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Surgery for Obesity and Related Diseases 13 (2017) 415–422

SURGERY FOR OBESITY AND RELATED DISEASES

Original article

A retrospective comparison of biliopancreatic diversion with duodenal switch with single anastomosis duodenal switch (SIPS-stomach intestinal pylorus sparing surgery) at a single institution with two year follow-up

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Received August 23, 2016; accepted November 24, 2016

Abstract

Background: The traditional duodenal switch is performed using a Roux-en-Y configuration. This procedure has proven to be the most effective procedure for long-term weight loss and co-morbidity reduction.

Recently, stomach intestinal pylorus sparing surgery (SIPS) has been introduced as a simpler and potentially safer variation of the duodenal switch (DS). It is a single anastomosis end-to-side proximal duodeno-ileal bypass with a sleeve gastrectomy. In this study, we compare our outcomes between biliopancreatic diversion with duodenal switch (BPD-DS) and SIPS at 2 years.

Setting: This is a retrospective analysis from a single surgeon at a single private institution.

Methods: We analyzed data from 182 patients retrospectively, 62 patients underwent BPD-DS while 120 other patients underwent SIPS between September 2011 and March 2015. A subset analysis was performed comparing data from both procedures to evaluate weight loss and complications.

Results: Of 182 patients, 156 patients were beyond 1 year postoperative mark and 99 patients were beyond 2 year postoperative mark. Five patients were lost to follow-up. None of our patients had complications resulting in death. BPD-DS and SIPS had statistically similar weight loss at 3 months but percent excess weight loss (%EWL) was more with BPD-DS than SIPS at 6, 9, 12, 18, and 24 months. Patient lost a mean body mass index (BMI) of 23.3 (follow-up: 69%) and 20.3 kg/m^2 (follow-up: 71%) at 2 years from the BPD-DS and SIPS surgery, respectively. However, patients who had undergone SIPS procedure had significantly shorter operative time, shorter length of stay, fewer perioperative and postoperative complications than BPD-DS ($P < .001$). Interestingly, even though BPD-DS patients lost slightly more weight, the actual final BMI for SIPS group was lower than BPD-DS group (25.6 versus 26.9) ($P < .05$). There was no statistical difference between 2 groups for postoperative nutritional data such as vitamins D, B1, B12, serum calcium, fasting blood glucose, glycosylated hemoglobin (HbA1C), insulin, serum albumin, serum total protein, and lipid panel.

Conclusion: The SIPS is a simplified DS procedure. The SIPS eliminates one anastomosis and compared with BPD-DS has fewer perioperative and postoperative complications, shorter operative time and length of stay, and similar nutritional results at 2 years. However, weight loss was more with BPD-DS. A fair criticism is that the vast majority of BPD-DS cases were done before the SIPS cases. As a result, experience and learning curve cannot be completely dismissed when viewing postoperative complications. (Surg Obes Relat Dis 2017;13:415–422.)

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http://dx.doi.org/10.1016/j.soard.2016.11.020

Keywords: Duodenal switch; SIPS; BPD-DS; Bariatric; Obesity; Laparoscopic

The duodenal switch (DS) procedure offers greater average weight loss and remission of metabolic syndromes than Roux-en-Y Gastric Bypass (RYGB) or vertical sleeve gastrectomy (VSG) [1,2]. Despite these results, DS accounts for a small percentage of current bariatric procedures [3]. The reasons include the technical difficulty of the procedure, the risk of malnutrition, micronutrient deficiency, and frequent bowel movements [3–6].

As with all bariatric procedures, individual centers and surgeons have their preference in types of DS construction. There are variations in the size of the vertical sleeve, as well as the lengths of the alimentary limb and common channel. Dr. Hess, the American pioneer of the procedure, sized the sleeve gastrectomy over a 40 French bougie and then moved >1 cm away from the bougie to begin the staple [7]. He measured the entire bowel, leaving 40% of the total length as the alimentary limb length and took 10% of this value to construct his common channel. Similarly, Marceau and the group in Quebec City, sized the sleeve with a 60-cm bougie, made the alimentary limb 200 cm and had a common channel length of 50 to 75 cm [8]. Our group's version of the DS involves a sleeve gastrectomy calibrated over a 40–46 French bougie, a 150-cm alimentary limb, and 150-cm common channel.

Major concerns with DS and other versions of biliopancreatic diversions (BPD) that reduce total bowel length and have a short common channel include diarrhea, malnutrition and deficiency in fat soluble vitamin levels [5,6]. These problems can require surgical revision. A recommended option is increasing the common channel to 300 cm. Therefore, it appeared reasonable to extend the common channel with a 300-cm efferent limb by performing loop anastomosis of ileum to duodenal stump. This construction aimed at effective weight loss while minimizing gastrointestinal side effects of short bowel syndrome [9].

An alternative version of a DS using a loop or Billroth 2 reconstruction with afferent and efferent limbs was initially investigated by Dr's Sanchez and Torres of Spain [10]. Named SADI or Single anastomosis duodeno- ileal bypass, the procedure was performed with a 54 bougie and 200-cm efferent limb. Because of intractable diarrhea, they have now increased the length of the efferent limb to 250 cm [11].

The stomach intestinal pylorus sparing surgery (SIPS) is a further attempt to improve the DS procedure. As in SADI, it combines an end-to-side proximal duodeno-enteral anastomosis with a sleeve gastrectomy. In comparison, the sleeve gastrectomy is smaller (40-cm French) and efferent limb longer. The attachment is performed 300 cm from the ilio-cecal valve in an attempt to minimize complications from short bowel syndrome [9]. In effect, this lengthens the common channel. Also, the pylorus is left intact. As mentioned, biliopancreatic diversion with duodenal switch (BPD-DS), a standard DS in our practice utilizes a sleeve gastrectomy combined with 150 alimentary limb, and 150-cm common channel with a Roux-en-Y construction. Therefore, the differences between BPD-DS and SIPS include one versus 2 anastomosis, longer common channel, and elimination of a mesenteric defect. The sleeve and the total bowel length are similar. This design allows us to study the benefits and detriments of the Roux and shorter common channel. To accomplish, we compared outcomes of BPD-DS versus SIPS at 2 years.

Aim

This study compares the midterm outcomes in terms of weight loss and complications of laparoscopic BPD-DS versus SIPS at a single institution at 2 years.

Methods

With adherence to HIPAA guidelines, 182 patients had undergone laparoscopic BPD-DS or SIPS procedure were retrospectively reviewed from a prospectively collected database. All patients were informed about the various surgical procedures for weight loss at an educational seminar before their individual evaluation in the clinic. Each patient had an informed consent to participate in our de-identified database. Each patient signed informed consent detailing the procedure, risks, and potential benefit.

Each patient was given an examination before surgery to verify the understanding of the procedure. Demographic data was collected for all patients including age, weight, and body mass index (BMI), as well as co-morbidities and prior medical history.

BPD-DS was one of the options given to the patients and 62 chose this surgery after a detailed discussion with the surgeon. Laparoscopic SIPS was introduced as one of the options after 2013 as we had stopped performing BPD-DS. One hundred twenty patients decided to undergo laparoscopic SIPS of all available options after the risks and benefits were discussed with the surgeon.

All patients met the NIH criteria for bariatric surgery and had an identical preoperative educational process that included both dietary and physical education. All patients were advised to have monthly postoperative follow-up visits and semi-annual laboratory analysis. All patients had specific informed consent for SIPS or BPD-DS before their surgical procedure. All the surgeries were performed laparoscopically by one of the 3 surgeons at the same institution. No revisions were included in the study. Details on the surgery and hospital stay were collected.

The Quorum IRB gave approval for this study (number 31353).

Statistical methods

Demographic characteristics were compared using t test analysis. Postoperative weight loss data was evaluated using nonlinear regressions. All the data collected was analyzed using Sigma plot statistical software. For all analyses that involved inferential statistics, a P value $< .05$ was considered statistically significant.

Surgical technique

BPD-DS procedure. The patients were operated in the supine position, under general anesthesia. Six trocars were placed in the supraumbilical abdomen.

First step was to locate an ileocecal valve. The small bowel was traced retrograde to 150 cm and marked. Next another 150 cm was counted retrograde and transected using a GIA stapler. The Biliary limb was then anastomosed to the ileum at the 150-cm mark using a GIA stapler and a side to side anastomotic technique. The enterotomy was closed with a GIA stapler as well. The mesenteric defect was closed with silk suture. This created a 150-cm common channel and a 150-cm Roux limb.

Next, the omentum was split. At this point, we dissected to the lesser sac and then sequentially fired a GIA stapler 5 cm from the pylorus, onto the stomach approximately 1.5 cm, and then fired up the greater curve of the stomach following a sizing tube from the Allergan Corporation (46 French). We then brought this all the way up to the angle of His. The stomach was taken out of the abdominal cavity.

We then dissected free the duodenal bulb 3-cm from the pylorus circumferentially. It was transected using a GIA stapler. We then over sewed the duodenal stump using PDS suture. Next, we brought up the Roux limb and sewed it to the duodenal stump using 2.0 polysorb. Enterotomies were made in both limbs and 3.0 polysorb was used to do another posterior row. An anterior row was also done using 3.0 polysorb.

SIPS procedure (Fig. 1)

The SIPS creates a SG over a 40 French bougie sizing tube. Our sleeve uses a 40 French bougie. There was no over sewing or buttressing in the SIPS procedure. Once the sleeve was completed, the gastroepiploic vessels were taken down from the end of the sleeve staple line past the pylorus to where the perforating vessels from the pancreas enter the duodenum. This was almost always 2 to 3 cm beyond the pylorus. A blunt instrument was passed across the duodenum to create a passageway for the division of the duodenum [12].

We then dissected free the duodenal bulb 3 cm from the pylorus circumferentially. The duodenum was then divided with an Endo GIA stapler (Covidien). The terminal ileum was then located and 300 cm of small bowel was measured. The antimesenteric border of the bowel at this point was attached to the end of the proximal duodenum staple line using an absorbable suture. The loop was set up so the efferent limb was descending on the patient's right, and the afferent limb was ascending coming up from the left. A duodenotomy and enterotomy was made that was approximately 2 cm. The enterotomy was closed with a running posterior layer and a running anterior layer. Another 2 interrupted sutures were placed one from the afferent limb to the antrum and the other from the afferent limb to the omentum to prevent chronic nausea and volvulus [13].

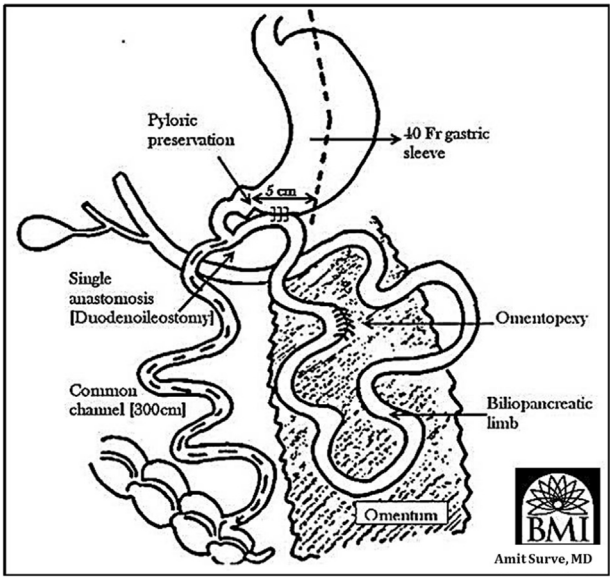

Fig. 1. Hand-drawn sketch of stomach intestinal pylorus sparing surgery (SIPS). Abbreviation = SIPS: Single anastomosis duodenal switch.

Results

There were 182 patients that qualified for the study. Of these, 62 patients underwent BPD-DS between September

Table 1
Demographic characteristic for BPD-DS and SIPS

Characteristic	BPD-DS	SIPS	P value
Patients (n)	62	120	-
Male/Female (n)	24/38	42/78	.74
Age (year)*	51.7 ± 12.3	49.1 ± 14	.23
Preoperative weight (lbs)*	322.4 ± 65.3	312.9 ± 68.9	.35
Preoperative BMI (kg/m^2)*	50.8 ± 9.3	49.5 ± 9.4	.37
Ideal weight (lbs)*	139 ± 22.4	136.5 ± 21.9	.45
Excess weight (lbs)*	183.4 ± 57.2	176.5 ± 61.9	.47

BMI = Body mass index; BPD-DS = biliopancreatic diversion with duodenal switch; SIPS = stomach intestinal pylorus sparing surgery.

There was no statistical significant difference in male/female ratio, ages, preoperative weight, BMI, ideal weight, and excess weight between both procedures.

*Values are expressed as means ± SD.

Table 2
Operative details for BPD-DS and SIPS

	BPD-DS	SIPS	*P* value
No of patients	62	120	
Operative time (min)*	136.9 ± 35.5	69.9 ± 15.8	<.001
Length of hospital stay (day)*	4.1 ± 6.2	2 ± 1	<.001

BPD-DS = biliopancreatic diversion with duodenal switch; SIPS = stomach intestinal pylorus sparing surgery.

Operative time and length of hospital stay was shorter with SIPS than BPD-DS ($P < .001$).

*Values expressed as mean ± SD.

2011 and August 2013, while the other 120 patients underwent SIPS between June 2013 and March 2015. Out of 182 patients, 5 patients lost to follow-up. One hundred fifty-six patients are beyond 1 year postoperative mark and 99 patients are beyond 2 year postoperative mark. See Tables 1 and 2 for demographic data and operative details for BPD-DS and SIPS, respectively.

Short-term morbidity and mortality were defined as death or complications, within 90 days after the surgery. None of our patients had complications resulting in death.

The short-term complication rate was 20.9% (n = 13/62) and 1.6% (n = 2/120) for BPD-DS and SIPS procedure, respectively. See Table 3 for short-term complications with BPD-DS and SIPS.

The long-term complication rate was 32.2% (n = 20/62) and 10.8% (n = 13/120) for BPD-DS and SIPS procedure, respectively. See Table 4 for long-term complications with BPD-DS and SIPS. The overall complication rate was higher with BPD-DS than SIPS ($P < .001$).

There was a significant difference in hospital stay between both the surgeries, with mean of 4.1 ± 6.2 days for BPD-DS and 2 ± 1 day for SIPS and ($P < .001$).

There was no statistical difference between 2 groups for postoperative nutritional data such as vitamins D, B1, B12, serum calcium, fasting blood glucose, glycosylated

Table 3
Short-term complications with BPD-DS and SIPS

Complications, n (%)	BPD-DS (n = 62)	SIPS (n = 120)	*P* value
Acute blood loss anemia	0	1 (0.8)	
Intraabdominal hematoma	0	1 (0.8)	
Intraabdominal abscess	2 (3.2)	0	
Anastomotic leak	2 (3.2)	0	
Sepsis	2 (3.2)	0	
Postoperative bleed	2 (3.2)	0	
Mild Renal failure	2 (3.2)	0	
Duodenal Stump leak	1 (1.6)	0	
Peritonitis	1 (1.6)	0	
Small bowel obstruction	1 (1.6)	0	
Total	13 (20.9)	2 (1.6)	<.001

BPD-DS = biliopancreatic diversion with duodenal switch; SIPS = stomach intestinal pylorus sparing surgery

BPD-DS: Two patients had postoperative bleed, of which one also had bile leak. The bleeding vessels were taken care of in both the patients. The bile leaked because the duodenal stumps staple line had broken down; it was replaced with a new staple line.

A patient had an acute renal failure due to septic shock due to small bowel obstruction with *Candida albicans* infection. The small bowel was resected. This patient also had blood loss anemia secondary to surgery and chronic disease-associated anemia, and was given erythropoietin and several transfusions during hospitalization.

Of 62 patients, 1 patient developed hypotension and felt a bit dizzy, postoperatively. The patient was diagnosed with septic shock and was started on vasopressors and antibiotics. On postoperative day 10, the patient had to undergo a diagnostic exploratory laparotomy. The patient had peritonitis secondary to gastric necrosis. Peritoneal lavage was done for peritonitis and also peritoneum culture was taken.

Two patients had anastomotic leak and developed abdominal abscesses.

SIPS: One of our patients had an abdominal hematoma diagnosed postoperatively. This patient required a second return to the operating room. A single bleeding vessel was responsible for the abdominal hematoma, which was then ligated and approximately 1000 mL of blood was evacuated. This patient recently had a pacemaker placed and had been on blood thinners and aspirin for ventricular fibrillation.

One case of acute blood loss anemia was treated by transfusing 2 units of blood in a patient who had a bleed in the JP drain. The patient was also started on octreotide drip.

Table 4
Long-term complications with BPD-DS and SIPS

Complications, n (%)	BPD-DS (n = 62)	SIPS (n = 120)	*P* value
Diarrhea	7 (11.2)	1 (0.8)	
Malnutrition	5 (8)	1 (0.8)	
Hiatal hernia	3 (4.8)	2 (1.6)	
Sleeve stricture	2 (1.6)	4 (2.5)	
Liver failure	1 (1.6)	0	
Constipation	0	2 (1.6)	
Retrograde filling of afferent limb	0	2 (1.6)	
Common channel lengthening	1	1 (0.8)	
Total	20 (32.2)	13 (10.8)	<0.001

BPD-DS = biliopancreatic diversion with duodenal; SIPS = stomach intestinal pylorus sparing surgery.

BPD-DS: Seven of our patients experienced severe diarrhea, of which 1 patient was diagnosed with short gut syndrome. The common channel was 150 cm in this patient. We reconstructed the common channel to 240 cm. Similarly, with another patient we reconstructed the common channel from 150 cm to 280 cm, as the patient had severe diarrhea and malnutrition. Another patient underwent a resection of an infarcted colon a few months after the BPD-DS and had a small bowel injury during the procedure. Thereafter, the patient developed chronic diarrhea which was treated by probiotics. This was not due to the BPD-DS.

One patient developed Gastric outlet obstruction and we found an extra piece of dilated stomach, kinking the stomach off. Scar tissue was also found adhering down the stomach posteriorly and causing the kink. Scar tissue was released and resection of the extra piece of stomach was done. A second patient had an abdominal abscess with gastric outlet obstruction. The abscess was drained and small bowel resection was performed.

Three patients developed diarrhea. Of which, only 1 was related to the surgery and the patient was reoperated for common channel lengthening. During the surgery, we found the common channel length to be 150 cm instead of 300 cm. So we added another 300 cm, making 450 cm of total common channel length. The second patient had diarrhea as a side effect of the drug colchicine which was taken for gout. The diarrhea stopped after stopping the drug.

hemoglobin (HbA1C), insulin, serum albumin, serum total protein, and lipid panel (Table 5).

We also compared the nutritional outcomes between baseline and 24 months for each procedure. We found that there was a statistical significant difference (normal > abnormal) for glucose, HbA1C, insulin, cholesterol, triglyceride, vitamin D, and vitamin B1 for both procedures. There was also a statistical difference for calcium with more patients having abnormal values at 24 months compared to baseline (abnormal > normal) for both procedures.

Weight loss analysis

Sub-analyses were performed. Weight loss was more with BPD-DS than SIPS (Fig. 2). Analysis of our graphical result suggests that on an average, a patient will lose over 23.3 BMI and 20.3 BMI 2 years from the BPD-DS and SIPS, respectively (Table 6).

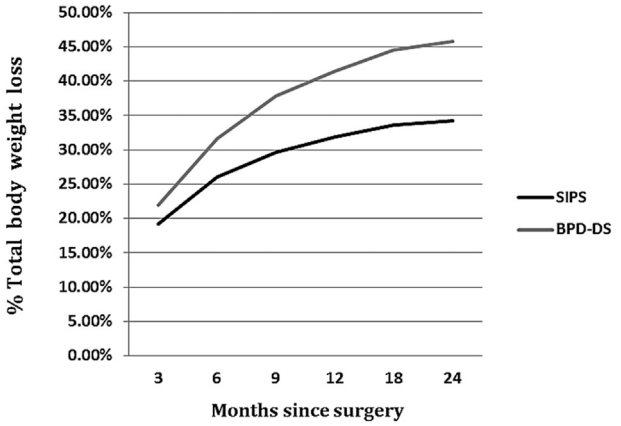

Fig. 2. Demonstrates weight loss with BPD-DS and SIPS at 3, 6, 9, 12, 18, and 24 months. Abbreviations =BPD-DS: Biliopancreatic diversion with duodenal switch, SIPS: Single anastomosis duodenal switch. Weight loss was more with BPD-DS than SIPS.

Discussion

BPD and DS are most effective bariatric procedures for weight loss and for selective metabolic diseases [14–16]. Despite these advantages, they are technically demanding operations with greater concerns for malnutrition, diarrhea, and other adverse consequences, particularly if patients are lost to follow up [17].

This is the first paper which compares the outcomes of the classic Roux-en-Y version of DS (BPD-DS) to single anastomosis version of DS (SIPS). Our results demonstrate slightly better weight loss with BPD-DS but BPD-DS had a much higher overall complication rate than SIPS ($P < .001$). Also, the ultimate BMI between each of 2 groups was identical.

Although this is not a randomized prospective trial, we believe that these are very important findings. A fair criticism is that the vast majority of BPD-DS cases were done before the SIPS cases. As a result, experience and learning curve cannot be completely dismissed when viewing postoperative complications. This is especially true for our short-term complications. However, our long-term complication rates are higher for the BPD-DS primarily due to the elevated levels of diarrhea and malnutrition and can't be explained by the learning curve but are unique to the operation.

The Roux configuration has become standard for American bariatric procedures. Interestingly, the initial reason why Griffen and Scopinaro preferred a Roux was to reduce the likelihood of marginal ulcer [18]. Improved weight loss was a bonus for them. Another benefit of the Roux reconstruction is reduced bile reflux. Frequent bile reflux and bile gastritis have been associated with gastric cancer [19,20]. As a result of these issues the mini gastric bypass, as proposed by Rutledge [21], has been unpopular in the United States (despite being very popular elsewhere in the world). The mini gastric bypass has a .5 to 1.5% rate of

Table 5
Nutritional outcomes with BPD-DS and SIPS at 24 months

	BPD-DS				SIPS				Statistics	
	Preop		24 months		Preop		24 months		*P* value	
	Abnormal	Total	Abnormal	Total	Abnormal	Total	Abnormal	Total	Preopop	Postop-
Glucose	33	61	6	36	64	118	13	81	.888	.851
HbA1C	33	58	2	34	61	109	7	72	.962	.773
Insulin	31	60	0	25	70	107	1	43	.114	1
Calcium	0	61	4	34	0	117	6	81	1	.693
Albumin	0	22	5	36	2	50	8	80	1	.767
Total protein	0	22	4	36	1	49	8	80	1	.883
Cholesterol	18	60	0	28	32	118	4	49	.82	.29
Triglyceride	33	60	2	28	66	118	6	49	.967	.703
Vitamin D	41	59	19	34	61	108	34	80	.138	.269
Vitamin B1	12	57	4	29	15	97	6	72	.508	.643
Vitamin B12	0	60	0	35	1	111	0	78	1	1

BPD-DS = biliopancreatic diversion with duodenal switch; HbA1C = glycosylated hemoglobin; SIPS = stomach intestinal pylorus sparing surgery. There was no statistical difference between 2 groups for nutritional data.

Table 6
Weight loss outcomes with SIPS and BPD-DS at 3, 6, 9, 12, 18, and 24 months

BMI lost (kg/m^2)		3 months	6 months	9 months	12 months	18 months	24 months
	SIPS	10.2	14.3	16.8	18.4	19.8	20.3
	n (%)	107/120 (89.1)	98/120 (81.6)	80/116 (68.9)	73/95 (76.8)	52/69 (75.3)	27/38 (71)
	CI	(9.7, 10.7)	(13.8, 14.9)	(16.3, 17.4)	(17.9, 18.9)	(19.1, 20.4)	(19.4, 21.1)
	BPD-DS	11.2	16.2	19.2	21.0	22.7	23.3
	n (%)	52/61 (85.2)	51/61 (83.6)	49/61 (80.3)	48/61 (78.6)	48/61 (78.6)	42/61 (68.8)
	CI	(10.4, 11.9)	(15.3, 17.0)	(18.4, 20.0)	(20.3, 21.7)	(22.0, 23.4)	(22.4, 24.2)
	P Value	.166	<.05	<.05	<.05	<.05	<.05
%EWL		3 months	6 months	9 months	12 months	18 months	24 months
	SIPS	44%	62.1%	72.7%	79.3%	85%	87.1%
	n (%)	107/120 (89.1)	98/120 (81.6)	80/116 (68.9)	73/95 (76.8)	52/69 (75.3)	27/38 (71)
	CI	(41.4, 45.3)	(59.8, 64.4)	(70.6, 74.7)	(77.4, 81.2)	(82.5, 87.6)	(83.8, 90.3)
	BPD-DS	46.7%	67.3%	79.3	86.6%	92.7%	94.9%
	n (%)	52/61 (85.2)	51/61 (83.6)	49/61 (80.3)	48/61 (78.6)	48/61 (78.6)	42/61 (68.8)
	CI	(44.0, 49.6)	(64.1, 70.6)	(76.3, 82.3)	(84.0, 89.2)	(90.0, 95.4)	(91.6, 98.2)
	P Value	.333	.069	<.05	<.05	<.05	<.05
TWL (lbs)		3 months	6 months	9 months	12 months	18 months	24 months
	SIPS	64.6	90.7	106	116	125	128
	n (%)	107/120 (89.1)	98/120 (81.6)	80/116 (68.9)	73/95 (76.8)	52/69 (75.3)	27/38 (71.1)
	CI	(61.0, 68.2)	(86.4, 94.9)	(102.0, 110.0)	(113.0, 120.0)	(120.0, 129.0)	(122.0, 134.0)
	BPD-DS	70.0	101.6	120.7	133.0	144.0	148.0
	n (%)	52/61 (85.2)	51/61 (83.6)	49/61 (80.3)	48/61 (78.6)	48/61 (78.6)	42/61 (68.8)
	CI	(65.2, 74.9)	(96.0, 107.0)	(115.0, 126.0)	(128.0, 138.0)	(139.0, 149.0)	(142.0, 154.0)
	P Value	.288	<.05	<.05	<.05	<.05	<.05
BMI (kg/m^2)		3 months	6 months	9 months	12 months	18 months	24 months
	SIPS	40.6	38	35.7	33.3	29.4	25.6
	n (%)	107/120 (89.1)	98/120 (81.6)	80/116 (68.9)	73/95 (76.8)	52/69 (75.3)	27/38 (71.1)
	CI	(39.8, 41.3)	(37.3, 38.3)	(34.9, 36.4)	(32.4, 34.1)	(28.3, 30.6)	(24.2, 27.1)
	BPD-DS	39.1	37.1	35.2	33.3	30.1	26.9
	n (%)	52/61 (85.2)	51/61 (83.6)	49/61 (80.3)	48/61 (78.6)	48/61 (78.6)	42/61 (68.8)
	CI	(38.0, 40.1)	(36.2, 38.0)	(34.4, 36.1)	(32.5, 34.2)	(29.0, 31.2)	(25.6, 28.3)
	P Value	.028	.075	.004	<.05	<.05	<.05
% TWL		3 months	6 months	9 months	12 months	18 months	24 months
	SIPS	19.2%	26%	29.7%	31.9%	33.6%	34.2%
	n (%)	107/120 (89.1)	98/120 (81.6)	80/116 (68.9)	73/95 (76.8)	52/69 (75.3)	27/38 (71)
	CI	(18, 20.3)	(24.6, 27.3)	(28.4, 30.9)	(30.7, 33.0)	(32.0, 35.1)	(32.3, 36.0)
	BPD-DS	22%	31.9%	37.8%	41.4%	44.6%	45.8%
	n (%)	52/61 (85.2)	51/61 (83.6)	49/61 (80.3)	48/61 (78.6)	48/61 (78.6)	42/61 (68.8)
	CI	(21.0, 23.1)	(30.7, 33.2)	(36.6, 39)	(40.4, 42.4)	(43.5, 45.6)	(44.5, 47.1)
	P Value	<.05	<.05	<.05	<.05	<.05	<.05

BMI = body mass index; BPD-DS = biliopancreatic diversion with duodenal switch; CI = confidence interval; %EWL = percent excess weight loss; SIPS = sin stomach intestinal pylorus sparing surgery; TWL = total weight loss

There was statistical significant difference in weight loss at 6, 9, 12, 18, and 24 months between both procedures. Percentage excess weight loss is more with BPD-DS than SIPS.

revision for bile reflux [22]. SIPS with an intact pylorus should be much lower.

In the SIPS procedure, the gastric resection is performed, and the afferent loop is attached passed the pyloric valve. The gastric resection and post-pyloric reconstruction should vastly reduce the chance of marginal ulcer [21]. As opposed to MGB, the pylorus is preserved [10,11,23]. Pylorus sphincter determines the rate of gastric emptying thereby reducing the occurrence of dumping syndrome [24,25].

Because loop anastomosis has not been popular in the United States, many think that they require much greater investigation before being used. We think our data suggest an alternative view. Before permanent division of the intestine is performed and an extra anastomosis done, which has risk of leakage and leaves a potential mesenteric deficit, there should be evidence that it is necessary. The burden should be on doing more, not less. A Roux was added to the DS; the operation was originally described by Dr. DeMeester to treat bile reflux gastritis [26]. This is a condition that rarely requires surgery. It was adapted by Dr. Hess who added the longitudinal gastrectomy as a weight loss procedure [7]. The major reason given for a Roux configuration is that it allows for adequate bowel length and a short common channel. The purpose of the short common channel is to reduce fat absorption. A negative consequence

is that it also reduces the absorption of fat soluble vitamins and essential fatty acids.

By eliminating one anastomosis and several staple firings, SIPS is faster, less expensive, and much less invasive [10,11,24]. The elimination of one anastomosis has obvious further benefits, as previously outlined: a reduction in the risk of postoperative leak, a lower probability of internal hernia because the mesentery is not divided, a lower chance of bowel obstructions from narrowing or rotation of the distal anastomosis, reduction in the operation and anesthesia time, and significant cost savings. On the other hand, the number of anastomotic leaks is very low in experienced hands [27], but it should be even lower if one anastomosis is performed instead of 2 [7].

Advocates of BPD-DS note that there are years of data with outstanding weight loss results but a minority of morbidly obese patients are offered BPD-DS, largely because of concerns about long-term complications. Recently, few surgeons from New York published long-term outcomes of BPD-DS where they showed EWL of 65.1% at 2 years, 8% internal hernias, 7% small bowel obstruction due to adhesions, and 4% malnutrition rate [28]. A randomized trial from Sweden and Norway on super morbidly obese patients also showed a greater weight loss and greater improvement of co-morbidities 5 years after the surgery with standard DS compared to RYGB but a higher chance of gastrointestinal disturbances [29]. Similar results were seen in a large cohort published in Arch Surgery between BPD-DS and RYGB at 4 years [30]. Patients had higher weight loss and resolution of co-morbidities with DS compared to RYGB but also reported higher postoperative risks.

Our retrospective analysis demonstrated that SIPS has less EWL compared with the BPD-DS. Analysis of our graphical result suggest that on an average, patients will lose over 20.3 BMI and 23.3 BMI from the SIPS surgery and BPD-DS surgery, respectively, after 2 years. However, we do not think this is significant, as the ending points of both surgeries were similar (25.6 versus 26.9) despite there being a statistical difference favoring SIPS. This suggests that over 2 years, both surgeries will reach similar stopping points despite no preoperative differences in excess weight. We feel this is related to the fact that that both surgeries had 300 cm of intestinal length and both sleeves were made with identical 40 French boogies. So any differences in weight loss would truly be attributed to the lack of small bowel exposure to bile and pancreatic juices in the 150-cm bypassed segment of small bowel. With only 2 years of follow-up, it remains to be seen if 150 cm less malabsorption will affect weight loss at 3 to 5 years.

Conclusion

The SIPS is a simplified DS procedure that is safe and has significantly shorter operative time, shorter length of stay, and fewer perioperative and postoperative complications than BPD-DS. However, weight loss was more with BPD-DS. A fair criticism is that the vast majority of BPD-DS cases were done before the SIPS cases. As a result, experience and learning curve cannot be completely dismissed when viewing postoperative complications. The SIPS offers the patients the opportunity to take any medication to treat their co-morbid conditions without placing them at high risk for ulcers or strictures, compared with gastric bypass, and eliminates the chances for internal hernia formation seen in BPD-DS. Additional long-term follow-ups and a larger study population would be required to further evaluate the outcomes of the SIPS procedure.

Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

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