Medicine Updates Faculty of medicine
July 2023,volume 14, issue 14
https://muj.journals.ekb.egdean@med.psu.edu.eg
vice_dean_postgraduate@med.psu.edu.eg
DOI: 10.21608/MUJ.2023.203000.1135

ISSN : 2682-2741

Submitted: 29 /03/2023
Accepted : 29/05/2023
Pages: 37 - 62

"One Year Follow-up of Laparoscopic Single Anastomosis Sleeve Ileal Bypass in Super-morbidly Obese Patients ."

Authors

Mohamed Mosaad Kandel [1]

Mohamed Mourad Hassan [2]

Reda Fawzi Ali [3]

[1] General Surgery Department, Faculty of Medicine, Port Said University, Port Said, Egypt

[2] General Surgery Department, Faculty of Medicine, Alexandria University, Alexandria, Egypt

[3] General Surgery Department, Faculty of Medicine, Kafr Elshiekh University, Kafr Elshiekh, Egypt

ABSTRACT

Background: Single anastomosis sleeve ileal (SASI) bypass has been introduced as a novel modification of sleeve gastrectomy by adding a side-to-side single loop anastomosis between the gastric pouch and the ileum. The SASI bypass is still considered an investigational technique that needs more assessment.

Aim: this study assessed the short-term operative and postoperative outcomes of laparoscopic "SASI" Bypass in management of patients with super-morbid obesity.

Methods And Patients: This cohort retrospective study included 20 adult patients with super- morbid obesity with a body mass index (BMI) more than 50 kg/m^2 who underwent laparoscopic SASI bypass surgery. All patients were scheduled for follow-up regularly at 3, six months, and 12 months post-operatively.

Results: Body weight, BMI and waist-hip ratio showed a significant progressive decrease over the one-year follow-up period ($p < 0.001$). Mean preoperative BMI was 53.49 ±2.20 and was significantly reduced to 36.71 ±1.84 at six months and 27.13 ±1.05 at one year. Rates of excess weight loss (EWL) and excess BMI loss showed a significant progressive increase over time ($p < 0.001$). The mean EWL was 33.11 ±3.33% at 3 months and significant increase to 52.18 ±4.34% at 6 months and 82.02 ±2.11% at 12 months. Evaluation of associated comorbidities 1

year following surgery revealed whole remission of hypertension in five out of six cases, with a statistically significant difference.

($p = 0.031$). At one -year post-operative, quality of life improved to very good (65.0%) or good (25.0%); however, it remained fair in two (10.0%) patients.

Conclusions: Laparoscopic SASI is efficient in reducing weight in patients with super-morbidly obesity. It showed progressively significant weight loss over one year and efficacy in controlling associated medical comorbidities. Additionally, it was a relatively safe technique with a reasonably little complication rate.

Keywords: Bariatric Surgery; SASI Bypass; Super-Morbid Obesity; Gastric Bypass; Complications; Bipartition.

INTRODUCTION

Worldwide, obesity incidence increased dramatically, reaching epidemic extents. There is a direct correlation between high mass index (BMI) and the prevalence of metabolic, cardiovascular, musculoskeletal, and psychological disorders that adversely impact on quality of life and longevity [1]. Super-morbid obesity (SMO), defined as a body mass index equal to or more than 50 kg/m^2, represents the tremendous severity of the disease and entails great vulnerability to its consequences in terms of morbidity and mortality [2]. Patients with super-morbid obesity have been accompanying with an elevated risk of death, with a loss of life up to 9.8 years, compared to normal body weight subjects [3].

For super morbid obese patients, obesity and metabolic surgery is the best clinically effective management choice. The ideal bariatric procedure for the management of super-obesity has not been fully established [4]. The two-step approach is a treatment option for (SMO) that includes a simple restrictive procedure as the initial stage, followed by a second technically more difficult malabsorption procedure at a later stage after a significant weight reduction [5]. Additionally, many obesity surgeries, including laparoscopic “SG” and Roux-en-Y bypass, have been shown to have a positive impact on weight loss and amelioration of comorbidities [6,7]. However, the amount of excess weight loss (EWL) was moderate in SMO compared to lower grades of obesity. Moreover, these surgical interventions face increased operative risks and a technically difficult approach in SMO patients [8].

According to the 2019 Global Consensus Meeting statement, SG is indicated for patients considered to be at great risk, including patients with morbid obesity with metabolic syndrome, patients with hepatic and renal transplantation, and individuals with BMI of thirty to thirty-five kg/m2 with comorbidities [9].

However, it is relatively contraindicated in the presence of severe esophageal reflux disease (GERD) and/or hiatal hernia and Barrett's changes in esophagus. Sleeve gastrectomy with minimization ring (BSG) is designated with clear contra-indications to RYGBP or BPD and for individuals taking medications requiring reliable intestinal resorption. It shows better durable weight reduction and lower weight regain rates than SG in super morbid obese patients [10]. Gastric bypass with one anastomosis (OAGB) is rather indicated in patients with super-obesity who must respect the advised nutritional supplementations. A single anastomosis sleeve ileal bypass (SASI) was introduced as an innovative change of the sleeve and a type of transient bipartition by addition of side-to-side single-loop anastomosis between the gastric sleeve and the ileum rather than the double anastomosis in Roux-en-Y bypass [11]. SASI's hypothesis is to induce neuroendocrine modulation to attain adequate and maintained weight loss. In addition to early stomach filling, SASI induces early satiety through the perception of nutrients in the terminal part of the intestine, which stimulates anorexigenic hormones [9]. A 1-year follow-up of patients with morbid obesity with DM II primarily managed with SASI revealed 90% EWL and complete resolution of type II DM [11]. A limited additional studies have evaluated safety and efficiency of SASI in morbidly obese patients with promising results as regrade of weight reduction and amelioration of co-morbid diseases, for example DM II, hypertension, apnea, hyper-lipidemia and joint pain[12-14] .

SASI bypass is still considered an investigative technique that requires further evaluation [15]. No prior studies have specifically assessed the results of SASI bypass in SMO. Therefore, this work aimed to assess the short-term outcomes regarding operative and postoperative results of laparoscopic SASI bypass in the management of patients with super-morbid obesity.

PATIENTS AND METHODOLOGY

Ethical considerations

The study met the requirements of the 1975 Helsinki Declaration and was accepted by the board of institutional review. Every patient was educated about the procedure's nature and its risks before providing their signed permission.

Study design, settings, and date

Between February 2019 and March 2020, this retrospective cohort analysis was carried out at Dar El-Elage Hospital and the main university hospital in Alexandria.

Eligibility criteria

Body mass index (BMI) ≥ 50 kg/m2 super-morbidly obese adult patients of both sexes who received laparoscopic SASI bypass were involved in this study. Patients under the age of 18 were ignored.

Preoperative assessment

Every patient had a thorough medical history taken, which included information on their age, sex, the age at which their obesity first appeared, any prior attempts at conservative weight loss, and any major comorbid diseases associated with obesity, e.g., hypertension, DM II, coronary artery disease, hyper-lipidemia, sleep apnea, hypoventilation syndrome, osteoarthritis, and infertility. We also asked about minor comorbidities such menstruation abnormalities, urinary stress incontinence, gastric reflux disease, and lower extremity venous stasis illness. Additionally, information on prior surgeries and food habits was gathered to look for any eating problems, such as Binge Eating Disorder (described as the ingestion of a bulky amount of food in relation to the circumstances and the known of loss of control), Overeating Disorder (Over Eater, defined as the frequent consumption of

a large amount of food without experiencing loss of control), and Atypical Eating Disorder, which includes two eating patterns; grazing (described as continuous eating) and night-eating syndrome (described as hyperphagia at night) and lastly Sweet Eating (characterized by consumption of more than 300 calories of sweetened diets or beverages e.g., candy, ice cream, soft drinks, etc. more than three times per average week).

A thorough physical examination is then conducted, and body measurements are taken. These include the BMI, which is designed as the weight in kgs divided by the square of the height in meters; excess weight, which is determined by subtracting the preoperative weight from the ideal body weight determined using the Lorentz formula (for men: (H - 100) - [(H -150)/4] and for women: (H - 100) - [(H -150)/2), where "H" is height in (the proportion between the hip circumference, measured across the broadest part of the buttocks with the tape parallel to the floor, and the waist circumference, measured at the roughly half-way between the bottom edge of the latest perceptible rib and the topmost of the iliac crest.

Preoperative investigations included coagulation profile, kidney and liver function tests, lipid profile, cortisol and thyroid hormones, and glycated hemoglobin (HbA1c) in diabetic patients before and 6 months after operation. A preoperative cardiopulmonary evaluation using chest X-ray, pulmonary function tests, electrocardiography, echocardiography, and abdominal ultrasound was also performed to determine the hepatic size and spleen and the existence of gallbladder stones. Upper l endoscopy was made in all individuals with a history of reflux symptoms to assess for signs of GERD, Barret's changes in esophagus, or hiatal hernia.

Using the Moorehead-Ardelt Quality of Life Questionnaire II (M-A QoLQ II)

score from the Bariatric Analysis and Reporting Outcome System (BAROS), we evaluated the preoperative quality of life (QoL). Six questions were used to calculate the patient's subjective perception of their quality of life (QoL) in relation to general self-confidence, physical activity, social interactions, job satisfaction, sexual pleasure, and eating habits [16].

Choice of bariatric procedure

All patients who were diagnosed as super-morbidly obese with evidence of GERD, Barret's esophagus, or hiatal hernia were advised against SG. Patients in absolute need of drugs requiring reliable bowel resorption were withheld from all malabsorptive surgeries and recommended for SG or BSG.
The decision regarding the type of bariatric surgery was taken by the patients after explaining the pros and cons of the technique available, including financial issue and absence of long-standing results. All patients gave informed consent to undertake SASI and usage of their data anonymously for research purposes.

Operative procedure:

Clexane® (Enoxaparin sodium: low molecular weight heparin LMWH), 40 mg (4000 IU) subcutaneous injection, was administered 12 hours before to surgery to prevent pre-operative thrombosis of the deep veins. The patient was positioned in the French position on the operation table. Endotracheal intubation and general anesthesia were used. The patient was positioned in a steep reverse-Trendelenburg for the initial portion of the procedure, and the surgeon standing between the patient's knees. The procedure started by devascularizing the stomach's greater curvature. The gastroesophageal junction was then the target of further dissection. After that, all connections to the left crus were removed to prevent the creation of a

posterior pouch when constructing gastric sleeve. Then, pancreatic' and gastric's posterior attachments were split. By a linear cutting stapler, the stomach was tabularized across a 36-French calibration tube starting 6 cm proximal to the pylorus. Titanium clips were then used to strengthen the staple line. The physician then proceeded to the patient's left side to undertake the second stage of the procedure after adjusting the table to a horizontal position with a slight tilt to the left. A 300 cm distance from the ileocecal valve was used to locate and measure the ileocecal junction. Without dividing the omentum, the chosen ileal loop was then pushed up to the gastric pouch. A linear cutting stapler was used to attach an iso-peristaltic side to side anastomosis to the anterior wall of gastric antrum and in anti-colic positioning, which was done 6 cm from the pylorus. The anastomosis shouldn't have a diameter larger than 3 cm. The size of the anastomosis makes it more prone to narrowing and obstruction, whereas a larger anastomosis is associated with higher rates of dumping syndrome and will force food to follow a wider passage [11,17]. With the use of V-Lock, the anterior wall of the gastro-ileal anastomosis was stitched. The next step was a methylenated blue saline test to check for leakage and insertion of intra-abdominal drain.

Postoperative care

Patients continued on anti-coagulations for two weeks post-operative and began drinking fluids 24 hours after surgery and were discharged when conditions permitted and the drain removed. The patients were followed by a nutritionist to manage the evolution of the diet as follows: on the second and third postoperative days, in the absence of leak, the oral intake was began in the form of sips of clear fluids, then switched to non-sugar clear caloric-free liquids, including juices; on postoperative day 4, A post-bariatric surgery diet consisting mostly of a high protein, low fat, vitamin and mineral-supplemented liquid diet was initiated and

followed for the next two weeks; full liquids/ pureed solids (e.g., mashed potatoes and applesauce) were added during the third and fourth postoperative weeks; in the fifth week, soft foods (ex., rice and overcooked vegetables); in week 6, regular foods were added (eg, extremely well chewed chicken and bread); and from the seventh week more regular foods were recommended.

Follow-up

At three, six, and 12-months following surgery, all patients were scheduled for routine follow-up appointments for clinical evaluation of weight loss data involving weight in kg, BMI, percentage of excess weight loss (EWL%) and excess BMI loss (BMIL%), and waist/hip ratio. After six months, diabetic patients had their full blood counts, fasting blood sugar, lipid profiles, and HbA1c levels checked. Twelve months following surgery, patients were evaluated for the improvement of comorbidities. Using the Moorehead-Ardelt Quality of Life Questionnaire II (M-A QoLQII) score from the Bariatric Analysis and Reporting Outcome System (BAROS), the quality of life was evaluated one year following surgery (16).

Outcomes

The results of this study included the rate of weight loss throughout the 1-year follow-up, the amelioration of comorbidities, improvement of the QoL, operative time, hospital stay, any intraoperative mishaps e.g., bleeding, organ injury, conversion, and the cause of conversion if occurred, and postoperative complications. Concerning the amelioration of comorbid diseases, the resolution of type II diabetes mellitus depended on HbA1c $< 6\%$ or fasting blood glucose less than 100 mg/dl in the absence of hypoglycemic drugs [18]. The complete resolution of hypertension was based on blood pressure less than 120/80 without using medications, while its improvement was considered a reduction in dosage or

number of anti-hypertensive drugs or systolic and diastolic pressure with the similar drugs [19]. Normal lipid profile after stopping the medications was demarcated as resolved dyslipidemia. At the end, complete resolution of obstructive sleep apnea was distinguished by asking the patient about the discontinuation of continuous positive airway pressure “CPAP” or sleeping well in lesser “CPAP” settings.

ANALYSIS OF STATISTICS

The statistical package for social science, SPSS version 22, was used to examine the data. Numbers and percentages were used to portray qualitative data. The Shapiro-Wilk test was used to determine the normality of quantitative data and mean, and standard deviation were used to summarize parametric data. Repeated-measures ANOVA was used to compare the weight loss data at the examined follow-up periods, and post hoc Bonferroni pairwise comparisons were then done. Additionally, to compare preoperative and postoperative comorbidities, the identical one-sided McNemar test was used. Significance of Statistical results defined as a p-value of 0.05.

RESULTS

Twenty patients of super morbid obesity were included, who underwent SASI bypass surgery. Most of them were women (75.0%), and their mean age was 37.6 SD5.8 years. The means of the preoperative BMI, excess weight, and waist/hip ratio were 53.49 SD2.20 kg/m^2, 92.23 SD9.18 kg, and 0.88 SD.03, respectively. The onset of obesity was in adulthood in 17 (85.0 %) patients, and 15 (75.0%) were bulk eaters. The most frequently reported comorbidities were hypertension, type II diabetes mellitus, and hyperlipidemia (30.0%, 20.0%, and 10.0%, respectively). Surgical history included one or more cesarean section (45.0%),

laparoscopic cholecystectomy (20.0 %), open/or laparoscopic appendectomy (15.0%), and open hysterectomy (5.0%) [Table 1].

The mean operative duration was 118.1 ±17 minutes, and the mean interval of hospital stay was 2.2 ±0.7 days. None of the patients needed conversion to the open technique, while three (15.0%) needed extra-port insertion. Enterotomy and bleeding from the upper pole spleen were the noticed intraoperative complications (5.0% each). Enterotomy was managed by laparoscopic direct repair and the bleeding from the spleen was managed by compression and surgicell application. Concomitant procedures included cholecystectomy and pelvic adhesolysis (5% each). Early postoperative complications involved vomiting and intraluminal bleeding that occurred two weeks after the surgery (5.0% each) and managed conservatively by anti-emetic, proton pump inhibitors, prokinetics and hold the anticoagulants. Further, cholelithiasis (10.0%), and bile reflux (5.0%) were the late postoperative complications [Table 2].

Table 3 provides evidence of the SASI bypass surgery's effectiveness in helping patients lose weight. During the 1-year follow-up period, weight, BMI, and waist/hip ratio all significantly and steadily reduced ($p < 0.001$). The mean preoperative weight (kg) was 153.4 ±12.5, and it considerably decreased to 122.7 ± 7.9 after three months, 105.2 ±7.4 after six months, and 77.7 ±4.8 after 12 months. The average BMI before to surgery was 53.49 ±2.20, and it considerably decreased to 36.71 ±1.84 at six months and 27.13 ±1.05 at twelve months. The rates of EWL and excess BMI loss showed a significant progressive increase with time ($p<0.001$). The mean EWL was 33.11 SD3.33 % at 3-months which significantly increased to 52.18 ±4.34 % at 6-months and 82.02 ±2.11 % at 12-months.

Assessment of the associated comorbidities at one year after the procedure revealed resolution of hypertension in five out of six cases, with a significant

difference (p=0.031). The other reported pre-operative comorbid diseases including DM type II, hyperlipidemia, obstructive sleep apnea, varicose veins, a venous ulcer, menstrual irregularities, Polycystic ovary, osteoarthritis, and back pain showed complete remission [Table 4]

The QoL was predominantly poor (75%) or fair (25.0%) before the operation. At 12 months after the operation, it improved to very good (65.0%) or good (25.0%), however, the QoL remained fair in two (10.0%) patients [Table 5].

Table (1): Preoperative data (N=20)

Women (N, %)	15 (75)
Age, years (mean± SD)	37.6±5.8
Weight, kg (mean± SD)	153.4±12.5
Height, cm (mean± SD)	169.3±5.9
BMI, kg/m^2 (mean± SD)	53.49±2.20
Waist/hip ratio (mean± SD)	0.88±0.03
Dietary habits (N, %)	
Bulk eater	15 (75)
Sweet eater	4 (20)
Binge eater	1 (5)
Comorbidities (N, %)	
Hypertension	6 (30)
Diabetes mellitus II	4 (20)
Hyperlipidemia	2 (10)
Obstructive sleep apnea	1 (5)
Varicose veins	1 (5)
Venous ulcer	1 (5)

Menstrual irregularities	1 (5)
Polycystic ovary	1 (5)
Controlled hypothyroidism	1 (5)
Osteoarthritis	1 (5)
Back pain	1 (5)
Surgical history (N, %)	
Cesarean section	9 (45)
laparoscopic cholecystectomy	4 (20)
Open/ laparoscopic appendectomy	3 (15)
Open hysterectomy	1 (5)

BMI: body mass index; N: number; SD: standard deviation

Table (2): Operative and postoperative data (N=20)

Operative time, minutes (mean± SD)	118.1±17.0
Hospital stays, days (mean± SD)	2.2±0.7
Extra-port insertion (N, %)	3 (15)
Intraoperative complications (N, %)	
Enterotomy	1 (5)
Bleeding upper pole of the spleen	1 (5)
Concomitant procedures (N, %)	
Cholecystectomy	1 (5)
Pelvic adhesiolysis	1 (5)
Postoperative complications (N, %)	
Early	
Bleeding (intraluminal)	1 (5)
Vomiting	1 (5)
Late	

Bile Reflux	1 (5)
Cholelithiasis	2 (10)

N: number; SD: standard deviation

	Preoperative	3 months	6 months	12 months	P-value
Weight, kg	153.4±12.5	122.7±7.9 [a]	105.2±7.4 [a b]	77.7±4.8 [a b c]	<0.001*
BMI, kg/m^2	53.49±2.20	42.83±1.59 [a]	36.71±1.84 [a] [b]	27.13±1.05 [a b c]	<0.001*
Waist/hip ratio	0.88±0.03	-------	0.81±0.03 [a]	0.77±.03 [a c]	<0.001*
% EWL	-------	33.11±3.33	52.18±4.34 [b]	82.02±2.11 [b c]	<0.001*
% Excess BMIL	--------	37.38±3.67	58.94±5.19 [b]	92.65±3.50 [b c]	<0.001*

Table (3): Weight loss and waist/hip ratio after single anastomosis sleeve ileal bypass

EWL: excess weight loss; BMIL: body mass index loss; data expressed as mean and SD

*Significant at $p<0.05$

[a]Significant difference between the preoperative and the postoperative three-, six-, and 12-months follow-up times ($p<0.001$)

[b]Significant difference between the postoperative 3 months versus 6- and 12-months follow-up times ($p<0.001$)

[c]Significant difference between the postoperative 6- months versus 12-months follow-up times ($p<0.001$)

Table (4): Comorbidities at 12 months after single anastomosis sleeve ileal bypass surgery

	Before surgery N (%)	12 months follow up	P-value
Hypertension	6 (30.0)	Resolved 5 Improved 1	0.031*
Diabetes mellitus II	4 (20.0)	Resolved	------
Hyperlipidemia	2 (10.0)	Resolved	------
Obstructive sleep apnea	1 (5.0)	Resolved	------
Varicose veins	1 (5.0)	Resolved	------
Venous ulcer	1 (5.0)	Resolved	------
Menstrual irregularities	1 (5.0)	Resolved	------
Osteoarthritis & Back pain	2 (10)	Resolved	------

N: number; *Significant at $p<0.05$ McNemar test Exact one-sided P-value

Table (5): Changes in the quality of life at 12 months after single anastomosis sleeve ileal bypass surgery (N=20)

		N	%
Before surgery	Poor	15	75.0
	Fair	5	25.0
After surgery	Very good	13	65.0
	Good	5	25.0
	Fair	2	10.0

DISCUSSION

People with super-morbid obesity with a BMI larger than 50 kg/m2 are a unique class of obesity that have comorbid complications and higher mortality rates than patients with lower morbid obesity, so they may benefit more from surgery bariatric. Standard bariatric procedures are very demanding in these patients, require more time and result in significantly higher perioperative morbidity and mortality [4]. Although SASI was approved as a prevailing technique by the Obesity Surgery Expert Consensus Panel in 2018 [9], it has not yet been validated as a standard procedure and requires further evaluation [8]. This work aimed to evaluate the early operative and postoperative results of laparoscopic SASI in the management of super-morbid obese patients.

SASI bypass is a technical variation of the SG with transit bipartition surgery (SG-TB). In SASI, sleeve gastrectomy is constructed maintaining a adequate length of the antrum, then a loop gastro-ileostomy is done between the gastric antrum and the ileum at 250 cm proximal to the caecum. On the other hand, in SG-TB which was introduced by Sergio Santoro, SG is performed then the ileal loop is transected at 250 cm proximal to the ileo-cecal junction; the distal ileal end is anastomosed to the gastric antrum while the proximal intestinal end of the transaction is anastomosed side to side at 80–130 cm proximal to the ileo-caecal valve to make the ileo-ileal anastomosis. The SASI bypass surgery has the same restrictive and malabsorptive advantages of SG-TB. However, it is characterized by reducing the risk of nutritional deficiencies and by being simpler and more feasible technique [20].

This study revealed that SASI bypass is a greatly efficient technique for weight reduction in super-morbid obese patients. The body weight, BMI, and waist/hip ratio showed significant incremental decrease throughout the follow-up period of

12 months. The mean preoperative BMI was 53.49 SD2.20 kg/m^2, which was significantly reduced to 36.71 SD1.84 kg/m^2 at six months and 27.13 SD1.05 kg/m^2 at 12 months. As well, there was a progressive increase in the cumulative weight loss since surgery where the EWL and excess BMI loss showed significant progressive increases with time. The mean EWL% was 33.11 SD3.33 at 3-months, which significantly increased to 52.18 SD4.34 at 6-months and 82.02 SD2.11 at 12-months.

The observed rates of weight loss in our study are better than that reported by Madyan et al. [13] who recruited 20 super-morbidly obese patients from Mansoura University Hospitals and reported a significant reduction in the preoperative BMI from 53.7 SD5.9 kg/m^2 to 39.9 SD5.2 kg/m^2 at six-months and then to 33.6 SD6 kg/m^2 at one year after laparoscopic SASI surgery. EWL% was 44.3 SD7.8 at six-months and 65.2 SD12.6 at 12-months. The observed difference may be due to changes in other baseline characters or procedural variations, such as the common limb length or the anastomosis size [21]. The standardization of the SASI technique is greatly required for proper outcomes and to avoid adverse effects [9,22].

A multicenter study that recruited 551 morbidly obese patients from seven countries revealed that SASI was effective as it significantly reduced the preoperative BMI (43.2 SD12.5 kg/m^2) to 31.2 SD9.7 kg/m^2 at a year postoperative. The mean EWL% was 63.9 SD29.5 at 12 months [14]. Moreover, Mahdy et al. [15] compared the efficacy of SASI to SG and one-anastomosis gastric bypass (OAGB) in 264 patients with morbid obesity, and they reported more superior weight loss after SASI compared to either SG or OAGB. Follow-up of the patients for 1- year resulted in significantly reduction in weight and “BMI” at six months and one year after SASI than post sleeve and OAGB. Percentages of total body weight loss and EWL were significantly greater following SASI bypass

than after Sleeve and OAGB. A systematic review encompassed ten studies involving 941 morbidly obese patients and stated a median EWL% of 59.4% at six months that significantly increased to 90.1% at 12 months [21].

SASI bypass was introduced as a metabolic procedure. The observed efficacy of SASI in reducing body weight and maintaining weight loss is mainly attributed to its neuroendocrine modulation rather than the mechanical restriction of the stomach or malabsorption of the nutrients. The passage of the food to the distal bowel may have stimulated satietogenic distal gut hormone secretion and hypothalamic-induced satiety feeling [23]. However, there are no studies that evaluated the hormonal changes after SASI in humans.

In the present study, assessment of the associated comorbid diseases at 1-year after the SASI bypass surgery revealed resolution of hypertension in five out of six cases, with a statistically significant difference ($p=0.031$). The other reported pre-operative comorbid diseases including DM II, hyperlipidemia, sleep apnea, varicose veins, a venous ulcer, menstrual irregularities, polycystic ovary, osteoarthritis, and back pain showed complete remission. Previous studies revealed similar metabolic consequences with a significant remission and improvement within one year after SASI [11-13]. Recently, Mahdy et al. [15] showed a significantly superior rate of resolution in DM after SASI bypass (97.7%) than after SG (71.4%) or OAGB (86.7%). The observed superiority of SASI in the improvement of diabetes might be due to neuroendocrine response with the rapid secretion of “GLP-1” and “polypeptide YY” due to stimulation of the ileum with the undigested food, insulin secretion, and the reduced caloric consumption [24].Compared with previous bariatric surgeries as SG, SASI was found more effective in improving hypertension [25]. Furthermore, there was complete remission of dyslipidemia in our study, which was better than that stated by Mahdy et al. [14] (88%) or Emile et al. [26] (65%) in morbidly obese patients.

The efficiency of SASI bypass in reducing the body weight and resolving the associated comorbidities is associated with improved quality of the patient's life [27]. In this study, the quality of life improved to very good (65.0%) or good (25.0%) 12 months following the operation; however, it remained fair in two (10.0%) patients.

In the current study, the mean operative time was 118.1 SD17 minutes, and the mean length of hospital stay was 2.2 SD0.7 days. The new SASI bypass procedure is a simplification of SG with transit bipartition, so it is an easier technique that has the advantage of being more feasible [28] and the one anastomosis makes it easier and short operative time also no need to close any mesenteric defects. Furthermore, the reduction of the number of anastomoses to one in SASI has been assumed to lower the anastomotic complications and shorten the operative time [22].

Intraoperative complications in our study included enterotomy in one patient and bleeding from the upper pole spleen in another one. The former was managed through direct laparoscopic repair and the latter was controlled by compression and surgicell application. Early postoperative complications involved vomiting and intraluminal bleeding that occurred two weeks after the surgery (one patient each). A comparable prospective observational study that included 80 obese patients with a BMI between 35 and 60 kg/m^2 who underwent SASI at Menoufia University, Egypt reported an anastomotic leak in one patient [29]. Another study assessed the 2-years outcomes of SASI bypass for morbidly obese patients and reported anastomotic intraluminal bleeding as the major early postoperative complication [28].

In the current study, cholelithiasis (two patients), and bile reflux (one patient) were the recorded late postoperative complications. The formation of gall stones after bariatric surgery is linked to rapid weight loss, and its maximum incidence is in the

year after surgery. The altered enterohepatic circulation and gall bladder physiology contribute to gall stones formation [30]. A study reported that SASI operation besides the duration of obesity in years and the rapid weight loss as the predictors of gall stones after bariatric surgeries [31]. In agreement with our study, Mahdy et al. [14] reported one case of bilious vomiting due to bile reflux and two cases of jaundice due to calculus obstruction triggered by gall-bladder stones development after the SASI bypass. It seems that single anastomosis between the intestine and the gastric pouch is commonly associated with bile reflux as it was observed after OAGB too [32]; however, SASI bypass has the advantage of easy access to the biliary tract to further manage these complications [14].

Limitations

This work was the first to evaluate the results of SASI bypass in patients with super morbid obesity. In addition, all patients in the study were operated on by the same surgeon using the same procedure and were closely monitored. However, it has some limitations, notably a retrospective nature that carries the risk of selection bias, as well as a small sample size, a short period of follow-up of one year, and the lack of a control group. Further prospective controlled trials with longer follow-up are recommended to assess the possibility of significant weight gain, recurrence of comorbidities, or nutritional deficiencies.

Conclusions

The current study revealed that laparoscopic SASI bypass was effective in reducing body weight in with super-morbid obese patients. It showed progressive significant weight loss over one year. Further, SASI bypass was effective in controlling DM, hypertension, hyperlipidemia, sleep apnea, and other medical comorbidities. The SASI procedure was relatively safe, with a reasonably low complication rate.

REFERENCES

1. Blüher M (2019) Obesity: global epidemiology and pathogenesis. Nat Rev Endocrinol 15:288-298. https://doi.org/10.1038/s41574-019-0176-8

2. Abdelaal M, le Roux CW, Docherty NG (2017) Morbidity and mortality associated with obesity. Ann Transl Med 5:161-161. https://doi.org/10.21037/atm.2017.03.107

3. Kitahara CM, Flint AJ, Berrington de Gonzalez A, Bernstein L, Brotzman M, MacInnis RJ, Moore SC, Robien K, Rosenberg PS, Singh PN (2014) Association between class III obesity (BMI of 40–59 kg/m2) and mortality: a pooled analysis of 20 prospective studies. PLoS Med 11:e1001673.

4. Bettencourt-Silva R, Neves JS, Pedro J, Guerreiro V, Ferreira MJ, Salazar D, Souteiro P, Magalhães D, Oliveira SC, Queirós J, Belo S, Varela A, Freitas P, Carvalho D (2019) Comparative Effectiveness of Different Bariatric Procedures in Super Morbid Obesity. Obes Surg 29:281-291. https://doi.org/10.1007/s11695-018-3519-y

5. Alexandrou A, Felekouras E, Giannopoulos A, Tsigris C, Diamantis T (2012) What is the actual fate of super-morbid-obese patients who undergo laparoscopic sleeve gastrectomy as the first step of a two-stage weight-reduction operative strategy? Obes Surg 22:1623-1628. https://doi.org/10.1007/s11695-012-0718-9

6. Onyewu SC, Ogundimu OO, Ortega G, Bauer ES, Emenari CC, Molyneaux ND, Layne SA, Changoor NR, Tapscott D, Tran DD, Fullum TM (2017) Bariatric surgery outcomes in black patients with super morbid obesity: a 1-year postoperative review. Am J Surg 213:64-68. https://doi.org/https://doi.org/10.1016/j.amjsurg.2016.05.010

7. Thaher O, Tallak W, Hukauf M, Stroh C (2022) Outcome of Sleeve Gastrectomy Versus Roux-en-Y Gastric Bypass for Patients with Super Obesity (Body Mass Index > 50 kg/m2). Obes Surg 32:1546-1555. https://doi.org/10.1007/s11695-022-05965-6

8. Mahawar KK, Borg CM, Agarwal S, Riebeiro R, De Luca M, Small PK (2017) Criteria for Inclusion of Newer Bariatric and Metabolic Procedures into the Mainstream: a Survey of 396 Bariatric Surgeons. Obes Surg 27:873-880. https://doi.org/10.1007/s11695-016-2398-3

9. Bhandari M, Fobi MAL, Buchwald JN (2019) Standardization of Bariatric Metabolic Procedures: World Consensus Meeting Statement. Obes Surg 29:309-345. https://doi.org/10.1007/s11695-019-04032-x

10. Lemmens L, Van Den Bossche J, Zaveri H, Surve A (2018) Banded Sleeve Gastrectomy: Better Long-Term Results? A Long-Term Cohort Study Until 5 Years Follow-Up in Obese and Superobese Patients. Obes Surg 28:2687-2695. https://doi.org/10.1007/s11695-018-3248-2

11. Mahdy T, Al Wahedi A, Schou C (2016) Efficacy of single anastomosis sleeve ileal (SASI) bypass for type-2 diabetic morbid obese patients: Gastric bipartition, a novel metabolic surgery procedure: A retrospective cohort study. Int J Surg 34:28-34. https://doi.org/10.1016/j.ijsu.2016.08.018

12. Salama TMS, Sabry K, Ghamrini YE (2017) Single Anastomosis Sleeve Ileal Bypass: New Step in the Evolution of Bariatric Surgeries. J Invest Surg 30:291-296. https://doi.org/10.1080/08941939.2016.1241841

13. Madyan A, Emile SH, Abdel-Razik MA, Ellithy R, Elbanna HG, Elshobaky A (2020) Laparoscopic Single Anastomosis Sleeve Ileal (SASI) Bypass for Patients With Morbid Obesity: Technical Description and Short-term Outcomes. Surg

Laparosc Endosc Percutan Tech 30:e13-e17. https://doi.org/10.1097/sle.0000000000000763

14. Mahdy T, Emile SH, Madyan A, Schou C, Alwahidi A, Ribeiro R, Sewefy A, Büsing M, Al-Haifi M, Salih E, Shikora S (2020) Evaluation of the Efficacy of Single Anastomosis Sleeve Ileal (SASI) Bypass for Patients with Morbid Obesity: a Multicenter Study. Obes Surg 30:837-845. https://doi.org/10.1007/s11695-019-04296-3

15. Mahdy T, Gado W, Alwahidi A, Schou C, Emile SH (2021) Sleeve Gastrectomy, One-Anastomosis Gastric Bypass (OAGB), and Single Anastomosis Sleeve Ileal (SASI) Bypass in Treatment of Morbid Obesity: a Retrospective Cohort Study. Obes Surg 31:1579-1589. https://doi.org/10.1007/s11695-020-05159-y

16. Moorehead MK, Ardelt-Gattinger E, Lechner H, Oria HE (2003) The validation of the Moorehead-Ardelt Quality of Life Questionnaire II. Obes Surg 13:684-692. https://doi.org/10.1381/096089203322509237

17. Mahdy T, Gado W, Emile S: Single Anastomosis Sleeve Ileal (SASI) Bipartition. Obesity, Bariatric and Metabolic Surgery: A Comprehensive Guide. Agrawal S (ed): Springer International Publishing, Cham; 2020. 1-15. 10.1007/978-3-030-54064-7_98-1

18. Salman AA, Salman MA, Marie MA, Rabiee A, Helmy MY, Tourky MS, Qassem MG, Shaaban HE, Sarhan MD (2021) Factors associated with resolution of type-2 diabetes mellitus after sleeve gastrectomy in obese adults. Sci Rep 11:6002. https://doi.org/10.1038/s41598-021-85450-9

19. Gandotra C, Basam M, Mahajan A, Ngwa J, Ortega G, Tran D, Fullum TM, Sherif ZA (2021) Characteristics and resolution of hypertension in obese African

American bariatric cohort. Sci Rep 11:1683. https://doi.org/10.1038/s41598-021-81360-y

20. Bhandari M, Kosta S, Khurana M, Mathur W, Reddy MK, Fobi M (2021) Emerging Procedures in Bariatric Metabolic Surgery. Surg Clin North Am 101:335-353. https://doi.org/10.1016/j.suc.2020.12.001

21. Emile SH, Mahdy T, Schou C, Kramer M, Shikora S (2021) Systematic review of the outcome of single-anastomosis sleeve ileal (SASI) bypass in treatment of morbid obesity with proportion meta-analysis of improvement in diabetes mellitus. Int J Surg 92:106024. https://doi.org/10.1016/j.ijsu.2021.106024

22. Emile SH, Mahdy T (2021) Excessive Weight Loss and Hypoalbuminemia After SASI Bypass: the Need for Standardization of the Technique. Obes Surg 31:865-866. https://doi.org/10.1007/s11695-020-04890-w

23. Lustig RH (2001) The neuroendocrinology of obesity. Endocrinol Metab Clin North Am 30:765-785. https://doi.org/10.1016/s0889-8529(05)70211-5

24. Larraufie P, Roberts GP, McGavigan AK, Kay RG, Li J, Leiter A, Melvin A, Biggs EK, Ravn P, Davy K, Hornigold DC, Yeo GSH, Hardwick RH, Reimann F, Gribble FM (2019) Important Role of the GLP-1 Axis for Glucose Homeostasis after Bariatric Surgery. Cell Rep 26:1399-1408.e1396. https://doi.org/10.1016/j.celrep.2019.01.047

25. Abelson JS, Afaneh C, Dolan P, Chartrand G, Dakin G, Pomp A (2016) Laparoscopic Sleeve Gastrectomy: Co-morbidity Profiles and Intermediate-Term Outcomes. Obes Surg 26:1788-1793. https://doi.org/10.1007/s11695-015-2002-2

26. Emile SH, Madyan A, Mahdy T, Elshobaky A, Elbanna HG, Abdel-Razik MA (2021) Single anastomosis sleeve ileal (SASI) bypass versus sleeve gastrectomy: a

case-matched multicenter study. Surg Endosc 35:652-660. https://doi.org/10.1007/s00464-020-07430-w

27. Mahdy T, Gado W: Revisional Surgery: Sleeve to Single Anastomosis Sleeve Ileal (SASI) Bypass. Laparoscopic Sleeve Gastrectomy. Springer; 2021. 579-588.

28. Khalaf M, Hamed H (2021) Single-Anastomosis Sleeve Ileal (SASI) Bypass: Hopes and Concerns after a Two-Year Follow-up. Obes Surg 31:667-674. https://doi.org/10.1007/s11695-020-04945-y

29. Nassar MNS (2022) Laparoscopic Single Anastomosis Sleeve Ileal Bypass: Initial Results. Ain Shams J Surg 15:39-49. https://doi.org/10.21608/asjs.2022.228482

30. Morais M, Faria G, Preto J, Costa-Maia J (2016) Gallstones and Bariatric Surgery: To Treat or Not to Treat? World J Surg 40:2904-2910. https://doi.org/10.1007/s00268-016-3639-2

31. El shafey HE, Elgohary H, El Azawy M, Omar W (2021) The incidence of gall stones after bariatric surgery and its association with weight loss. Int J Surg Open 33:100340. https://doi.org/10.1016/j.ijso.2021.100340

32. Saarinen T, Räsänen J, Salo J, Loimaala A, Pitkonen M, Leivonen M, Juuti A (2017) Bile Reflux Scintigraphy After Mini-Gastric Bypass. Obes Surg 27:2083-2089. https://doi.org/10.1007/s11695-017-2608-7