Laparoscopic Single Anastomosis Sleeve-Jejunal (SASJ) Bypass

Original Article

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ABSTRACT

Background: Bariatric and metabolic operations have gained distinctive and worldwide approval given the confirmed efficiency and safety of bariatric approaches and the increasing prevalence of obesity and its accompanying co-morbidities. A novel procedure was developed to form an anastomosis between the sleeve gastrectomy (SG) and the jejunum instead of the ileum (SASJ).

Patients and Methods: This prospective study enrolled 30 cases diagnosed with morbid obesity and scheduled for laparoscopic SASJ. All patients received standard preoperative preparation including history taking, clinical examination, laboratory investigations, pelviabdominal ultrasound, and upper gastrointestinal (UGI) endoscopy. The operation was conducted for all of them, and they were followed for one year after the procedure. We recorded postoperative complications, the %EWL, and changes in obesity-related comorbidities.

Results: The mean values of %EWL were 21.39, 40.44, 54.46, and 71.86% at one-, three-, six-, and twelve-month follow-up visits respectively. Late postoperative complications included dumping syndrome (6.67%), hair loss (10%), and hypocalcemia (6.67%), while no patients developed sleeve tube stenosis during the follow-up period. The SASJ procedure was accompanied by excellent diabetic outcomes. All patients with pre-existing dyslipidaemia showed remission or improvement after twelve months. All patients with pre-existing OSAS showed improvement in their condition, and that improvement persisted till the twelve-month follow-up visit. There was a significant improvement in the quality of life (QoL) after the procedure as manifested by the increased QOLOS 1 questionnaire values after the procedure compared to the preoperative one. Also, QOLOS 2 questionnaire also showed significantly increased values after the procedure.

Conclusion: SASJ is a safe and efficacious bariatric approach, as it yields excellent weight loss (WL) outcomes, improvement of obesity-related comorbidities, with low risk of postsurgical complications.

Key Words: Bariatric surgery, obesity, SASJ, GERD.

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INTRODUCTION

Obesity is an increasingly critical public health problem globally and accompanied by a higher incidence of mortality and morbidity which include diabetes mellitus (DM), hypertension (HTN), osteoarthritis (OA) and obstructive sleep apnea syndrome (OSAS)[1].

Bariatric surgery is an efficient approach in the management of morbid obesity as it could accomplish significant and sustained WL and improvement of co-morbidities[2]. The perfect approach has to modify the neuroendocrine regulation of hunger and satiety and shouldn't induce harm to essential digestive functions unrelated to obesity[3].

The most frequently conducted bariatric surgery globally is the vertical SG (VSG), the Roux-en-Y gastric bypass (RYGB), and the mini-gastric bypass (MGB), reported to be accompanied by promising bariatric and metabolic results[4,5]. In addition, a one-loop duodenal switch has emerged as another novel approved successful[6].

Together with the previously reported approaches, Santoro *et al*. conducted a new approach: the SG with transit bipartition (SG+TB). It has been demonstrated that SG+TB raises the stimulation of the lower GIT and reduces the exposure of the upper part to food[3].

A novel approach emerged in Iran in which anastomosis between the sleeved stomach and the jejunum was conducted instead of the ileum[7,8]. SASJ bypass has been considered a modified SASI utilizing a smaller biliopancreatic limb length compared with SASI to avoid nutritional adverse events[9]. Due to its improved surgical ergonomics, the SASJ bypass appears to be simpler and safer than the SASI surgery in patients with excess weight loss (EWL) and nutritional deficiencies[10]. SASJ bypass is an approach that combines restrictive and malabsorptive procedures[11].

Early food exposure to the ileum in such an approach accompanied by increased formation of GLP-1 (Glucagon-like peptide) and peptide-YY causes further beta cell

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activation for insulin production, minimal glucagon response, and diminished stomach emptying time[12]. This neuroendocrine modulation is helping patients to stop eating earlier since it causes a hypothalamic-produced fullness sensation which is triggered by the nutritional perception in their lower gut. The extensive lower GIT stimulation decreases upper GIT activity in another essential way[13].

OBJECTIVES

This prospective study aimed to assess the efficacy of laparoscopic SASJ bypass as a new bariatric approach in the treatment for morbid obesity and the associated comorbid conditions.

PATIENTS AND METHODS

This prospective interventional study was held at Gastrointestinal Surgical Center (GISC), Mansoura University, Egypt, over the period of two years, from January 2021 to January 2023. This study included 30 patients aged from 18 to 59 years old from both genders and diagnosed clinically with primary morbid obesity with BMI >40 kg/m^2 or with BMI >35 kg/m^2 with at least one of obesity accompanying comorbidities and scheduled for laparoscopic SASJ. But we excluded patients with contraindication for laparoscopic surgery such as advanced liver cirrhosis, severe bleeding tendency, severe cardiopulmonary illness, and history of upper abdominal surgery, patients with upper gastrointestinal pathology (active gastroduodenal ulcerations, severe GERD, large hiatus hernia), patients with previous bariatric or gastric surgeries, with major psychiatric illness, with significant abdominal ventral hernia and with secondary obesity, such as uncontrolled hypothyroidism, and Cushing disease.

Ethical consideration

The study was approved by the ethics committee, faculty of medicine, Mansoura University (Code number: MD.20.10.378). Patient confidentiality was preserved, and the collected data were used only for scientific aims. An informed written consent was acquired by all participants after a comprehensive explanation of the advantages, drawbacks, and possible adverse events of the SASJ procedure.

Methods

Every patient was subjected to full history taking which include personal history (name, age, sex, occupation, and residence), present history (onset of obesity, dietary history, other methods used for weight reduction and their effectiveness), family history of obesity, and medical history due to obesity (diabetes mellitus, hypertension, ischemic heart diseases and respiratory complications).

Clinical examination included general examination for head, neck, chest, abdomen, and lower limb examination, routine abdominal examination to look for any masses, scars, and hernial orifices. Anthropometric measurements of weight were performed in the morning, after voiding, in light clothing and without shoes. BMI was calculated as kg/m^2.

Laboratory investigations included complete blood count (CBC), liver function (albumin, bilirubin, and hepatic transaminases), international normalized ratio (INR), serum creatinine, random blood sugar, and glycosylated hemoglobin in diabetic cases (HbA1C). Endocrine profile included vitamin D, serum total calcium, serum iron, thyroid function tests and 9 am & 9 pm cortisol levels to exclude hypoparathyroidism and Cushing disease as secondary causes of obesity,

Upper GI endoscopy was done for all cases for the diagnosis of GERD or any other gastroesophageal pathology. Pelviabdominal ultrasonography was ordered for all cases as a general assessment tool for the abdominal cavity and liver status. The presence of gall stones was also noticed, to be removed at the same bariatric setting.

Anesthetic consultation was ordered to perform an echocardiography and pulmonary function tests to evaluate the cardiopulmonary condition before the operation. All patients were assessed by anesthetic team and their physical status was classified according to ASA score system for physical status[14].

Assessment of QoL was done using QoL for Obesity Surgery (QOLOS) Questionnaire which is composed of 2 sections, a thirty six-item section one QOLOS form targeting presurgical and postsurgical aspects across 7 domains (eating disturbance, physical functioning, body satisfaction, family support, social discrimination, positive activities, partnership) and a 20-item section two QOLOS form emphasizing postsurgical concerns only (domains: excess skin, eating adjustment, dumping, satisfaction with operation)[15].

Preoperative preparation

Patients were advised to eat less caloric diet for 2 weeks before surgery aiming to decrease the size of the left liver lobe at operation time. Patients were admitted to the center the day before the surgery. DVT prophylaxis was done prophylactic low molecular weight heparin (LMWH) given 12 hours before the surgical approach, along with elastic stockings that were applied just before surgery

Surgical Procedure

One gram of 3rd generation cephalosporin was administered by intravenous injection at induction of anesthesia before trocars insertion. All operations were done with general anaesthesia. The patient was in French position. The 1st part of the surgery was conducting on the operating table under forced anti-Trendelenburg position and the surgeon positioned between the legs of the patient, the assistant to the left of the patient and the camera man to the right of the patient. The abdomen was insufflated with

CO2 up to a pressure of 14 to 15 mmHg through a Veruss needle. Five ports were placed, camera port (10–12 mm) 15-20 cm below the xiphoid process slightly to the left of the mid-line, two working ports (12-15 mm) at the right and left mid clavicular lines and slightly above the camera port for the right and left hands of the surgeon, one assistant port (five mm) at the left anterior axillary line and one liver retractor port five mm just below the xiphoid process. The approach started with the devascularization of the greater curvature of the stomach. The dissection then continued proximally toward the gastroesophageal junction. The left crus was then totally dissected of any attachments to evade leaving a posterior pouch when performing the sleeve in this area and distally till 3-4 cm from the pylorus. Posterior connections between the stomach and pancreas were divided. After that, the stomach was stapled over a calibration tube, starting six cm proximal to the pylorus with a linear stapler charged with a 60 mm green cartridge for the antrum and 60 mm blue cartridges for the body and fundus. When ended, the table was changed to the horizontal position and the duodenojejunal (DJ) junction was recognized, the whole small bowel length was measured then a point two hundred cm from the DJ is evaluated. The gut loop was after that brought up to the gastric sleeve with no division of the greater omentum and fixed with a stay suture to the sleeved stomach. A stapled isoperistaltic side-to-side anastomosis to the anterior wall of the antrum of the stomach just three cm far from the pylorus was performed using linear cutting stapler charged with a 60 mm blue cartridge, the diameter of jejuno-antral anastomosis was not exceeding three centimeter in caliber. The defect of the gastro-jejunal anastomosis was closed with a two-layer running suture (3/0 polydioxanone suture (PDS) sutures). After that, the transected stomach was excised via the twelve-mm left midclavicular port. The anastomosis was examined for water tightness by using methylene blue dye.

Postoperative care

All cases were transferred to the recovery room after that to the internal ward, or to the ICU if the anesthetic team recommended ICU admission for close monitoring. Any early post-operative complications including bleeding, leakage, vomiting and surgical site infection were evaluated by Clavian-Dindo Grading (GI = any deviation from normal postsurgical course, GII = complication requiring medical treatment, GIIIa, b = complication requiring surgical, endoscopic or radiological interference, GIVa, b = organ failure, and GV = death). Pain was managed by IV paracetamol 1 gm/6 h in addition to IV ketorolac 30 mg/12 h. If the patient reported a breakthrough pain, IV morphine 3 mg was administered. Patients were kept NPO for the first day after operation, and IV fluids (3000 ml) commenced for all of them. IV antiemetic (primperan) along with proton pump inhibitor (Controloc 40 mg vial) was administered. Early mobilization was encouraged, and prophylactic LMWH was administered 12 hours after operation. By the end of the 1st postoperative day (POD), patients were allowed to start oral fluids after ruling out leaking by an oral gastrograffin test. Mostly, all patients were discharged on the subsequent day, after ensuring good oral fluid tolerance, good pain management by oral medications, and emptiness from complications.

Follow up

Follow-up visits were scheduled for all cases at 1, 3, 6, and 12 months after the approach. Besides clinical assessment, weight loss changes was recorded, hemoglobin and albumin levels were assessed as monitors for nutritional deficiency. Vitamin D, Serum calcium levels and serum iron levels were recorded at 1 year follow-up visit. Glycemic control was classified as complete remission (CR), partial remission, improvement, unchanged, or recurrence. Patient blood pressure was also classified as improvement, partial remission, and CR. The changes in dyslipidemia were classified as remission, improvement, or unchanged. Improvement in OSAS was established when the patient reported improvement in sleep hygiene and manifestations of sleep apnea, or when the patient self-discontinued the usage of sleep apnea management CPAP/BiPAP according to improved symptoms. The quality-of-life questionnaire (QOLOS section 1) was repeated at 1-, 3-, 6-, and 12-month follow-up visits, and QOLOS section 2 was assessed in the same visits.

Primary outcome included the percentage of EWL on follow-up following SASJ bypass. Secondary outcomes included early complications, late complications, changes in patients reported QoL and improvement of obesity-related co-morbidities.

Statistical Analysis

Data were fed to the computer and analysed using IBM SPSS version 22.0. Qualitative data were defined using number and percentage. Quantitative data were described using median for non-parametric data and mean±SD for parametric data following testing normality. Repeated measures ANOVA were applied to compare numerical variables at various time points, while Marginal homogeneity test was applied to compare different categorical variables at multiple time points. In addition, McNemar's test was applied for paired nominal data. Significance test results are quoted as two-tailed probabilities. The level of significance was set at 0.05.

RESULTS

The mean age of the included cases was 37.63 ± 10.76 years. Most of the included patients were women, who represented 80% of the study population. The remaining participants were men. The mean BMI of the included cases was 46.87 ± 6.56 kg/m^2. Regarding obesity related comorbidities, type 2 DM was present in eleven cases (36.67%), whereas hypertension was present in 22 cases (73.33%). Additionally, dyslipidaemia, GERD, and OSAS were detected in 63.33%, 33.33%, and 43.33% of cases,

respectively. Ultrasound revealed fatty liver in all patients with no gallbladder stones. The duration of the surgical procedure had a mean value of 98.93 ± 13.47 minutes. The mean intraoperative blood loss 85 ± 40.79 ml. Bleeding from the short gastric vessels happened in a single case due to hemostatis device failure, and it was controlled with surgical clips. Median hospital stay was 2 days. Median ICU stay was one day (range, 1-5 days). All patients started oral fluids in the 1st post-operative day after ruling out leaking by an oral gastrograffin test. Regarding early postoperative complications, intraperitoneal bleeding occurred in one patient (3.33%), who was managed conservatively by haemostatics and blood transfusion. NO patients developed leakage, pulmonary embolism, or port site infection in the current study. Postoperative transient vomiting was encountered in only one patient (3.33%), which was managed by IV fluids and antiemetics (Table 1). The mean values of %EWL were 21.39, 40.44, 54.46, and 71.86% at one, three-, six-, and twelve-month follow-up visits respectively. Preoperative haemoglobin had a mean value of 13.21 gm/dl which decreased down to 12.82, 12.46, 12.04, and 11.88 gm/dl at one-, three-, six-, and twelve-month follow-up visits, respectively (Figure 1).

(Table 2) shows that preoperative haemoglobin had a mean value of 13.21 gm/dl which decreased down to 12.82, 12.46, 12.04, and 11.88 gm. /dl at one-, three-, six-, and twelve-month follow-up visits, respectively. Although there was a significant difference between the recorded readings, the difference was clinically irrelevant and most of the recorded readings were within the normal values. Serum albumin had a mean value of 4.14 gm/dl before the procedure, and it decreased to 4.08, 3.97, 3.96, and 3.9 gm/dl in the scheduled one-, three-, six, and twelve-month follow-up visits, respectively. There was a significant decline in that parameter at follow up compared to the baseline value. Glycosylated hemoglobin showed a significant decline after the procedure, as it decreased from 7.95% prior to the procedure, down to 7.37, 6.9, 6.31, and 5.83% after one, three, six, and twelve months, correspondingly. There was a significant decline in that parameter at follow-up compared to the baseline value. There was a significant improvement in the QoL after the procedure as manifested by the increased QOLOS 1 questionnaire values after the procedure compared to the preoperative one ($p < 0.001$). It had a mean value of 56.5 before the procedure, which increased to 58.8, 73.57, 90.67, and 124.27 after one, three, six, and twelve months, respectively. QOLOS 2 questionnaire also showed significantly increased values after the procedures as it had mean values of 74.67, 76.73, 78.6, and 79.17 after one, three, six, and twelve months, respectively.

(Table 3) shows that 24 patients (80%) presented vitamin D deficiency before the procedure. At 1 year follow-up visit Vitamin D became sufficient (more than 30 ng/ml) in all patients. Serum iron level was recorded within normal value before the procedure and at 1 year follow-up visit (89, 91 mcg/dl), respectively. All patients presented by normal serum total calcium level before the procedure (9.4 ± 0.8 mg/dl) but only 2 patients (6.67%) revealed hypocalcemia at 1 year follow up visit. Hair loss was detected in 3 patients (10%) at 3- and 6-months follow-up visits.

(Table 4) shows that the SASJ procedure was associated with excellent diabetic outcomes, as remission and/or improvement were noted in 81.82% after six months and 90.9% after twelve months. Remission or improvement of hypertension was noted 59.09% of hypertensive patients after six months, and 68.18% of cases after twelve months. All patients with pre-existing dyslipidaemia showed remission or improvement after twelve months. All patients with pre-existing OSAS showed improvement in their condition, and that improvement persisted till the twelve-month follow-up visit.

Statistical analysis showed that no patients with preoperative GERD reported worsening of their preoperative status after the procedure. Resolution of GERD was recorded in 50% of cases, while 40% of them reported their improvement. Only 10% of cases reported no significant changes in their GERD status. No patients developed denovo GERD after the procedure during the scheduled follow up visits.

Table 1: Baseline demographic criteria, Operative and postoperative data of the study population

Variable	Data (n = 30)
Age (years)	
Mean±SD	37.63 ± 10.76
Gender	
-Female	24 (80%)
-Male	6 (20%)
BMI (kg/m^2)	
Mean±SD	46.87 ± 6.56
Obesity accompanying co-morbidities	
-T2DM	11 (36.67%)
-HTN	22 (73.33%)
-Dyslipidemia	19 (63.33%)
-GERD	10 (33.33%)
-OSAS	13 (43.33%)
Operative data	
Operative time (minutes)	
Mean±SD	98.93 ± 13.47
Intraoperative blood loss (ml)	
Mean±SD	85 ± 40.79
Intraoperative complications	
-Bleeding from the short gastric vessels	1 (3.33%)
Early postoperative complications	
Bleeding	1 (3.33%)
Vomiting	1 (3.33%)

Table 2: Hb, Albumin, HbA1C, and QOLOS 1and 2 changes after the procedure

	Baseline	1 month	3 months	6 months	12 months	*P value*
Hb	13.21 ± 0.89	12.82 ± 0.83 < 0.001*	12.46 ± 0.80 < 0.001*	12.04 ± 0.80 < 0.001*	11.88 ± 0.78 < 0.001*	< 0.001*
Albumin	4.14 ± 0.17	4.08 ± 0.17 < 0.001*	3.97 ± 0.16 < 0.001*	3.96 ± 0.18 < 0.001*	3.90 ± 0.18 < 0.001*	< 0.001*
HbA1C	7.95 ± 0.67	7.37 ± 0.57 < 0.001*	6.90 ± 0.48 < 0.001*	6.31 ± 0.52 < 0.001*	5.83 ± 0.47 < 0.001*	< 0.001*
QOLOS 1	56.50 ± 7.68	58.80 ± 7.36 < 0.001*	73.57 ± 7 < 0.001*	90.67 ± 9.23 < 0.001*	124.27 ± 17.72 < 0.001*	< 0.001*
QOLOS 2		74.67 ± 11.97	76.73 ± 11.47 0.002*	78.60 ± 9.33 < 0.001*	79.17 ± 9.44 < 0.001*	< 0.001*

Table 3: Vitamin D, serum iron and serum total calcium changes after the procedure

Variable	Preoperative	1 year post-operative	*P value*
Vitamin D (ng/ml)	32.1 ±7.3 24 (80%) deficient	35.1 ± 4.9 100% sufficient	< 0.001*
Iron (mcg/dl)	89.3 ± 7.6 100% normal	91.1 ± 7 100% normal	< 0.001*
Ca (mg/dl)	9.4 ± 0.8 100% normal	9.1 ± 1.1 2(6.67%) hypocalcemic	< 0.001*

Table 4: Changes in the diabetic, hypertensive, dyslipidemic, and OSAS state at follow-up

	Diabetic State Data (n = 11)	Hypertensive State Data (n = 22)	Dyslipidemic Data (n = 19)	OSAS Data (n = 13)
Six-month follow-up				
-Complete remission	2 (18.18%)	2 (9.1%)	6 (31.58%)	
-Partial remission	4 (36.36%)	5 (22.73%)		
-Improvement	3 (27.27%)	6 (27.27%)	9 (47.37%)	13 (100%)
-Unchanged	2 (18.18%)	9 (40.91%)	4 (21.05%)	0 (0%)
Twelve-month follow-up				
-Complete remission	3 (27.27%)	3 (13.64%)	9 (47.37%)	
-Partial remission	4 (36.36%)	6 (27.27%)		
-Improvement	3 (27.27%)	6 (27.27%)	10 (52.63%)	13 (100%)
-Unchanged	1 (9.1%)	7 (31.82%)	0 (0%)	0 (0%)

Fig. 1: %EWL during the scheduled follow-up visits

DISCUSSION

Recently, bariatric surgery has created a new avenue for WL for cases patients being resentful of their excess weight and doctors who are trying to find the best technique to help their patients lose weight, as it is the only apparent way for patients who are morbidly obese to lose weight[16,17]. Complication records after bariatric surgeries changed these surgical approaches trends to make novel, temporary, less invasive approaches, that need fewer patient complementary observations and imply a quicker rate of WL, associated with healthy metabolic state attainments[18].

SASJ bypass is a combined restrictive and malabsorptive procedure[11], which hasn't been well-confirmed in previous literatures. That is why we conducted the current study at Mansoura university Gastrointestinal Surgical Centre (GISC) aiming to report perioperative and one-year outcomes of SASJ bypass. We included 30 cases whose mean age was 37.63 years.

In the current study, the prevalence of female gender was 80%, which was very high compared to males (20%). This agrees with multiple studies which confirmed the higher prevalence of obesity in women[19-21].

Our findings showed that the duration of the surgical procedure had a mean value of 98.93 minutes (range, 80 – 120). Another study recorded that the mean operative time (OT) for the same procedure was 104 ± 23 minutes[22]. Another study recorded that the same parameter had a mean value of 104.7 ± 10.38 minutes[23]. The previous two studies reported operative durations near our findings. Other authors reported a shorter OT that had a mean value of 72.6 ± 10.6 minutes for the same procedure[24]. In the current study, intraoperative blood loss ranges between 50 and 150 ml (mean = 85 ml). Elrefai *et al*. reported that the mean amount of intraoperative blood loss was 122.5 ± 41.279 ml[25].

No patients developed postoperative leakage in the current study. Similarly, Sewefy *et al*. reported no incidence of the same complication after SASJ (0%)[22], which is similar to our findings. Other authors reported a 0% incidence for the same complication[25].

In our study, intraperitoneal bleeding occurred in one patient (3.33%), who was managed conservatively by haemostatics and blood transfusion. Sewefy and Saleh reported an incidence of 1.3% of the same complications after SASJ. A single case presented by haematemesis and melena secondary to intraluminal hemorrhage from anastomotic staple line was treated by endoscopic injection of adrenaline and cauterization by utilizing argon plasma. The other patient had intraabdominal bleeding treated by laparoscopic exploration which demonstrated omental bleeding treated by cauterization[9]. Another study reported an incidence of 2.3% and 7% for intraperitoneal and intraluminal bleeding following SASJ, respectively[22].

Our findings revealed that the mean values of %EWL were 21.39, 40.44, 54.46, and 71.86% at one-, three-, six-, and twelve-month follow-up visits respectively. Sewefy *et al*. reported that 3-, 6-, and 12-month %EWL had mean values of 17.2%, 55.3%, and 76.5%, respectively after SASJ[22]. Helmy *et al*. recorded that the %EWL had mean values of 2.8, 20.8, 38.2, and 57.4% after one, three, six, and twelve months following the SASJ procedure[23]. Sayadishahraki *et al*. recorded that the % EWL had mean values of 21.46, 41.24, and 54.54% after one, three and six months respectively following SASJ[26].

Our study revealed that serum albumin had a mean value of 4.14 gm/dl before the procedure, and it decreased to 4.08, 3.97, 3.96, and 3.9 gm/dl in the scheduled one-, three-, six-, and twelve-month follow-up visits, respectively. There was a significant decline in that parameter at follow up compared with the basal value. Sayadishahraki *et al*. reported significant decline in serum albumin after the same procedure. It decreased from 4.23 gm/dl before the procedure, down to 4.13, 4.11, and 4.10 gm/dl after one, three, and six months correspondingly ($p < 0.05$)[26].

In our study, Preoperative haemoglobin had a mean value of 13.21 gm/dl which decreased down to 12.82, 12.46, 12.04, and 11.88 gm/dl at one-, three-, six-, and twelve-month follow-up visits, respectively. Sayad ishahraki *et al*. recorded that hemoglonin level had a mean value of 10.07 gm/dl before the procedure down to 9.97, 9.71, and 9.66 gm/dl after one, three, and six months correspondingly ($p<0.05$)[26].

In the current study, the SASJ procedure was associated with excellent diabetic outcomes, as remission and/or improvement was noted in 81.82% after six months and 90.9% after twelve months. Sewefy *et al*. reported that diabetic remission happened in all cases with DM within three months of operation[22]. In another study, normalization of blood sugar happened within 60 days from surgery in all cases with DM. The prevalence of diabetes was 23.3% before the procedure, and decreased down to 0% two years after it ($p < 0.001$)[9]. Furthermore, Rezaei *et al*. recorded that the diabetic remission rate at 18 months was 100%[27].

In our study, remission or improvement of hypertension was noted 59.09% of hypertensive patients after six months, and 68.18% of cases after twelve months. In the study performed by Sewefy and Saleh, HTN was remitted in 89% of hypertensive cases[9]. Another study reported 80% remission rate for the same comorbidity one year after SASJ[22], while the same authors reported 93% remission for the same comorbidity after one year follow-up in an additional study[22].

Our study revealed that all patients with dyslipidaemia showed remission or improvement after twelve months. Another study established the significant positive impact of SASJ on dyslipidaemia which showed improvement in all patients with pre-existing dyslipidaemia two years after

the operation[9]. Furthermore, Sewefy *et al*. reported a 83.3% remission rate for dyslipidemia[22].

In our study, starting from the six months after the procedure, all patients with pre-existing OSAS showed improvement in their condition, and that improvement persisted till the twelve-month follow-up visit. Another study coincided with our findings as OSAS showed significant improvement in all cases (100%)[9].

Our study displayed that GERD resolution was recorded in 50% of patients, while 40% of them reported their improvement. SASJ bypass is believed to enhnace presurgical GERD via the drop of intragastric pressure by the gastro-jejunal anastomosis[28]. According to the study conducted by Sewefy and Saleh, GERD manifestations showed significant improvement in 87% of patients who had preoperative GERD[9]. Moreover, another study reported that GERD manifestations were improved in 86.7% of cases[22].

We didnot encounter any patients with denovo GERD. Likewise, Sayadishahraki *et al*. reported that in the six months of follow-up, none of the cases presented manifestions of recent onset GERD[26].

Our study revealed that there was a significant improvement in the QoL after the SASJ procedure as manifested by the increased QOLOS values. In line with our findings, Elrefai *et al*. applied the same score in SASJ patients, and the authors reported a rise in QOLOS 1 part from 69.25 before the procedure to 98 and 118.45 after six and twelve months respectively. For QOLOS 2 part, it had mean values of 75.2 and 78.95 at the same follow-up visits, respectively[25].

The main limitation of our study included a small sample size that was collected from a single surgical institution. Additionally, the study lacks intermediate and long-term follow-up assessment. The previous disadvantages should be well addressed in the upcoming prospective and multicenter studies. Further studies comprising more cases from various surgical centers have to be conducted. Long-term follow-up must be assessed in SASJ cases.

CONCLUSION

SASJ is a safe and efficacious bariatric procedure, as it yields excellent weight loss outcomes, improvement of obesity-related comorbidities, with low risk of postoperative complications.

STATEMENTS AND DECLARATIONS

Authors' Contributions: All authors equally contributed to this work.

The writers affirm that they have all read and approved the manuscript, that they have fulfilled the standards for authorship, and that they all think the work is honest.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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