Effects Of Single Anastomosis Sleeve Ileal (SASI) Bypass on Morbid Obese Patients with Metabolic Syndrome

Emad M. Abdelrahman, Hussein Elgohary, Mohamed S. Kharoub, Abdallah H. Diab, Mohamed A. Elsayed

Department of General Surgery, Faculty of Medicine, Benha University, Egypt

Correspondence to Emad M. Abdelrahman, MD, Fareed Nada Street, Al-Qalyubia 13518, Banha, Egypt. Tel: +0122 676 3986; fax: 0133231011; e-mail: emadsahan301@gmail.com, emad.sarhan@fmed.bu.edu.eg

Received: 12 December 2023
Revised: 25 December 2023
Accepted: 7 January 2024
Published: 22 March 2024

The Egyptian Journal of Surgery 2024, 43:493–501

Background

Metabolic syndrome (MetS) is a silent epidemic that is a major global public health concern. Bariatric surgery is an approved treatment for obesity where weight reduction is crucial for the control of metabolic syndrome. This study aimed to report our institutional experience in the effect of single anastomosis sleeve ileal (SASI) on metabolic syndrome.

Patients and methods

The current prospective study included 50 Morbid Obese Patients with MetS who were eligible for SASI. Follow-up was planned for 1 year.

Results

The mean age of patients was 41.56±6.32 years. The mean % EWL was 56.94 ±4.65 and 83.16±8.09 at 6 and 12 months, respectively. HbA1c showed significant improvement which decreased from 8.34±1.23 to 5.04±0.38 after 1 year follow-up. Triglycerides (mg/dl) and LDL-C (mg/dl) show significant reduction at 6 months and 1 year postoperative from 177.48±30.95 preoperative to 131.98±17.65 and 104.10 ±14.03 for Triglycerides, and from 180.76±21.04 preoperative to 104.64±7.13 and 77.56±8.93 for low density lipoprotein-C (LDL-C) (<0.001). HDL-C (mg/dl) showed a significant increase from 40.44±10.93 preoperative to 49.58±8.71 and 57.96 ±6.64 (<0.001). As regards the blood pressure; mean arterial pressure showed a significant decrease from a baseline of 103.38±11.38 to 88.36±5.72 at 6 months and to 74.46±5.83 at 1 year of follow-up.

Conclusion

As demonstrated by this study, all MetS characteristics significantly improved following the SASI bypass treatment.

Keywords:
metabolic syndreome, single anastomosis sleeve ileal, super obese

Egyptian J Surgery 43:493–501

1110-1121

Introduction

Metabolic syndrome (MetS) is a silent epidemic that is a major global public health concern. The syndrome is a collection of metabolic disorders that include dyslipidemia, hypertension (HTN), and insulin resistance. One of the cardiovascular risk factors that predicts the development of cardiovascular diseases is insulin resistance, which is commonly associated with the accumulation of central fat [1].

The accumulation of body fat and adult weight increase, along with an inclination to store fat in intra-abdominal regions such as the liver, pancreas, and heart (ectopic fat), are the two elements that lead to the development of metabolic syndrome. Physical inactivity and easy access to a never-ending supply of high-calorie, low-nutrient meals are hallmarks of a lifestyle that is strongly linked to MetS. Early life exposure to this substance is particularly effective in causing juvenile obesity, which raises the adult risk of having MetS [2].

Elevated blood pressure, elevated triglycerides (TG), reduced high density lipoprotein-C (HDL-C), elevated waist circumference, and elevated fasting glucose are the five metabolic complications or correlates of abdominal obesity that have been clinically measured and are collectively referred to as MetS [3].

Weight loss and keeping it there over time are the main strategies for successfully reversing every feature of MetS. Bariatric surgery is a safe, effective, and long-lasting treatment for obesity and its co-morbidities. More individuals are understanding that advanced neurohormonal systems also play a part in the outcomes of bariatric surgery, particularly when it comes to co-morbidities; forced calorie restriction alone is not the primary cause. Bariatric surgery is essentially a weight-loss technique combined with metabolic surgery [4].

Bariatric surgery is an approved treatment for obesity that can lead to substantial, long-lasting weight loss when all other treatments have been tried. Most people who are eligible for bariatric procedures have multiple traits in common with the MetS [5].

It enhances MetS by reducing body weight and, more specifically, by eliminating excess visceral adipose tissue depots. The improvement and remission of obesity and its comorbidities after bariatric surgery are likely due to a number of factors, including hormonal changes related to appetite and other metabolic and physiological features, as well as body weight loss related to gastric volume restriction and malabsorption. One eats less due to early satiety brought on by gastric restriction, which lowers the quantity of glucose the body has to metabolize. In addition, intestinal resection causes a mal-absorbative process that reduces the amount of calories and available nutrients [6].

Bariatric surgeries can be categorized as restrictive, malabsorptive, or mixed weight loss procedures based on the weight loss strategy employed. Current physiologic knowledge can be used to create new bariatric procedures that seek to elicit neuroendocrine modifications rather than only mechanical restriction and/or malabsorption [7].

A side-to-side gastro-ileal anastomosis is performed after a sleeve gastrectomy in a novel modality developed by the Brazilian surgeon Santoro and colleagues [8] but up till now it is not yet approved by the International Federation for the Surgery of obesity and metabolic disorders.

And American Society for metabolic and Bariatric surgery (ASMBS). This procedure was later named the single anastomosis sleeve ileal (SASI) bypass by Mahdy *et al.* [9,10]. The patient stops eating earlier after an SASIS bypass, in part because their stomach fills up and in part because they feel sated earlier. The idea behind the early satiety theory was that the ileum's perception of nutrients would cause a decrease in proximal bowel movements and encourage the release of satieto-genic distal gut hormones, which would slow down gastric emptying [11].

One advantage of SASI bypass is that it leaves no inaccessible leftovers and enables complete endoscopic imaging of the biliary system in patients at high risk of stomach cancer [12]. Additionally, several studies have shown that a decrease in stomach pressure following sleeve gastrectomy significantly decreased the incidence of leaks and gastroesophageal reflux disease [13].

The grey area about the efficacy of SASI in controlling the MetS has motivated the authors to conduct this study.

Patients and methods

Study design

Following the code of ethics of Helsinki declaration, the current study was conducted after obtaining an informed consent from all included patients. The current study included 50 supermorbid obese patients (BMI $\geq$50 kg/m^2) with MetS who were eligible to undergo laparoscopic SASI Bypass procedure at the general surgery department in Benha University hospitals, Faculty of Medicine, Benha university throughout the period from January 2022 to November 2023. Eligible patients underwent laparoscopic SASI bypass procedure. Follow-up was designed for 6 months and 1 year postoperative for weight loss and control of MetS including disorders of HTN, type 2 diabetes mellitus (T2DM) and dyslipidemia.

A written informed consent was obtained from all included patients.

The study included super morbid obese Patients who have BMI greater than or equal to 50 kg/m^2 with MetS and obesity-associated comorbidities including HTN, T2DM or dyslipidemia. Patients were excluded from the study when they have one of the following: Super obese patients without metabolic syndrome, Patients with ASA score more than 3, patients undergone previous bariatric procedure and patients refused to be included in the study.

Preoperative evaluation

A comprehensive history was taken with a great concern about the MetS like HTN, T2DM and dyslipidemia and methods used for their control. All patient were to have thorough clinical examination particularly for blood pressure, weight and height and BMI was then calculated. Then patients were also evaluated preoperatively for the presence of MetS according to criteria of National Cholesterol Education Program Adult Treatment Panel (NCEP-ATP) III where at least three of the following criteria identify presence of MetS (obesity defined as BMI ≥30 kg/m^2, fasting blood glucose ≥100 mg/dl or T2DM, blood pressure ≥130/85 mmHg or HTN, serum TG level ≥150 mg/dl, and/or serum HDL-cholesterol <50 mg/dl for women or <40 mg/dl for men).

Preoperative preparation

Prior to the operation, each patient received anticoagulation and antibiotic prophylaxis. All patients were operated under general anesthesia by means of laparoscopy.

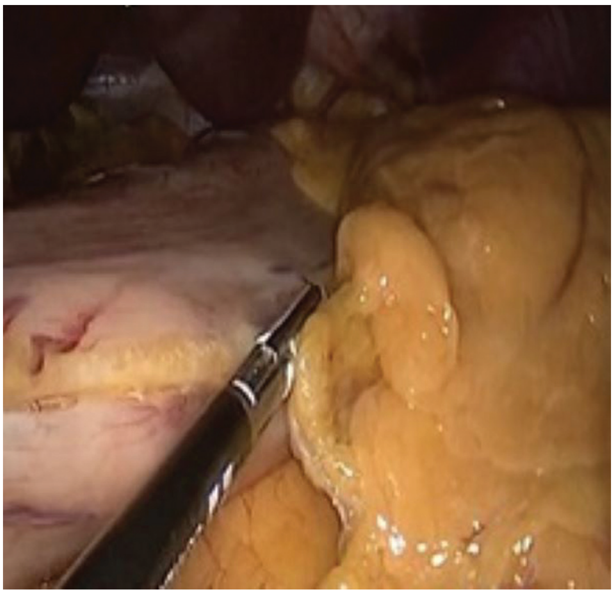
Surgical procedure

Under General anesthesia, During the first part of the procedure, which is performed on an operating table in a forced anti-Trendelenburg posture, the surgeon positions himself between the patient's legs. Following the preparation and drapery of the abdomen, a Veress needle was inserted into the supraumbilical region to facilitate the infusion of 15 mmHg of CO_2 into the peritoneal cavity. An Excel 12 mm optical trocar was then placed around 20 cm below the xiphoid process and 3 cm to the left of the midline in order to directly see the abdomen.

There are four more ports that are visible. The ports are positioned as follows: the liver retractor's insertion is made through a 5 mm trocar under the xiphoid process, and the assistant's 5 mm trocar is positioned in the left anterior axillary line. Two 12 mm trocars were used to treat the right and left midclavicular areas. The greater curvature of the stomach is devascularized first using a Liga Sure device (Fig. 1). Dissection then starts on the larger curvature, which is 5 cm from the pylorus to the gastro-esophageal junction. This process is repeated until the gastric fundus is completely mobilised.

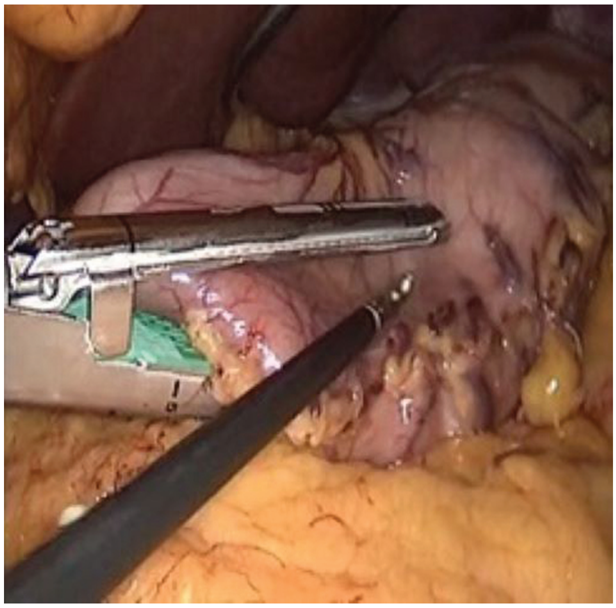
After that, the left crus is completely freed from all attachments to avoid leaving a posterior pouch behind when the sleeve is being built in this region. Next, there is a division of the posterior attachments between the pancreas and the stomach. The gastroesophageal junction was the next site of dissection. Next, a linear stapler was used to resect the stomach, starting 5 cm from the pylorus up to the angle of Hiss (Fig. 2). Subsequently, the stomach was tabulated over a Bougie orogastric tube, measuring 36 French. The second part of the procedure is then

Figure 1



Devascularization of the Greater curvature.

Figure 2



Stabling of the stomach.

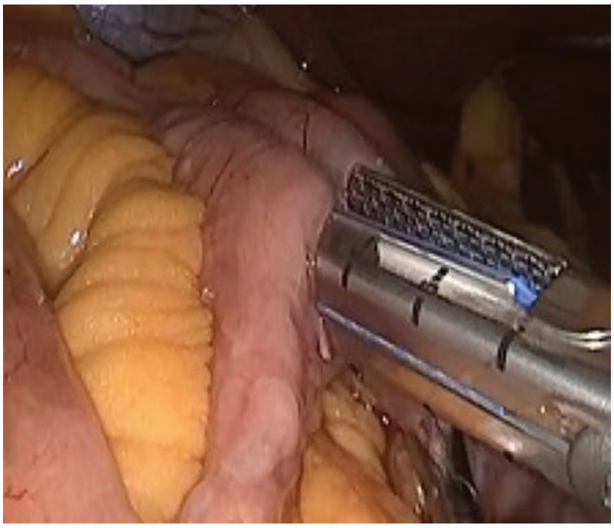
Figure 3

Identification of the Caecum.

performed by the surgeon by moving the table to the patient's left side.

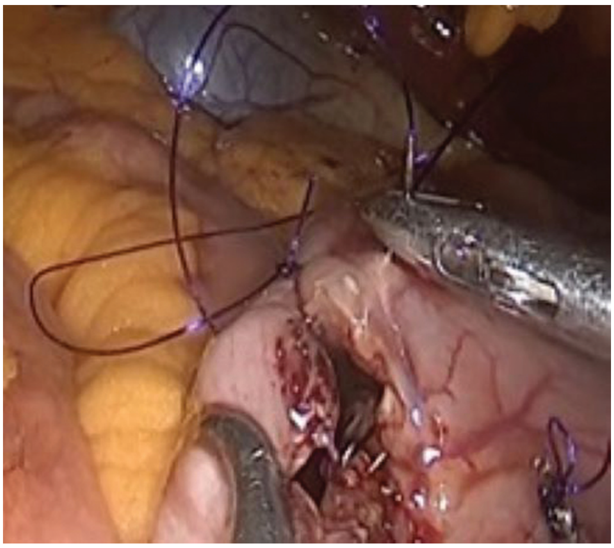
Once the ileocecal junction has been located (Fig. 3), a measurement of 250 cm is taken upward. Only three centimetres from the pylorus, the selected loop is isoperistaltically stapled side to side to the anterior wall of the stomach's antrum using a linear stapler (Fig. 4). The maximum diameter of the ileal antrum anastomosis is 3 cm. In order to close the staple defect, a two-layer running 3/0 polydioxanone suture is employed (Figs 5 and 6). Using the 12 mm left midclavicular port, the transected stomach is removed. The purpose of the methylene blue test is to check for leaks and assess if the anastomosis is watertight. The air-leak test was finished, and then a drain was placed behind the anastomosis.

Figure 4



Side to side Sleeve ileal anastomosis.

Figure 5



Closure the site of stapler entry.

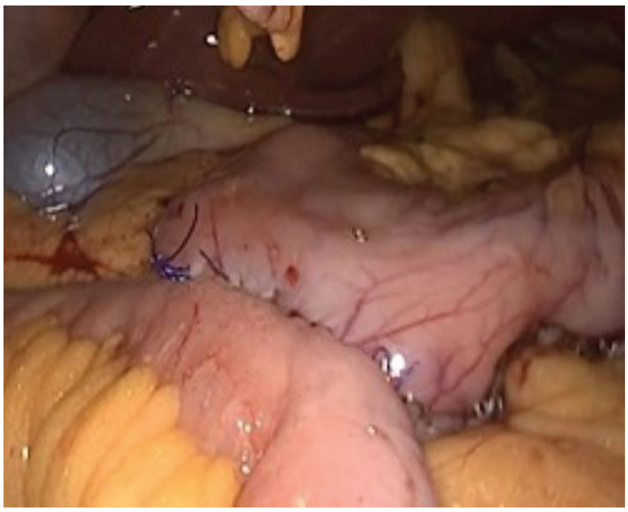
Postoperative care and follow-up

Patients were advised to stroll around early in the few hours after surgery. Oral fluids were allowed four to 6 h after full recovery. Documentation was kept of the surgical process as well as the early postoperative issues. The duration of each patient's hospital stay was recorded. Patients received intravenous fluids, 1 g of cefotaxime, and omeprazole in the first 24 h after surgery. Pain was managed with intravenous pethidine or paracetamol on demand.

The patients were discharged home on the third postoperative day. All patients received the same postoperative protocol, which included three months of Proton pump inhibitors, 2 weeks of liquid diet, 2 weeks of soft diet, and daily oral supplements of a multivitamin, 1000 μg of vitamin B12, 1000 mg of calcium carbonate, 40 μg of vitamin D3, and 65 mg of iron for fertile women. During the follow-up, the dosage of these supplements may need to be adjusted. Taking vitamin supplements is advised for life.

To monitor the results of the surgery, patients were requested to come in for evaluation every 2 weeks for the first 3 months and then every 3 months for the following year. Patients were advised to visit the outpatient clinic once a week for the first month after surgery in order to identify any postoperative issues as soon as possible.

Figure 6



Final view of the Sleeve ileal anastomosis.

Outcome and follow-up

Primary outcome

The primary outcome was successful SASI procedure with minimal postoperative complications.

Secondary outcome

The secondary outcome was the potential remission or improvement of MetS including disorders of T2DM, HTN and dyslipidemia. According to standardized outcome reporting devised by ASMBS [14,15].

Statistical analysis

The sample size required to achieve a power of 1-β=0.80 (80%) for the spearman's correlation at level α =0.05 (5%), under these assumptions amounts to 50 (G*power, version 3.1).

Data was collected, revised, coded and entered to the statistical package for social science (SPSS) version 23. Qualitative data was presented as number and percentages while quantitative data was presented as mean, standard deviations and ranges. the *P* value was considered statistically significant if *P* less than 0.05.

Results

The current study included fifty super morbid obese patients with MetS who underwent SASI bypass procedure. The mean age of patients was (41.56 ±6.32). A 36 (72.0%) had HTN, 46 (92.0%) had T2DM and 33 (66.0%) had dyslipidemia. The BMI (kg/m^2) 54.72±2.68. The mean arterial pressure (MAP) was 103.38±11.38 (Table 1).

Table 1 Demographic data, baseline anthropometric measurements and mean blood pressure, glycemic and lipid profile

Variables	*N*=50
Age (y)	41.56±6.32
Sex	35 (70.0%)
	15 (30.0%)
Co-morbidities	
HTN *n* (%)	36 (72.0%)
T2DM *n* (%)	46 (92.0%)
Dyslipidemia *n* (%)	33 (66.0%)
Weight (kg) Mean±SD	157.28±8.78
Height (cm) Mean±SD	169.62±5.85
BMI (kg/m^2) Mean±SD	54.72±2.68
MAP Mean±SD	103.38±11.38
HbA1c (%) Mean±SD	8.34±1.23
FBS (mg/dL) Mean±SD	156.50±21.90
TG (mg/dL) Mean±SD	177.48±30.95
LDL-C (mg/dl) Mean±SD	177.48±30.95
HDL-C (mg/dl) Mean±SD	40.44±10.93

Baseline glycemic and lipid profile

The baseline means of HbA1c and FBS were 8.34 ±1.23 and 156.50±21.90, respectively and the mean TG, (mg/dL) LDL-C (mg/dl), HDL-C (mg/dl) were 177.48±30.95, 180.76±21.04 and 40.44±10.93, respectively (Table 1).

Operative data and complications

The mean operative time was 99.72±5.78 with a mean hospital stay of 2.52±0.80, no intra operative complications or postoperative mortality occurred. Four (8%) postoperative complications were recorded, one (2%) patient developed major postoperative complications of staple line bleeding undergone laparoscopic exploration and controlling of the bleeding site at stable line with sutures was done and evacuating intraperitoneal collection complete hemostasis was done and pt needed blood transfusion. Three patients developed non major complication, one (2%) patient had paralytic ileus. the other two (4%) patients had pneumonia. Three patients needed postoperative ICU admission for less than 5 days (Table 2).

Outcome and follow-up

Weight loss (primary outcome)

For primary outcome of the study at 6 months after SASI procedure there was a significant decrease of body weight and BMI from baseline weight of 157.28 ±8.78 kg and 54.72±2.68 kg/m^2 to 108.68±7.69 kg and 37.78±1.89 kg/m^2 ($P<0.001$). The mean % excess weight loss (EWL) at 6 months was 56.94±4.65. At 1 year after SASI bypass, significant reduction in body weight and BMI compared with its initial value and value at 6 months as follow 86.38±10.07 kg and 29.96 ±2.42 kg/m^2 ($P<0.001$). The mean % EWL at 12 months showed a significant increase compared with its value at 6 months 83.16±8.09 ($P<0.001$) (Table 3).

Effects on comorbidities (secondary outcome)

Regarding glycemic parameters at 6 months and 1 year postoperative HbA1c and fasting blood sugar show

Table 2 Operative data and postoperative complications

Variables	*N*=50
Operative time (minimum) Mean±SD	99.72±5.78
Intra operative complications *n* (%)	0
Postoperative complications	
staple line bleeding *n* (%)	1 (2.0%)
Paralytic ileus *n* (%)	1 (2.0%)
Pneumonia *n* (%)	2 (4.0%)
ICU admission *n* (%)	3 (6.0%)
Postoperative mortality *n* (%)	0
Hospital Stay (day) Mean±SD	2.52±0.80

Table 3 Follow-up of weight, BMI baseline and % EWL: glycemic and lipid profile andMAP (baseline, 6 month and 12 months)

	Baseline No.=50	6 months No.=50	12 months No.=50	Baseline versus 6 month	Baseline versus 12 month	6 month versus 12 month
Weight (kg) Mean±SD	157.28±8.78	108.68±7.69	86.38±10.07	<0.001*	<0.001*	<0.001*
BMI (kg/m^2) Mean±SD	54.72±2.68	37.78±1.89	29.96±2.42	<0.001*	<0.001*	<0.001*
% EWL Mean±SD		56.94±4.65	83.16±8.09			<0.001*
HbA1c	8.34±1.23	6.36±0.57	5.04±0.38	<0.001*	<0.001*	<0.001*
FBS (mg/dl)	156.50±21.90	104.48±8.31	85.60±6.59	<0.001*	<0.001*	<0.001*
TG (mg/dl)	177.48±30.95	131.98±17.65	104.10±14.03	<0.001*	<0.001*	<0.001*
LDL-C (mg/dl)	180.76±21.04	104.64±7.13	77.56±8.93	<0.001*	<0.001*	<0.001*
HDL-C (mg/dl)	40.44±10.93	49.58±8.71	57.96±6.64	<0.001*	<0.001*	<0.001*
MAP	103.38±11.38	88.36±5.72	74.46±5.83	<0.001*	<0.001*	<0.001*

Table 4 Remission and improvement of co-morbidities at end of study

	Baseline	Remission	NO Remission	*P* value
HTN *n* (%)	36 (72.0%)	31 (86.11%)	5 (13.8%)	<0.001*
T2DM *n* (%)	46 (92.0%)	44 (95.65%)	2 (4.34%)	<0.001*
Dyslipidemia *n* (%)	33 (66.0%)	33 (100.0%)	100.0%	<0.001*

significant improvement which decrease from 8.34 ±1.23 to 6.36±0.57 and 5.04±0.38 for HbA1c and from 156.50±21.90 to 104.48±8.31 and 85.60±6.59 for FBS, respectively. And regarding lipid profile TG (mg/dl) and LDL-C (mg/dl) show significant reduction at 6 and 1 year postoperative from 177.48±30.95 preoperative to 131.98±17.65 and 104.10±14.03 for TG, and from 180.76±21.04 preoperative to 104.64 ±7.13 and 77.56±8.93for LDL-C (<0.001). HDL-C (mg/dl) show significant increase from 40.44±10.93 preoperative to 49.58±8.71 and 57.96±6.64 (<0.001).

As regarding the blood pressure; MAP show significant decrease from baseline of 103.38±11.38 to 88.36±5.72 at 6 month and to 74.46±5.83 at 1 year of follow-up (<0.001) (Table 3).

Improvement of comorbidities

At 12 months postoperative from 36 (72.0%) who had HTN 31 (86.11%) patients had complete remission and five (13.8%) patients show partial improvement and still needed antihypertensive medication, and from 46 (92.0%) who had T2DM most of them were on hypoglycemic drugs preoperative 44 (95.65%) patients had complete remission and only two (4.34%) patients showed marked improvement in diabetic state and needed small dose of oral hypoglycemic drugs for control. All of patients 33 (100.0%) who had dyslipidemia showed complete remission (Table 4).

Discussion

Compared with lifestyle therapies and medicine, bariatric surgery offers a widely accepted alternative technique for managing obesity and other aspects of MetS, with a longer-lasting initial weight loss. Bariatric Surgery is a safe, simple to perform technique that effectively reduces weight and resolves co-morbidities [16,17].

SASI bypass procedure was developed as a modification of the previously used SG with transit bipartition. The primary reports regarding safety and efficacy were encouraging, with EWL reaching up to 94% at a year of follow-up. However, the average BMI of the patients included in these trials was less than 50 kg/m^2, suggesting that a small percentage of extremely obese individuals with BMIs above 50 were included [9,13,17].

Super obesity, which is defined as having a body mass index (BMI) of 50 or above, has been identified as a difficult issue [18]. Patients with higher BMIs have lower initial and EWL percentages; this is especially noticeable during the rapid weight loss phase. Additionally, it has been shown that within the first year following surgery, less obese people with a BMI under 50 continued to lose weight, while people with a BMI over 50 significantly gained weight back [19]. Consequently, in order to ascertain whether SASI bypass is as safe and successful in super obese individuals as it has been documented in patients with BMI less than 50, we carried out the current study to look into these issues. The recruited 50 adult patients with BMIs greater than 50 kg/m^2 were mainly females, which supports the literature's findings that women are more likely than men to be obese [20].

The mean operational time for the current study was 99.72±5.78 min. This was less than what was reported by many authors (9, 21, 22) who reported a relatively longer time and this is may be assumed to the different learning curve and available energy resources. The average length of stay at the hospital was 2.52±0.80, which was similar to the findings of earlier research [21–24]

In the current study, one (2%) patient experienced staple line leakage as a postoperative complications. and three (6%) patients experienced nonmajor complications; two of them had pneumonia, and one patient suffered paralytic ileus which was consistent with other researchs [22,23].

The study's main finding is that, at 6 months postoperatively, the mean BMI showed a statistically significant decrease from 54.72±2.68 to 37.78±1.89 kg/m^2, and at one year postoperatively, it further decreased to 29.96 ±2.42 kg/m^2. These results are in line with those of Emile *et al.* [25], who reported BMIs of 36.5 and 30.6 at 6 months and 1 year of follow-up. This is superior to Madyan *et al.* [26] who reported BMIs of 39.9 at 6 months and 33.6 at 1 year, respectively.

After 6 postoperative months, the mean EWL was 56.94%±4.65%. At 12 months, the mean EWL was 83.16%±8.09%, which is similar to the percentages reported by Kermansaravi *et al.* [17], and Romero *et al.* [27]. It was much better than Madyan *et al.* [26], who reported that the percentage of EWL at one year postoperatively was 65.2%, which could be explained by wide variation in preoperative BMI and comorbidities. Khalaf *et al.* [28] and Hosseini *et al.* [29] reported % EWL of 86.2, 85.6, 86.9, and 87.37%, respectively. It is noteworthy to emphasise that the percentage EWL following SASI bypass found in this investigation is marginally lower than that seen in the initial published studies pertaining to the treatment.

The discrepancy between the current results and other studies [24,30,31] who reported % EWL ranging from 90 to 97% after 1 year follow-up may be explained by the higher BMI of the patients in the present study, which may slow the rate of weight loss after surgery and result in lower % EWL. The effects of preoperative BMI may not be the only factors influencing the different results following SASI bypass and other variables can be involved. These variables include the common channel length and the size of the gastro-ileal anastomosis. Because anastomoses of less than 2 cm are more likely to experience stenosis and occlusion, the gastro-ileal anastomosis should be 3–4 cm in size. Other findings included heterogeneous groups of patients with anastomosis sizes of either 3 or 4 cm and common channel lengths of 250, 300, or 350 cm, despite Mahdy *et al.*'s [9] recommendation that the anastomosis size not exceed 3 cm and the common channel length be 250 cm. In accordance with Mahdy *et al.*, we chose to set the gastro-ileal anastomosis's size at no more than 3 cm and to measure the common channel length upward from the ileocecal junction to 250 cm.

After a year, 95.65% of patients had complete remission in their glycemic control, and 4.34% had greatly improved their diabetic state. This was evidenced by the significant improvement in glycemic parameters at 6 months and 1 year postoperatively, where HbA1c and fasting blood sugar levels decreased from 8.34±1.23 to 6.36±0.57 and 5.04±0.38 for HbA1c, respectively, and from 156.50±21.90 to 104.48±8.31 and 85.60±6.59 for FBS, respectively.

Following an SASI bypass, the resolution of T2DM may be linked to several factors, including a decrease in caloric intake following gastric volume restriction, the quick passage of undigested gastric content into the ileum, which has been demonstrated to enhance the nutritive stimulation of the distal gut, and a reduction in the overstimulation of the proximal gut due to less food passing through the duodenum [9].

This was in line with the findings of the recent study by Aghajani *et al.*, 2023 [31], which found a 93% full remission of T2DM and a 7% improvement. It was also in line with the findings of earlier research, which reported a rate of 88.9–100% diabetic remission [4,5,7,9]. Compared with recorded outcomes following Sleeve gastrectomy (72–81.6%), the remarkable remission of T2DM with SASI bypass is higher [32,33].

One year after the SASI bypass, there was a significant drop in fasting blood glucose, indicating the procedure's therapeutic benefit for T2DM. Through a number of mechanisms, including the bipartition mechanism that allows for the quick entry of undigested food to increase the nutritive stimulation of the distal gut and the passage of a smaller portion of the meal through the duodenum to reduce the nutritive overstimulation of the proximal gut, SASI Bypass helps to elicit a significant improvement in T2DM. The early satiety was caused by the ileum's quick activation of GLP-1 and PYY release by undigested meal, insulin secretion, and calorie restriction [9,34,35].

In terms of HTN, 13.8% of patients exhibited improvement and 86.11% of patients experienced total remission. This is consistent with the 85.7–91.3% remission rates that have been previously reported in other trials [9,17,24,27]. Compared with the previous studies published by Hosseini *et al.* [29] and Aghajani *et al.* [31], which showed improvements of 75% and 73%, respectively, this study demonstrates greater improvement. This difference may be due to differences in the number of individuals, length, and severity of HTN.

Additionally, during the analysis of the dyslipidemia condition, highly significant findings were seen, meaning that by the end of the trial, all patients with dyslipidemia (100%) had achieved complete remission and maintained normal lipid profile values. This result was in line with the 100% remission reported by Kermansaravi *et al.* in 2020 [17] and Hosseini *et al.* in 2022 [29], as well as with other studies that shown a similar percentage of resolution and improvement of dyslipidemia [9,22,25].

Thus, as demonstrated by this study, all MetS characteristics significantly improved following the SASI bypass treatment.

Conclusion

Laparoscopic SASI bypass Procedure seems to be an effective and safe bariatric procedure that confers significant loss of weight and improvement in medical comorbidities, it is an accepted option for management of MetS with a better and more sustained weight reduction and produced a significant remission of MetS and all its features (obesity, T2DM, HTN and dyslipidemia). The current study is reporting the short term results and for long term outcomes other studies with longer follow-up period are highly recommended.

Acknowledgements

Financial support and sponsorship: Nil.

Declaration of conflicting interests: there are no potential conflicts of interest with respect to the research, authorship and publication of this article.

Financial disclosure: the authors receive no financial support for the research project or in any techniques or equipment used in this study or in the publication of this article.

Authors contribution: Emad M. Abdelrahman: Concept and designed the study, conducted procedure, analyzed data, and drafted the manuscript. Hussein Elgohary: Study design, conducted procedure, and supervised cognitive and behavioral assessments. Mohamed S. Kharoub Study design, conducted procedure. Abdallah H. Diab: Collected the data, and conducted procedure. Drafting and final revision. Mohamed A. Elsayed: Collected the data, and conducted procedure. Drafting and final revision.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Bovolini A, Garcia J, Andrade MA, Duarte JA, *et al.* Metabolic Syndrome Pathophysiology and Predisposing Factors. Int J Sports Med 2021; 42:199–214.

2 Han TS, Lean ME. A clinical perspective of obesity, metabolic syndrome and cardiovascular disease. JRSM Cardiovasc Dis 2016; 5:204800401663337.

3 Hopkins JL, Hopkins PN, Brinton EA. Expression of Metabolic Syndrome in Women with Severe Obesity. Metab Syndr Relat Disord 2017; 15:283–290.

4 Batsis JA, Romero-Corral A, Collazo-Clavell ML, Sarr MG, *et al.* Effect of bariatric surgery on the metabolic syndrome: a population-based, long-term controlled study. Mayo Clin Proc 2008; 83:897–907.

5 Shuai X, Tao K, Mori M, Kanda T, *et al.* Bariatric surgery for metabolic syndrome in obesity. Metab Syndr Relat Disord 2015; 13:149–160.

6 Cordero P, Li J, Oben JA. Bariatric surgery as a treatment for metabolic syndrome. J R Coll Physicians Edinb 2017; 47:364–368.

7 Santoro S, Velhote MCP, Malzoni CE. (2006) Preliminary results from digestive adaptation: a new surgical proposal for treating obesity, based on physiology and evolution

8 Santoro S, Castro LC, Velhote MCP (2012) Sleeve gastrectomy with transit bipartition: a potent intervention for metabolic syndrome and obesity.

9 Mahdy T, Alwahedi 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

10 Mahdi T, Wahid Alwahidi A, Schou C (2015) Laparoscopic single anastmosis sleeve ileum bypass (SASI bypass): technique and preliminary results

11 Lustig RH (2001) The neuroendocrinology of obesity. Endocrinol Metab Clin North Am

12 Santoro S, Castro LC, Velhote MCP (2012) Sleeve gastrectomy with transit bipartition. Ann Surg

13 Mui WLM, Lee DWH, Lam KKY (2014) Laparoscopic sleeve gastrectomy with loop bipartition: a novel metabolic operation in treating obese type II diabetes mellitus

14 Brethauer SA, Kim J, el Chaar M, *et al.* Standardized outcomes reporting in metabolic and bariatric surgery. Surg Obes RelatDis 2015; 11:489–506.

15 Melgarejo JD, Yang WY, Thijs L, Li Y, *et al.* International Database on Ambulatory Blood Pressure in Relation to Cardiovascular Outcome Investigators*. Association of Fatal and Nonfatal Cardiovascular Outcomes With 24-Hour Mean Arterial Pressure. Hypertension 2021; 77:39–48.

16 Billeter AT, de la Garza Herrera JR, Scheurlen KM, Nickel F, *et al.* Management Of Endocrine Disease: Which metabolic procedure? Comparing outcomes in sleeve gastrectomy and Roux-en Y gastric bypass. Eur J Endocrinol 2018; 179:R77– R93.

17 Kermansaravi M, Kabir A, Pazouki A. 1-Year Follow-up of Single Anastomosis Sleeve Ileal (SASI) Bypass in Morbid Obese Patients: Efficacy and Concerns. Obes Surg 2020; 30:4286–4292.

18 Elbanna H, Ghnnam W, Negm A. Impact of preoperative body mass index on the final outcome after laparoscopic sleeve gastrectomy for morbid obesity. Ulus Cerrahi Derg 2016; 32:238–243.

19 Ochner CN, Jochner MC, Caruso EA. Effect of preoperative body mass index on weight loss after obesity surgery. Surg ObesRelat Dis 2013; 9:423–427.

20 Kanter R, Caballero B. Global gender disparities in obesity: a review. Adv Nutr 2012; 3:491–498.

21 Salama TMS, Sabry K, Ghamrini Y El. Single Anastomosis Sleeve Ileal Bypass: New Step in the Evolution of Bariatric Surgeries. J Invest Surg 2017; 30:291–296.

22 Abouzeid MM, Helmy MM, Abdulaziz MM, Elhusseini M, *et al.* Single Anastomosis Sleeve Ileal Bypass (SASI) for management of obese patients with type 2 Diabetes. Life Sci J 2019; 16:112–120.

23 Abdalaziz A, Sarhan XX, Abou-Eisha XX, H. A, Abdelsalam XX, *et al.* Laparoscopic Single Anastomosis Sleeve Ileal Bypass with Follow-up of Weight Loss and Metabolic Impact. Open Access Maced J Med Sci 2022; 10:1325–1331.

24 Vennapusa A, Bhargav XX, Panchangam RK. A Feasibility Study of Novel 'Laparoscopic Sleeve Gastrectomy with Loop Gastroileal Bypass' for Obesity: An Indian Experience. Int Surg 1 2017; 102:504–513.

25 Emile SH, Madyan A, Mahdy T, Elshobaky A, Elbanna HG, Abdel-Razik MA. Single anastomosis sleeve ileal (SASI) bypass versus sleeve gastrectomy: a casematched multicenter study. Surg Endosc 2021; 35:652–660.

26 Madyan A, Emile SH, Abdel-Razik MA, Ellithy R, *et al.* Laparoscopic Single Anastomosis Sleeve Ileal (SASI) Bypass for Patients with Morbid Obesity: Technical Description and Short-term Outcomes. Surg Laparosc Endosc Percutan Tech 2020; 30:e13–e17.

27 Romero RJ, Colorado-Subizar R, De Uriarte-Lorente M. Single Anastomosis Sleeve Ileal Bypass (SASI Bypass): Short-Term Outcomes and Concerns. Obes Surg 2021; 31:2339–2343.

28 Khalaf M, Hamed H. Single-Anastomosis Sleeve Ileal (SASI) Bypass: Hopes and Concerns after a Two-Year Follow-up. Obes Surg 2021; 31:667–674.

29 Hosseini SV, Moeinvaziri N, Medhati P. The Effect of Single-Anastomosis Sleeve Ileal (SASI) Bypass on Patients with Severe Obesity in Three Consecutive Years. World J Surg 2022; 46:2744–2750.

30 Khalil OH, Mansy WS, Abdalla WM, Baiomy TA, *et al.* Laparoscopic sleeve gastrectomy with loop bipartition versus laparoscopic sleeve gastrectomy in treating obese people with type II diabetes mellitus: a prospective randomized comparative study. Egypt J Surg 2019; 38:610–617.

31 Aghajani E, Schou C, Gislason H. Mid-term outcomes after single anastomosis sleeve ileal (SASI) bypass in treatment of morbid obesity. Surg Endosc 2023; 37:6220–6227.

32 Emile XX, Sameh H. 'Laparoscopic Sleeve Gastrectomy Then and Now: An Updated Systematic Review of the Progress and Short-term Outcomes Over the Last 5 Years'. Surg Laparosc Endosc Percutan Tech 2017; 27:307–317.

33 Sista F, Abruzzese V, Clementi M. Resolution of type 2diabetes after sleeve gastrectomy: a 2-step hypothesis. Surg Obes Relat Dis 2018; 14:284–290.

34 Holst JJ, Madsbad S, Bojsen-Møller KN. (2018) Mechanismsin bariatric surgery: gut hormones, diabetes resolution, andweight loss. Surg Obes Relat Dis

35 Larraufie P, Roberts GP, McGavigan AK. (2019) Importantrole of the GLP-1 axis for glucose homeostasis after bariatric surgery. Cell Rep