastomosis gastric bypass; OSAS, obstructive sleep apnea syndrome; PE, pulmonary embolism; PEM, protein-energy malnutrition; RYGB, Roux-en-Y gastric bypass; SG, sleeve gastrectomy.

days) and in-hospital mortality (0.11 vs. 0.7%). In another study by Nguyen *et al.* [28] using the same database comparing outcome of patients older than 55 years in 44 low-volume (228 patients) versus 27 medium-volume (794 patients) versus 22 high-volume (1276 patients) hospitals, the observed-to-expected in-hospital mortality ratio was 3.9, 1.7, and 1.2%, respectively (P <0.05 between low and high volume centers).

The third factor for risk reduction in SOE patients is the implementation of minimally invasive approaches in management [10]. Laparoscopic approach is safer than open approach in SOE patients [10,19,20]. Many authors recommend simple procedures with low morbidity profile, such as SG and LAGB, in SOE patients [6,29]. In a study using American College of Surgeon's National Surgical Quality Improvement Program (ACS NSQIP) database, Dorman *et al.* [8] observed an inflection point in the type of the bariatric procedure at patient age more than 65 years with significant increase in LAGE compared with RYGB in those patients. Open approach (adjusted odds ratio: 5.5) and gastric bypass procedure (adjusted odds ratio: 1.6) are demonstrated to be the modifiable risk factors for early postoperative mortality in a study using the Nationwide Inpatient Sample (304 515 patients) [29]. Other studies demonstrated no increase in the postoperative morbidity in malabsorptive and complex procedures [30–32].

The fourth factor contributing to risk reduction in SOE is a specialized follow-up program. Our experience with SOE patients leads to implementation of a close follow-up program in the first 2 months after surgery for early detection of life-threatening medical and surgical complications. This included implementation of telemedicine and serial

laboratory surveillance with low threshold for suspicion of complications. Patients received phone calls from a trained nurse twice a week in the first 2 weeks then weekly for 2 months. Laboratory markers of sepsis and coagulopathy (leukocytic count, C-reactive protein, D-dimer, and serum lactate) were requested every 2 weeks in the first month. Patients were educated to contact the specialized nurse if there is any concern about newly developed symptoms.

The 2-year %EWL and rate of diabetic remission in studies limited to SOE patients by Elbahrawy *et al*. [11], Daigle *et al*. [12], and McGlone *et al*. [13] were 48.8±20.8 and 44%; 44.5±20.5 and 33.3%; and 56.7 ±22.0 and 53%, respectively. The %EWL was significantly higher in the MOE compared with the SOE group (P=0.0001); however, there was no significant difference between both group regarding resolution of diabetes mellitus (P=0.74), hypertension (P=0.45) and obstructive sleep apnea syndrome (P=0.26). Our findings cope with the notion that resolution of comorbidities in SOE patients exceeds the reduction of weight [33,34]. This may support the future adoption of outcome measures and quality indicators rather than mere progress of weight loss alone in SOE patients. Resolution of comorbidities, reduction in medications, and better quality of life are important parameters to follow in case of reduced life expectancy as in SOE patients [13,33].

The limitations of this study are small unequal sample size, although this is a relatively accepted number for a study limited to SOE. This is also a retrospective study but the data were retrieved from a prospectively maintained bariatric database. Another limitation is the absence of a younger control group. Although most of the comparative studies between young and elderly populations demonstrate a superior outcome in the young control group, we believe that the pathophysiology of obesity and outcome measures for SOE patients is different from the younger age and the comparison cannot be accurate [3,33]. A prospective randomized study with equal distribution of operative procedures is highly recommended.

Conclusion

The safety of bariatric surgery in SOE patients is comparable to MOE patients. Although SOE should not be deterred from bariatric surgery, judicious perioperative management is important for safety and better outcome. Preoperative risk stratification, multidisciplinary risk optimization, minimally invasive approaches, and specialized follow-up programs implementing telemedicine and serial laboratory investigations are helpful elements in risk reduction. Although the %EWL is not optimal, the resolution of medical comorbidities and reduction of medications are satisfactory. Further multicenter studies are required to define the ideal procedure, safety, and outcome of bariatric surgery in SOE patients.

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Conflicts of interest

There are no conflicts of interest.

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