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Original Research Article

Laparoscopic Roux-en-Y gastric bypass versus single anastomosis sleeve ileal bypass for the treatment of morbidly obese patients: a prospective randomized comparative study

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ABSTRACT

Background: Bariatric surgery has proven to be the most effective long-term treatment of morbid obesity, after bariatric surgery, weight loss and remission of obesity-related comorbidities is significantly higher than after non-surgical measures. The present study aimed to compare single-anastomosis sleeve ileal (SASI) bypass and Roux-en-Y gastric bypass (RYGB) in terms of weight loss, remission of comorbidities, complications, and nutritional status.
Methods: This prospective randomized comparative study was carried out at gastrointestinal and laparoscopic surgery unit, General Surgery Department, Tanta University Hospitals, during the period from October 2020 to October 2022 and included 40 morbidly obese patients who accepted to participate in the study and signed an informed consent. Patients were randomly assigned into 2 equal groups by the closed envelope method, group I: were submitted to laparoscopic RYGB, group II: were submitted to laparoscopic SASI bypass.
Results: The mean age of RYGB group was 39.20±6.56 years, compared to 34.75±7.91 in SASI group. A highly statistically significant difference was present in operative time between both groups; RYGB Group had operative time mean of 194.25±27.11 minutes, compared to 153.15±23.74 minutes in SASI group. Both procedures were followed by a significant decrease in body mass index at 12 months and were comparable in terms of excess and total weight loss. Improvement in comorbidities after the two procedures was similar.
Conclusions: RYGB and SASI bypass cause weight loss by both restriction and malabsorption mechanisms. Early results with the two procedures are encouraging with acceptable weight loss, comorbidity improvement rates with disadvantages as malnutrition, biliary reflux and dumping, yet the risk of malnutrition was more likely after SASI bypass.

Keywords: Morbid obesity, Roux-En-Y gastric bypass, Single anastomosis sleeve ileal bypass, Sleeve ileal

INTRODUCTION

It has been shown that bariatric surgery is the most successful long-term therapy for morbid obesity. According to reports, weight loss and the remission of comorbidities associated with obesity, as diabetes mellitus (DM), hypertension, and dyslipidemia, are substantially higher following bariatric surgery than following non-surgical interventions like diets and exercise regimens.[1,2] According to Mihmanli et al, there are several types of bariatric surgery, ranging from minor procedures like laparoscopic sleeve gastrectomy (LSG) to significant procedures like laparoscopic Roux-en-Y Gastric Bypass (LRYGB), one anastomosis gastric bypass (OAGB), and duodenal switch.[3] Because it combines restriction and malabsorption, the Roux-en-Y

gastric bypass (RYGB) is presently the gold standard bariatric treatment among modern weight control operations.[4] A single anastomosis sleeve ileal (SASI) bypass is a novel surgery that is an adaptation of Santoro's procedure, a simplification of digestive adaptation procedure and duodenal switch, entailed sleeve gastrectomy (SG) and Roux-en-Y ileo-gastrostomy.[5]

METHODS

Study design

This prospective randomized comparative study was carried out on 40 morbidly obese patients, 18-60 years with BMI≥50 kg/m2 with or without comorbidities, both sexes. Patients were randomly assigned into 2 equal groups: Group I was submitted to laparoscopic Roux-en-Y gastric bypass (RYGB). Group II was submitted to laparoscopic single anastomosis sleeve-ileal bypass (SASI).

Study duration

The study period was from October 2020 to October 2022.

Ethical approval

from the ethical committee with informed written consent was obtained from the patients, who were identified by a code number to maintain confidentiality.

Exclusion criteria

We excluded surgically unfit patients as compromised cardiopulmonary function, liver cirrhosis, mentally unstable patients, secondary obese patients caused by hormonal disorders as hypothyroidism or Cushing's syndrome, drug and/or alcohol abuse patients, pregnant females, and malignant conditions.

Patients were subjected to a detailed history, height, weight, and body mass index (BMI) were noted, a general, abdominal examination was conducted, and laboratory tests including an upper GIT endoscope, an ECG, a chest x-ray, abdominal ultrasonography with liver span estimation, renal functions, lipid profiles, fasting, and two hours postprandial blood glucose, HA1C, TSH, free T3, free T4, and hepatitis markers.

All patients have been advised to be on a low-calorie, high-protein diet at least 2 weeks before surgery. Clear fluids were allowed the day before the operation. Prophylaxis against DVT includes chemoprophylaxis with low molecular weight heparin (enoxaparin 40 mg/0.4 ml) has been routinely given to every patient subcutaneously once 12 hours before operation and mechanical prophylaxis by wearing below knee elastic stockings.

Surgical technique

Patient positioning and initial operative steps for both procedures

Typically needed positioning was supine, reverse Trendelenburg, possibly with Trendelenburg with the patient's arms were placed on arm boards, angled at less than 90 degrees. After general anesthesia and endotracheal intubation, the patient was tapped to the operating table at the pelvis and lower chest, the abdomen was prepped, an oro-gastric tube was inserted to deflate the stomach, and a Foley catheter was inserted into the urinary bladder.

Then a prophylactic broad-spectrum antibiotic was administered in the form of IV 2 gm ceftriaxone after testing for allergy (doubling the dose in obese patients). We prefer the "French" position, the surgeon stand between the patient's legs in steep reverse Trendelenburg. The camera holder (1st assistant) stands on patient's right side, the 2nd assistant on patient's left side, and the scrub nurse and instruments trolley at the patient's feet.

The laparoscopic tower is placed at the patient's head beside the anaesthetic tower and the vessel sealing energy machine (Harmonic scalpel® or Ligasure®) behind the surgeon.

Creation of pneumoperitoneum and port placement

The procedure was performed through five abdominal ports; the first 5-12mm optical trocar was placed in the midline 15-18 cm caudal to the xiphoid process for the 30° optical system, and then insufflation to an intra-abdominal pressure of 15 mm Hg was achieved. Other two working trocars 5-12-mm were placed in the right and left mid-clavicular lines 5 cm below the costal margin.

A 5-mm left anterior axillary line trocar 5 cm below costal margin for the 2nd assistant.

A 5-mm trocar was placed below and to the left of the xiphoid process for a 5-mm liver retractor (Nathanson liver retractor).

Operative steps in RYGB

The head end of the table was elevated. An initial diagnostic laparoscopy was performed with the objective of ensuring that no abdominal adhesions are present and to check for any hiatus hernia. The applied technique in our study was alimentary limb position antecolic, length of alimentary and biliopancreatic limb (BPL) was 100 cm and 150 cm respectively. Start with the creation of the gastric pouch and the gastrojejunal anastomosis (GJA) followed by the jejunojejunal anastomosis (JJA) then closure of the mesenteric defect.

Creation of the gastric pouch

The orogastric tube was removed from the stomach. Starting at the angle of His to dissect the stomach lateral to the left leaflet of the right crus of the diaphragm. A lesser curve based gastric pouch was performed by creating a window at the lesser curvature between the 2nd and 3rd gastric branches of the left gastric vessels using the vessel sealing device opening the lesser sac then through the right 5-12 mm port, the first fire was applied using ethicon echelon flex 60 endopath stapler articulating linear cutter perpendicular to the lesser curve by passing through the created window and a 60 mm 3.5 mm cartridge (Ethicon™ blue cartridge) was fired forming the base of the pouch (About 4 cm in length). Dissection of the posterior wall of the gastric pouch till angle of His was done then serial staplers were fired in a cephalic direction parallel to the lesser curvature alongside of a 36 Fr bougie towards the angle of His (Figure 1).

Construction of gastro-jejunal anastomosis with antecolic omega loop

By adding a gentle pressure with bougie, a gastrostomy was done on the posterior wall of the gastric pouch about 1-2 cm from the staple line then the patient's position was changed to Trendelenburg. The whole length of the small bowel was measured. Then a loop 150 cm of jejunum from DJ was measured and taken up to the level of the gastric pouch in an antecolic antegastric position with its proximal limb to the left side and its distal limb to the right side. A jejunotomy was performed on the anti-mesenteric border and the linear stapler was partially inserted forming a 3 cm gastro-jejunal anastomosis (GJA) (Figure 1). The gastro-enterotomy was then closed in using 2/0 monofilament absorbable sutures (Covidien V-Lock®) followed by leak test.

Jejuno-Jejunostomy and closure of the mesenteric defect

The afferent limb was then divided just proximal to the GJA using a 60 mm 3.5 mm (Ethicon™ blue cartridge) creating the biliopancreatic limb (BPL) then omentum was split in a cranial-caudal direction using the Harmonic scalpel to reduce tension on the Roux limb and gastrojejunal anastomosis. The Roux limb (alimentary limb) is measured distally from the gastro-jejunostomy for a distance of 100 cm. Two enterotomies were performed at the ani-mesentric borders of both BPL and alimentary limb and Jejuno-Jejunostomy was established using a 60 mm 3.5 mm Ethicon™ blue cartridge. Then enterotomy was closed with a continuous 2/0 absorbable monofilament sutures Covidien V-Lock®. The mesenteric defect (Petersen's space) was then closed using a purse-string non-absorbable suture, then checking for hemostasis, suctioning residual fluid, extraction of gauze and the insertion of a 20 Fr drain in the left upper quadrant through the left 5-mm trocar then.

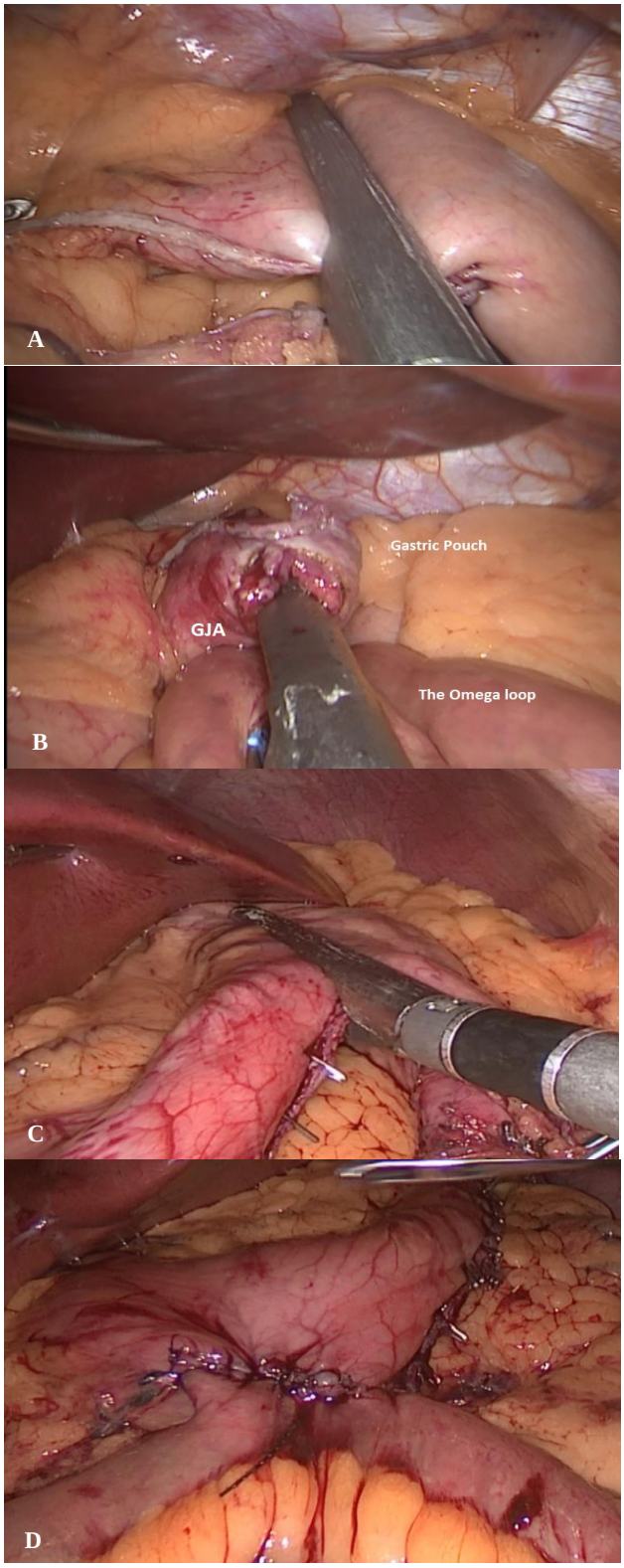

Figure 1: (A) creation of gastric pouch in RYGB, (B) Gastro Jejunal Anastomosis in RYGB, (C) Sequential firings of the stapler along the left side border of the bougie for sleeve gastrectomy and (D) Closure of gastro-enterotomy using V-LOC suture in SASI bypass. RYGB: Roux-en-Y gastric bypass, SASI: single-anastomosis sleeve ileal

Operative steps in SASI Bypass

Sleeve gastrectomy

The head of the table was elevated to help the abdominal contents to fall down. Devascularization of the greater curvature was started at the level of the middle of the body of the stomach where the greater omentum is made of single layer using vessel sealing energy machine (Harmonic scalpel® or Ligasure®).

Then extended cephalic through the short gastric vessels till the GEJ exposing the left leaflet of left crus with complete mobilization of the posterior aspect of the fundus.

A 36 French (Fr) bougie was introduced into the stomach after taking out the Ryle's tube to help to calibrate the pouch size by keeping it aligned along the lesser curvature of the stomach all through the process of stapling.

The first stapler was placed with its tip pointing to the patient left shoulder with the bougie medial to it against the lesser curvature to avoid narrowing of the sleeve at the level of the incisura angularis.

Followed by sequential firings of the stapler going cephalic toward the angle of his while testing the free mobility of the bougie in and out before each firing to avoid too tight or too wide sleeve and in the last firing the stapler was applied about 1-2 cm lateral to the angle of His (Figure 1).

The leak test was done using 100 ml of diluted methylene blue dye injected through the bougie with closure of the antrum by pressure with a non-traumatic graspe.

Construction of sleeve ileal anastomosis

After creation of the gastric tube, the patient's position was changed to Trendelenburg position. The transverse mesocolon was retracted toward the head of the patient and the surgeon moves to the left-hand side of the patient, the ileocecal junction is identified and 300 cm ileal loop from ileocecal junction was measured.

The selected loop is ascended with a stay suture with the antrum. an antecolic side-to side sleeve-ileal anastomosis at the antrum of the stomach was performed with linear stapler; followed by closure of the anterior wall of gastroenterostomy with V-lock 2/0 running sutures (Figure 1).

Intraoperative leak test was performed, and the resected stomach was then removed through the left mid-clavicular port. A drain was placed inside the peritoneal cavity alongside the staple line in the left subphrenic.

Follow up

Twelve hours after surgery, the patient began taking clear liquids orally. A routine contrast study was performed on the first postoperative day. Patients were discharged with a follow-up program that involved visits to the outpatient clinic once a week for the first three months, then once a month for the first 3 months, and finally once every three months for a year. Weight was noted and BMI was computed at each visit.

Comorbidity improvement was evaluated a year following surgery. Changes in nutritional indicators such as serum albumin and iron were measured and documented. The primary endpoints were the excess body weight loss (EWL) at one year after surgery and improvement of co-morbidities. Secondary endpoints were other outcomes including the operative time, complications, change of the patients' QOL and mortality.

Statistical analysis

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Qualitative data were described using numbers and percentages. The Shapiro-Wilk test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation, median and interquartile range (IQR). The significance of the obtained results was judged at the 5% level.

RESULTS

The Demographic characteristics of our study groups were shown in table 1.

Preoperative obesity-related comorbidities

The most prevalent co-morbidities were musculoskeletal, dyslipidemia (elevated cholesterol, triglycerides, LDL, and decreased HDL), hypertension, T2DM, Obstructive sleep apnea (assessed by STOP-BANG questionnaire), and pseudotumor cerebri, (Table 2).

The mean operative time was 194.25±27.11 minutes in RYGB group and 153.15±23.74 minutes in SASI, the difference was found significant (P value<0.001) (table 3), regarding intraoperative complications.

In RYGB group (n=20) superficial liver injury occurred in 3 patients (15%), staple line bleeding one patient (5%), stenosis of gastrojejunal anastomosis occurred in one patient, in SASI group (n=20) superficial liver injury (2 patients 10%) staple line bleeding (2 patients 10%) stapler misfire occurred in one patient (5%) in sleeved stomach (Table 3).

Table 1: The demographic characteristics of our study groups.

	RYGB, (n=20)		SASI, (n=20)		Test	P value
	No.	%	No.	%		
Weight (kg)						
Min.–Max.	122.0–202.0		125.0–221.0		T =1.502	0.141
Mean±SD	140.50±18.50		150.35±22.76			
Median (IQR)	135.5(132.50–139.50)		147.50 (137.50–159.0)			
BMI (kg/m)						
Range	52.0–70.0		50.30–69.80		1.159	0.255
Mean±SD.	60.06±5.02		57.81±7.06			
Median (IQR)	60.50 (56.0–63.50)		54.55 (52.0–62.50)			
EBW (kg)						
Min.–Max.	75.0–123.0		65.0–130.0		182.50	0.640
Mean±SD.	84.80±12.83		88.46±18.62			
Median (IQR)	81.0 (77.50–87.0)		81.50 (77.63–98.35)			
WC						
Min.–Max.	123.0–150.0		121.0–136.0		1.523	0.136
Mean±SD.	133.10±8.39		129.55±6.19			
Median (IQR)	130.50 (126.0–139.0)		133.0 (122.0–135.0)			
W/H ratio						
Min.–Max.	0.87–0.93		0.87–0.90		1.639	0.109
Mean±SD.	0.90±0.01		0.89±0.01			
Median (IQR)	0.90 (0.89–0.91)		0.90 (0.88–0.90)			

RYGB: Roux-en-Y gastric bypass, SASI: single-anastomosis sleeve ileal. BMI: body mass index.

Table 2: Preoperative obesity related co-morbidities in the two study groups.

	RYGB, (n=20)		SASI, (n=20)		Test, χ^2	P value
	No.	%	No.	%		
Metabolic S	7	35.0	5	25.0	0.476	0.490
T2DM	6	30.0	5	25.0	0.125	0.723
Hypertension	7	35.0	6	30.0	0.114	0.736
Dyslipidaemia	8	40.0	7	35.0	0.107	0.744
Osteoarthritis	11	55.0	10	50.0	0.100	0.752
OSA	10	50.0	9	45.0	0.100	0.752
Pseudotumor cerebri	1	5.0	0	0.0	1.026	1.000

RYGB: Roux-en-Y gastric bypass, SASI: single-anastomosis sleeve ileal.

Table 3: The operative time in the two study groups.

	RYGB (n=20)	SASI (n=20)	U	P value
Range	160.0–245.0	120.0–200.0	49.50*	<0.001*
Mean±SD	194.25±27.11	153.15±23.74		
Median (IQR)	180.0 (180.0–210.0)	150.0 (129.0–167.50)		

Significant p value≤0.05.

Table 4: Preoperative EW and postoperative EWL% in the two study groups.

	RYGB, (n=20)	SASI, (n=20)	U	P value
EBW before operation				
Range	75.0–123.0	65.0–130.0	182.50	0.640
Mean±SD.	84.80±12.83	88.46±18.62		
Median (IQR)	81.0 (77.50–87.0)	81.50 (77.63–98.35)		
EWL % after 3 months				
Range	21.0–30.0	20.50–38.60		

Continued.

	RYGB, (n=20)	SASI, (n=20)	U	P value
Mean±SD.	26.50±2.09	28.04±4.62	180.50	0.602
Median (IQR)	27.0 (26.0–27.0)	26.75 (25.35–31.50)		
EWL % after 6 months				
Range	39.0–49.0	33.50–58.50	157.0	0.253
Mean±SD.	44.0±2.79	45.90±8.71		
Median (IQR)	44.50 (41.50–45.50)	47.0 (36.0–53.25)		
EWL % after 12 months				
Range	51.0–59.0	54.50–89.0	147.50	0.157
Mean±SD.	56.65±2.08	60.71±7.99		
Median (IQR)	57.50 (56.0–58.0)	57.85 (56.80–62.50)		

Significant P value≤0.05, RYGB: Roux-en-Y gastric bypass, SASI: single-anastomosis sleeve ileal.

Table 5: Preoperative and postoperative BMI in the two study groups.

BMI	RYGB, (n=20)	SASI, (n=20)	t value	P value
BMI before operation				
Range	52.0–70.0	50.30–69.80	1.159	0.255
Mean±SD.	60.06±5.02	57.81±7.06		
Median (IQR)	60.50 (56.0–63.50)	54.55 (52.0–62.50)		
BMI after 3 months				
Range	44.50–54.0	41.50–58.90	1.124	0.272
Mean±SD.	51.18±2.34	49.50±6.26		
Median (IQR)	51.50 (51.0–52.50)	48.65 (43.40–56.50)		
MBI after 6 months				
Range	41.50–49.0	35.50–49.80	1.548	0.134
Mean±SD.	46.78±1.49	45.41±3.67		
Median (IQR)	47.0 (47.0–47.0)	46.65 (44.30–47.70)		
BMI after 12 months				
Range	38.0–43.0	27.80–43.60	1.483	0.152
Mean±SD.	41.40±1.05	40.07±3.87		
Median (IQR)	42.0 (41.0–42.0)	41.25 (40.20–42.0)		

Significant p value≤0.05, BMI: body mass index.

Table 6: effects of weight reduction on obesity related co-morbidities at 12th month in the two study groups.

	RYGB (n=20)		SASI (n=20)		χ^2	P value
	No.	%	No.	%		
T2DM						
Complete remission	4	20.0	3	15.0	0.173	1.000
Partial remission	1	5.0	1	5.0	0.0	1.000
Hypertension						
Complete remission	3	15.0	4	20.0	0.173	1.000
Partial remission	2	10.0	2	10.0	0.0	1.000
Dyslipidaemia						
Complete remission	4	20.0	5	25.0	0.143	1.000
Partial remission	2	10.0	2	10.0	0.0	1.000
Osteoarthritis						
Complete remission	8	40.0	7	35.0	0.107	1.000
Partial remission	2	10.0	3	15.0	0.229	1.000
OSA						
Complete remission	7	35.0	7	35.0	0.0	1.000
Partial remission	3	15.0	2	10.0	0.229	1.000

Postoperative data

Early postoperative data

The mean hospital stay was 3.95±0.69 and 3.75±0.85 days in RYGB and SASI group respectively. Regarding the early postoperative complications (within 30 days from the operation); port site infection occurred in two patients in each group. Fever due to lung atelectasis in the first two days postoperative occurred in 2 patients (10%) in RYGB and 3 patients (15%) in SASI group. Only one

patient (5%) in RYGB group was presented with blood-tinged vomiting and refusing of feeding with readmission and was managed medically.

Late post-operative complications and sequelae (>30 days after the operation)

Port site hernia occurred two months postoperative in one patient (5%) in SASI group at the midline supraumbilical port. Six patients (18.18%) developed gall stones at a period from 3 to 12 months postoperative, 3 patients in each group, 3 of them presented with biliary pain and the others were asymptomatic and discovered by U/S examination, while GERD symptoms were experienced by 2 patients in RYGB group and responded well to regular PPIs therapy, biliary reflux, and gastritis occurred in one patients (5%) in SASI group diagnosed clinically and by endoscopic findings during follow up, managed by prokinetics, deoxycholic acid and cholestyramine (as chelating agent). Dumping syndrome was presented in 5 patients (12.5%), 2 patients (10%) in RYGB group and 3 patients (15%) in SASI group and successfully managed conservatively.

Stenosis of sleeved stomach presented in one patient (5%) in SASI group and was presented one month postoperative with frequent vomiting, diagnosed by CT with contrast and upper gastrointestinal endoscope, in regard to nutritional parameters during the postoperative follow-up period; there was an increase in the incidence of mild anemia and hypocalcaemia in SASI than in RYGB group that was managed by medical treatment and follow up, but with no statistically significant difference, but severe malnutrition developed in 3 patients (15%) in SASI group

Excess weight loss (EWL %), change in BMI and improvement of associated comorbidities

Our results revealed that there was a slightly higher excess weight loss and excess BMI loss in SASI group than in RYGB group but with no statistically significant difference. At 12th month follow-up all comorbidities showed variable degrees of improvement among different patients after both procedures with no statistically significant difference, (Table 4-6).

DISCUSSION

While Santoro et al, introduced the concept of bipartition surgery, which involves partially diverting some of the ingested meal while maintaining the normal pathway for a portion of the food consumed, RYGB and SASI bypass employ two different mechanisms of action. The former involves the exclusion of an intestinal segment and complete diversion of the ingested meal. The goal of the bipartition procedure is to induce neuroendocrine effects to enhance the metabolic effect of the operation. Subsequently, Mahdy et al, changed the transitory bipartition process from a roux en-Y anastomosis to a single loop anastomosis (sleeve gastrectomy with loop bipartition; SG+LB). However, the comparison of effectiveness and safety between RYGB and SASI bypass remains unclear.[5,6]

Regarding the preoperative comorbidities in our study, the incidence of the metabolic syndrome was 35% and 25% in patients of two groups respectively. The most prevalent comorbidities in patients were dyslipidemia, oosteoarthritis, HTN, OSA and T2DM (40, 55, 35, 50, 30% in RYGB and 35, 50, 30, 45, 25% in SASI group). Our reported comorbidities are not similar to other comparative studies as Mahdy et al, who have reported dyslipidemia, HTN, OSA and T2DM in 8.7, 26, 2.17, 41.3% in RYGB and 28.2, 45.6, 10.8, 63% in SASI group. Khalaf and Hamed, reported in their study on 322 patient who underwent SASI bypass prevalence of Osteoarthritis, dyslipidaemia, HTN, OSA and T2DM in 13, 12.1, 17.4, 6.5, 35.1% of patients respectively. the most prevalent comorbidities in Thereaux et al, study on patients who underwent RYGB were dyslipidemia, osteoarthritis, OSA, HTN, and T2DM in 32.6, 74, 70.2, 51.9, and 34.1% of patients respectively.[6,7,8]

Regarding the mean operative time, it was 194.25±27.11 minutes and 153.15±23.74 minutes in RYGB and SASI group respectively with significantly shorter time in SASI and RYGB group. The longer operative time in RYGB is secondary to technical difficulties, more steps and double anastomoses than in SASI bypass that was simple, straightforward, and a single-step approach that considered as complementary to sleeve gastrectomy with single anastomosis.

Regarding RYGB group, our operative time was longer than other studies as operative time has been recorded in many studies concerning with RYGB as Kothari et al.,9 and Arapis et al, who recorded 149.5 and 175 min. respectively, that can be explained by that their study has a lower initial BMI than ours and the operative time decreased to average 170 minutes in the last 10 cases. On the other hand regarding SASI bypass group, these results are coincident with other similar studies as Vennapusa et al, who reported a mean duration of surgery on 113 patients was 148.36±38.56 minutes. But our operative time was longer than other studies concerning with SASI bypass as Romero et al, who recorded a mean operative time of 116.3 and 108 min respectively.[10,11,12]

Furthermore, intraoperative complications: there was no significant difference between the two groups. The total incidence of intraoperative complications in this study was 27.5% (11 patients) 5 patients in RYGB and 6 patients in SASI group.

Different studies reported various rate of intraoperative complications as; Rheinwalt et al, 13 who have reported intraoperative complication rates of 8.68% in the RYGB group. Joo et al, have been reported an overall incidence

of intraoperative complication rates of 7.1% out of 405 patients that underwent RYGB.[14]

Obesity and rapid weight loss are known risk factors for gall stones formation, and some centers routinely perform prophylactic cholecystectomies with bariatric procedures to prevent complications of cholelithiasis, whereas other centers prefer to do cholecystectomy only for those having gallstones by Hamad et al.[15] Our study adopts the second policy. Hence, we did preoperative abdominal ultrasound examination routinely for all patients to detect cases with asymptomatic gallstones. Laparoscopic cholecystectomy was done in 7 patients (17.5%), 4 patients in RYGB group and 3 patients in SASI group because of having gallstones weather symptomatic or not.

The early postoperative complications (within 30 days from the operation), were reported in 10 patients. While late post-operative complications (>30 days postoperative) and sequelae occurred in this study in RYGB group were in the form of GERD (10%), dumping (10%), anemia (10%), hypocalcaemia (10%), hypoalbuminemia (10%) and gallbladder stones (15%). While in SASI group, these complication rates were 0.0%, 15%, 20%, 20%, 15% and 15% respectively. Also, severe biliary reflux and gastritis occurred in 1 patient (5%) in SASI group diagnosed clinically and by endoscopic findings during follow up, managed by prokinetics, deoxycholic acid and cholestyramine (as chelating agent). Port site hernia occurred 2 months post-operatively in one patient (5%) in SASI group. Stenosis of sleeved stomach presented in one patient (5%) in SASI group and was presented one month postoperative with frequent vomiting, diagnosed by CT with contrast and upper gastrointestinal endoscope then managed endoscopically by endoscopic dilatation followed by medical treatment with good response.

Following a systematic review by Emile et al, ten studies involving over 900 patients that evaluated the outcome of SASI bypass revealed that, because the procedure involves a single loop anastomosis between the stomach and ileum, there may be a high incidence of bile reflux and nutrient deficiencies.[16] The results of this review, however, indicated that the incidence of vitamin shortages (hypoalbuminemia of 1.3% and hypocalcaemia of 0.2%) was also quite low, and the rate of bile reflux was only 3.4%. According to Puzziferri et al, systematic review, which focused on the follow-up of obese patients who had RYGB, there were late complications during the follow-up period that included nutritional deficiencies (anemia, iron deficiency requiring transfusion, or vitamin B12 deficiency, 2% each), as well as 0.1% for operative revision rates due to abdominal pain or non-healing ulcers.[17]

Postoperative nutritional deficiencies can occur either because of the malabsorptive nature of the procedures (bypassed jejunum), inadequate dietary intake or noncompliance of the patient to take the advised supplementations after the operation. Our results showed that the deficiencies were higher in the SASI group. The nutritional deficiencies in our patients were mild and managed medically except 3 patients in SASI group (15%) who developed severe malnutrition due to non-compliance as regard post-operative supplementation and presented to us after one year with severe anemia, hypoalbuminemia, elevated liver enzymes and ascites, these tree patients were readmitted in our unit and managed with nutritionist.

Referring to the primary outcome parameter that was reduction of patients' weight during the period of follow up, our results regarding % EWL was 56.6% and 60.7% at 12th month in RYGB group and SASI group respectively this result is less than other comparative study as Mahdy et al, who reported in their study EWL% after RYGB was 79.4% on the other hand, in SASI bypass group they recorded EWL% of 78.5% at 12 months. Also, Schauer et al, reported that the %EWL after SASI bypass was also close to that reported after RYGB (88%).[6,18]

The linked co-morbidities that either resolved or improved as a result of the obtained weight reduction. Reducing the amount of medicine taken and improving the symptoms or results of blood investigations related to the co-morbidity were considered improvements in co-morbidity. According to Disse et al, remission of the co-morbidity was defined as complete medication discontinuation, normalization of symptoms, and results of blood tests related to the co-morbidity. Medical comorbidities improved similarly with both surgeries. 83% of DM patients saw remission or improvement after RYGB, which is consistent with findings from Mahdy et al, which found that 73% of patients had DM remission or improvement after RYGB, and from a previous meta-analysis by Buchwald et al, that found 80% of patients had DM remission or improvement after RYGB.[6,19,20]

The rate of improvement in diabetes mellitus following SASI bypass in our study was 80%. This was lower than that reported in earlier studies by Mahdy et al, and Emile et al, which surpassed 95%. It was also close to that reported in Mahdy et al, which was less than 82.7%.[21,22]

About hypertension remission (defined by Schiavon et al, as systolic and diastolic blood pressure <140 mm Hg and 90 mm Hg, respectively, without medication), In our study, the rate of improvement in hypertension was 71% in the RYGB group and over 95% in the SASI group. This is a higher result than that of Mahdy et al, who found that the rate of improvement in hypertension was 58% in both categories.[6,23]

Referring to the remission rate of dyslipidaemia (the remission of hyperlipidemia (defined as total cholesterol<200 mg/dl, HDL>40 mg/dl, LDL<160 mg/dl, and triglycerides<200 mg/dl), our results were 50% and 71.4% in group I and II respectively. Mahdy et al, have

reported a higher remission rate of dyslipidemia in group II than I (100% vs 76.4%). Furthermore, Disse et al, had stated that the remission rate was 44% in RYGB group, also Emile et al, reported a remission rate of 87.5% in SASI bypass, Mohamed et al, has a remission rate in their study on SASI bypass about 76.9%. [6,19,22,24]

CONCLUSION

RYGB and SASI bypass cause weight loss by both restriction and malabsorption mechanisms. Early results with the two procedures are encouraging with acceptable weight loss, comorbidity improvement rates with disadvantages as malnutrition, biliary reflux and dumping, yet the risk of malnutrition was more likely after SASI bypass.

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