Original Article

Short and intermediate-term effects of laparoscopic single anastomosis sleeve-jejunal bypass on type 2 diabetic morbidly obese patients

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ABSTRACT

Background: Obesity and its comorbidities are considered one of the major health tolls. Bariatric surgery offers significant and long-lasting weight loss as well as significant enhancements in glycemic management for severely obese individuals with type 2 diabetes mellitus. The single anastomosis sleeve jejunal (SASJ) bypass procedure is a novel form of bariatric surgery, it combines both malabsorptive and restrictive techniques.

Aim: To evaluate the efficacy of laparoscopic SASJ bypass as a novel bariatric procedure for managing type 2 diabetes mellitus in morbidly obese patients during the first year following surgery.

Patients and Methods: The current combined prospective and retrospective study was conducted at Mansoura University Gastrointestinal Surgical Center from December 2019 to January 2023. A total of 25 patients were included in the study. They were diagnosed clinically with primary morbid obesity with a body mass index (BMI) greater than 35 kg/m^2 and documented type 2 diabetes mellitus All patients underwent laparoscopic SASJ procedure and were followed-up for 1 year after the operation.

Results: The SASJ procedure was associated with significant weight loss outcomes, as the % excess weight loss (% EWL) was 26.29, 41.47, 53.33, and 67.52% at 3-, 6, 9-, 12-month follow-up visits, respectively, and % total weight loss (%TWL) values of 19.16, 30.16, 38.76, and 50.71% at the same intervals. Glycated hemoglobin, fasting blood sugar, and postprandial blood sugar showed a significant decrease at the scheduled follow-up visits compared with the baseline values. At 1-year follow-up, complete remission, partial remission, and improvement of diabetes were detected in 32, 40, and 28% of cases, respectively.

Conclusion: The SASJ is a safe bariatric procedure that is associated with low morbidity rates. Besides excellent weight loss outcomes, it yields a beneficial impact on diabetes.

Key Words: Bariatric, bypass, diabetes mellitus, laparoscopy, single anastomosis sleeve jejunal.

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INTRODUCTION

Obesity is considered a global health burden. According to a recent global estimate, ~650 million adult people (out of 5.5 billion people) have obesity, defined by BMI of 30 and above[1]. About 40% of adult Egyptians are obese, as per the '100 million health' survey, which was carried out in Egypt in 2019. Adult females were more likely to be obese than adult males)[2]. With bariatric surgery being the apparent method of significant weight loss among patients who are morbidly obese; it has opened new avenues for weight loss for patients suffering from excess weight and associated comorbidities such as diabetes mellitus (DM), hypertension, musculoskeletal disorders and obstructive sleep apnea syndrome[3]. Reports of complications from bariatric surgeries spurred the advancement of new, reversible, and less invasive treatments. These treatments aim to reduce the need for frequent patient follow-up visits and achieve quicker weight loss, leading to a healthier metabolic state. This development has shifted trends in surgical procedures[4].

The most commonly performed bariatric surgeries worldwide are vertical sleeve gastrectomy, Roux en-Y gastric bypass (RYGB), and mini-gastric bypass, which have been demonstrated to produce excellent bariatric and metabolic outcomes[5].

A technical modification has been performed by Mahdy *et al*. on sleeve gastrectomy and transit bipartition to become single anastomosis between the gastric pouch and the ileum, known as single anastomosis sleeve ileal bypass (SASI)[6].

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The increasing rate of SASI procedures arouses concerns because some patients developed severe malnutrition refractory to conservative measures which may require revisional surgery[7,8].

A novel procedure was developed to form an anastomosis between the sleeved stomach and the jejunum rather than the ileum. In single anastomosis sleeve jejunal (SASJ), a shorter biliopancreatic limb (250 cm from the duodenojejunal junction) is performed compared with SASI (250–300 cm from the ileocaecal junction) to prevent long-term nutritional complications[9,10].

SASJ has many advantages besides few malnutrition complications, it is a simpler procedure with less operative time than RYGB, and biliopancreatic diversion. Also, it preserves the normal pathway to the duodenum which allows access for endoscopic retrograde cholangiopancreatography for the management of biliary conditions. Reversal of the malabsorptive component of the procedure is easy to perform by simply taking down the sleeve jejunal anastomosis with a linear gastrointestinal stapler[7].

Theoretically, SASJ appears to be safer than SASI procedures. However, there is not enough data in literature that evaluates the safety and efficacy of this novel procedure in terms of weight loss and management of metabolic syndrome in morbidly obese patients[10,11].

Aim

To evaluate the efficacy of laparoscopic SASJ bypass as a novel bariatric procedure for managing type 2 diabetes mellitus (T2DM) in morbidly obese patients during the first year following surgery.

PATIENTS AND METHODS:

The current combined prospective and retrospective study was conducted at Mansoura University Gastrointestinal Surgical Center. The retrospective phase spanned from December 2018 to January 2021, while the prospective phase took place from January 2021 to January 2023. The study gained approval from the local ethical committee and Institutional Review Board. Patients diagnosed clinically with primary morbid obesity with documented T2DM with a body mass index (BMI)>35 kg/m^2, aged from 18 to 60 years old of both sexes were included while patients with severe GERD, previous bariatric, or gastric operations were excluded. A total of 25 cases were enrolled in the current study (15 in the retrospective limb and 10 in the prospective limb). All patients provided informed consent, which involved explaining the procedure and its potential risks. All patients received the standard preoperative preparation including history taking, clinical examination, upper GI endoscopy, abdominal ultrasound, and routine laboratory investigations. The volume of the liver was reduced by placing all patients on a low-calorie protein-rich diet for 1 month before the surgery. Prophylaxis for deep vein thrombosis was initiated 12 h before the surgery using subcutaneous injections of low-molecular-weight heparin (40 mg of enoxaparin).

The surgery was conducted under general anesthesia with the patient in the French position. Initially, the operating table was adjusted to a steep anti-Trendelenburg position, with the surgeon stationed between the patient's legs. The operation commenced with the insertion of an optical trocar into the abdomen, approximately 20 cm below the xiphoid process and 3 cm to the left of the midline, ensuring entry under direct vision. A pneumoperitoneum was established using carbon dioxide at 15 mmHg pressure. Four additional trocar ports were inserted under direct vision at the same locations typically used for a sleeve gastrectomy. The operation started with standard sleeve gastrectomy by devascularization of greater gastric curvature. The surgical dissection proceeded toward the gastroesophageal junction. The left crus of the diaphragm was then fully released from its attachments to prevent the formation of a posterior pouch during the creation of the sleeve in this area. The stomach was then stapled over a 36-French calibration tube using 4–5 endolinear cutting staplers (Echelon 60, Ethicon Endo-Surgery, Inc., Johnson and Johnson). Green cartridges were utilized for the antrum, while blue cartridges were used for the body and fundus. Stapling started 6 cm from the pylorus. After creating the sleeve, 250 cm of the small bowel were counted starting from the ligament of Treitz, and an antecolic isoperistaltic side to side anastomosis was created 3–4 cm from the pylorus via a blue cartridge, and the wall defect was closed by a two-layer vicryl 3/0 or polydioxanone 3/0 continuous running sutures. The anastomosis was done either in an anterior or posterior fashion. The stoma size was ~3 cm in diameter. Intraoperative methylene blue test was done and an abdominal drain was inserted at the gastric staple line. After the operation, most patients were transferred to the general ward, and they started clear oral fluids 6 h after surgery. Most patients were discharged on the first or second postoperative day. Frequent fluid intake and mobilization were encouraged. Patients were recommended to receive a liquid diet for the first week, followed by a soft diet for the following 3 weeks. A hypo-caloric protein-rich diet was recommended. Daily oral supplements of multivitamins and weekly administration of the intramuscular vitamin B12 were commenced for all patients.

Regular follow-up was scheduled for all patients for 1 year after surgery, weekly in the first month, then monthly in the first postoperative year. During these visits, patients were clinically and biochemically assessed if needed. Any postoperative complications were noted and recorded. Weight changes were recorded as %EWL and %TWL. The percentage of EWL was calculated using the formula: [(preoperative weight – follow-up weight)/preoperative

excess weight]x100, while the %TWL was calculated with the formula: [(preoperative weight – follow-up weight)/(initial weight)]x100. The ideal body weight was calculated at BMI of 25 kg/m^2. The primary outcomes were glycemic control response postoperatively, the %EWL, and the %TWL while secondary outcomes included postoperative complications. (Table 1) summarizes the definitions of the glycemic control response post-SASJ.

Table 1: Definitions of glycemic outcomes after bariatric surgery[12]

Outcome	Definition
Remission (complete)	Normal measures of glucose metabolism (HbA1c <6%, FBG (Fasting blood glucose) <100 mg/dl) in the absence antidiabetic medications
Remission (partial)	Sub-diabetic hyperglycemia (HbA1c 6–6.4%, FBG 100–125 mg/dl) in the absence antidiabetic medications
Improvement	Statistically significant reduction in HbA1c and FBG not meeting criteria for remission or decrease in antidiabetic medications requirement (by discontinuing insulin or one oral agent or 1/2 reduction in dose)
Unchanged	The absence of remission or improvement as described above
Recurrence	FBG or HbA1c in the diabetic range (≥126 mg/dl and ≥6.5%, respectively) or the need for antidiabetic medication after any period of complete or partial remission

Statistics/data analysis

Data were collected and recorded for further statistical analysis. The analysis was conducted using the (SPSS) Statistical Package for Social Science software (version 26.0; IBM Corporation, Armonk, NY, USA). Qualitative variables were recorded as frequencies and percentages and compared using the χ^2 test. Quantitative measures were presented as means±standard deviation (SD) and compared using the Student t test. A *P value* less than 0.05 was considered significant.

RESULTS:

The total number of patients in the study was 25 patients. The mean age of included patients was 37.92 years. Most of the included patients were females (20 patients), who constituted 80% of the study population. Their preoperative BMI had a mean value of 47.14±5.07 kg/m^2. History of previous abdominal surgery was reported in 60% of patients. Gallstones were detected by ultrasonography in two (8%) patients. All of the included patients had T2DM, and the mean diabetic state duration was 7.1±3.4 years.

The mean duration of the surgical procedure was 119±30.27 min. An anterior anastomosis was done in 52% of cases while the remainder had a posterior one. Intraoperative blood loss had a mean value of 104±20 ml. Regarding intraoperative complications, hemorrhage from the short gastric vessels occurred in only one (4%) patient which did not require conversion to the open approach (Table 2). The surgery resulted in minimal postoperative complications. There were no instances of postoperative leakage or significant emesis. One (4%) case experienced bleeding from the intra-abdominal drain, managed conservatively without requiring surgical or radiological interventions. Some patients developed superficial thrombophlebitis (12%) or infections (pneumonia: 8%, surgical site infection: 4%). Most patients tolerated oral intake within 24 h and they experienced short hospital stays averaging around 2 days (Table 3). Regarding delayed postoperative complications, dumping syndrome, hair loss, and anemia had a similar incidence, which was 8% (Tables 4 and 5). Two (8%) cases required hospital readmissions. The first case had a port-site hernia after 11 months of the operation and the second case had an episode of intestinal obstruction which was managed conservatively with nasogastric suction and bowel rest. The results showed a steady increase in %EWL and %TWL over the follow-up period, with %EWL values of 26.29, 41.47, 53.33, and 67.52% at 3, 6, 9, and 12 months, respectively, and %TWL values of 19.16, 30.16, 38.76, and 50.71% at the same intervals. HbA1C, fasting blood sugar and postprandial blood sugar showed a significant decrease at the scheduled follow-up visits compared with the baseline values (*P<0.001*) (Tables 6–8). As shown in (Table 9), the procedure was associated with a beneficial impact on all diabetic patients. At the 6-month follow-up visit, complete remission, partial remission, and improvement were detected in 24, 44, and 32% of cases, respectively. At 1-year follow-up, the same three outcomes were detected in 32, 40, and 28% of cases, respectively. Notably, most of the patients who failed to achieve remission at the 1-year follow-up had a history of severe T2DM for more than 10 years and were on a combined treatment regimen of oral hypoglycemic agents and insulin.

Table 2: Operative data in the study cases

Variables	*N*=25 [*n* (%)]
Operative time (min)	119±30.27
Anastomosis type	
Anterior	13 (52)
Posterior	12 (48)
Intraoperative blood loss (cc)	104±20
Intraoperative difficulties	
Large left lobe	2 (8)
Adhesions	1 (4)
Intraoperative complications	
Hemorrhage from the short gastric vessels	1 (4)

Table 3: Postoperative data demonstrating early complications

Variables	*N*=25 [*n* (%)]
Complications	
Leakage	0
Bleeding	1 (4)
Pulmonary embolism	0
Chest infection	2 (8)
Wound infection	1 (4)
Abdominal collection	0
Superficial thrombophlebitis	3 (12)

Table 4: Data showing delayed postoperative complications

Variables	*N*=25 [*n* (%)]
Dumping syndrome	2 (8)
Hair loss	2 (8)
Anemia	2 (8)
Port site hernia	1 (4)
Intestinal obstruction	1 (4)

Table 5: Percentage excess weight loss and percentage total weight loss during the scheduled follow-up visits

	3 months	6 months	9 months	12 months
%EWL	26.29±9.29	41.47±10.59	53.33±9.0	67.52±6.81
%TWL	19.16±7.48	30.16±8.61	38.76±8.05	50.71±8.60

Table 6: Fasting blood sugar (FBS) changes in the scheduled follow-up visits

FBS	Basal	3 months	6 months	9 months	12 months	*P* value
	120.96±10.031	114.84±11.34	109.2±12.43	105.28±14.51	104.44±14.29	**0.003***
		0.006*	0.001*	**< 0.001***	**< 0.001***	

*Significant *P value* less than 0.05.

Table 7: Postprandial blood sugar changes (PPBS) in the scheduled follow-up visits

PPBS	Basal	3 months	6 months	9 months	12 months	*P* value
	226.16±48.26	202.6±47.83	174.16±36.91	168.6±33.36	164.68±31.44	**< 0.001***
		< 0.001*	**< 0.001***	**< 0.001***	**< 0.001***	

*Significant *P value* less than 0.05.

Table 8: Glycated haemoglobin changes in the scheduled follow-up visits

HbA1C	Basal	3 months	6 months	9 months	12 months	*P* value
	7.55±0.76	6.97±0.65	6.41±0.66	6.26±0.66	6.06±0.70	**<0.001***
		0.010*	**< 0.001***	**< 0.001***	**< 0.001***	

*Significant *P value* less than 0.05.

Table 9: Changes in the diabetic state at follow-up

Variable	Data (*N*=25) [*n* (%)]
6-month follow-up	
Complete remission	6 (24)
Partial remission	11 (44)
Improvement	8 (32)
12-month follow-up	
Complete remission	8 (32)
Partial remission	10 (40)
Improvement	7 (28)

DISCUSSION

The contemporary human diet has become high in calories and low in fiber, often pre-processed through cooking and refining, making it readily absorbable[13]. Foods like glucose are fully prepared for absorption, leading to nutrient absorption peaks in the proximal parts of the intestine. Consequently, the distal portions of the intestine have less to absorb, resulting in decreased production of GLP-1 (Glucagon-like peptide-1) and PYY (Peptide YY) hormones. SASJ bypass combines both restrictive and malabsorptive approaches. Additionally, it promotes earlier ileal exposure leads to higher GLP-1 and peptide YY release causes more beta cell stimulation for insulin secretion, less glucagon response, and faster stomach emptying[14]. The current combined prospective and retrospective study was conducted at Mansoura University Gastrointestinal Surgical Centre aiming to assess the efficacy of laparoscopic SASJ bypass as a bariatric procedure in treatment of T2DM morbidly obese patients.

The procedure was associated with a beneficial impact on all diabetic patients. At 1-year follow-up, complete remission, partial remission, and improvement were detected in 32, 40, and 28% of cases, respectively. That was manifested by the significant decline in fasting, postprandial blood glucose, and HbA1C levels. According to the study by Farrag *et al*., 47.4% of patients experienced diabetic remission after the SASJ procedure, and 52.6% showed improvement. In contrast, the OAGB procedure had a higher rate of diabetic remission at 70.8%, with 29.2% of patients showing improvement[15]. This suggests that OAGB might be more effective than SASJ in achieving diabetic remission. The research by Salminen *et al*. on RYGB outcomes after one year shows that 30.2% of patients achieved full DM remission, 25.6% experienced partial remission, 37.2% saw improvements, and 7% reported no change[16]. These results seem to align with those of our study, indicating a similar level of efficacy in DM control following RYGB. A previous study by Sayadishahraki *et al*. highlighted that all of the patients who had SASJ improved DM during the 6-month study and ceased medication, and also insulin therapy (100%)[17]. It is noteworthy that not all studies have the same reporting system for DM remission and improvement. We followed the American Diabetes Association (ADA) criteria to ensure consistency[18].

Our findings revealed that the SASJ procedure was associated with significant weight loss outcomes, as the %EWL was 26.29, 41.47, 53.33, and 67.52% at 3-, 6, 9-, and 12-month follow-up visits, respectively. Efficient %EWL occurs after SASJ secondary to multiple factors including restriction of the gastric cavity (by sleeve gastrectomy), malabsorption (by passing 2.5 m of jejunum), hormonal changes, alternation of gut microbiota, and improvements in insulin sensitivity and glucose metabolism[19]. In the study conducted by Elrefai *et al*., the %EWL after SASJ had mean values of 39.99, 53.47, and 77.61% at 3-, 6-, and 12-month follow-up visits, respectively. These results were comparable to the values obtained in the sleeve gastrectomy and minigastric bypass groups[20]. Sayadishahraki *et al*. reported their findings in their short-term follow-up study, at which the %EWL was 21.46, 41.42, and 54.54% after 1, 3, and 6 months, respectively[17]. Furthermore, Rezaei and his associates reported that 18 months following SASJ, patients lost 43.4±11 kg of their weight and 68±14% of their excess weight[21]. In another study that assessed the efficacy of SASJ as a revisional bariatric procedure, the %EWL

had mean values of 17.2, 55.3, and 76.5% after 3, 6, and 12 months, respectively[19]. Khalaf and Hamed demonstrated a comparable pattern of %TWL in their SASI group. They reported a mean %TWL of 29.5% at 6 months, which increased to 44.2% at 1 year. Our findings corroborate these observations, with a %TWL of 30.16% at 6 months and 50.71% after 1 year.

In the current study, we did not encounter any patients with leakage after the operation. Our incidence of leakage is concomitant with the leakage rate reported in the literature after different bariatric procedures that ranges between 0 and 8%[22,23]. In the current study, the incidence of postoperative bleeding was 4%. The incidence of bleeding after bariatric procedures could range between 0 and 10%[24,25].

In our study, postprandial dumping syndrome was reported by two (8%) patients. Elrefai *et al*. reported an incidence of 5% of the same adverse event after SASJ[20], while Sewefy *et al*. reported an incidence of 9.3% for the same complication[19]. That could be secondary to the rapid passage of food content from the stomach to the jejunum leading to either early or late dumping[26].

In the current study, anemia occurred in two (8%) patients. Sewefy *et al*. reported an incidence of 7% for the incidence of iron deficiency anemia after the SASJ procedure[19], which is near to our findings. Anemia, specifically iron deficiency anemia, is a common complication that can occur after bariatric surgery[27]. In the current study, postoperative hair loss occurred in 8% of cases. A previous similar study reported that the same complication occurred in 30% of cases after SASJ[20], which is higher than our incidence. Hair loss following bariatric surgery is a prevalent side effect attributed to various factors, including deficiencies in micronutrients or macronutrients, psychological aspects, and the rapid weight loss experienced during the postoperative period. This condition is believed to arise from a combination of these factors rather than being solely attributable to any single cause[28].

Our study has some limitations. The relatively small sample size that was collected from a single surgical institution is the main drawback. The lack of long-term follow-up is also another limitation. The upcoming studies should address the previous limitations.

CONCLUSION AND RECOMMENDATIONS

We concluded that the SASJ is a safe bariatric procedure that is associated with low morbidity rates. Besides excellent weight loss outcomes, it yields excellent beneficial impact on DM. Further studies must be done to analyze all aspects of this issue.

CONFLICT OF INTEREST

There are no conflicts of interest.

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