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The Drawbacks of Laparoscopic Single Anastomosis Duodeno-ileal Bypass-sleeve Gastrectomy versus Laparoscopic Sleeve Gastrectomy on Iron and Hemoglobin

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Authors' contributions

This work was carried out in collaboration among all authors. Author MSA designed the study, performed the statistical analysis and wrote the protocol. Author MFI wrote the first draft of the manuscript. Author AEMMM managed the analyses of the study. Author AMAB managed the literature searches. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Background: BMI can be decreased after Biliopancreatic diversion, but there is a risk of malnutrition and diarrhea. This risk may be abolished by pyloric preservation with duodenal switch. Loop duodenal switch (Single anastomosis duodeno-ileal bypass with sleeve gastrectomy=SADI-S) is hybrid intervention combining moderate food restriction with moderate malabsorption for treatment of morbid obesity, In a trial to modify the effective BPD-DS procedure-the same way Rutledge modified RYGB by creating one loop end-to-side anastomosis – and to keep its principles, the single anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S) was first mentioned in 2007 by Sánchez-Pernaute and Torres as they fashion Sleeve gastrectomy followed by 1-loop duodenoileostomy, with 250 cm between anastomosis and ileocecal valve. Anastomosis performed in antecolic and isoperistaltic manner. Purpose to assess the drawbacks of the two procedures on iron and hemoglobin.

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Patients and Methods: The interventions were led at Beni-suef University Hospital between January 2018 and December2019 ,after the patients fitted both the inclusions and exclusions criteria.
Results: This study consisted of 36 patients which were randomized into 2 groups. Group (A): 18 patients assigned for Single Anastomosis Duodeno-ileal bypass – Sleeve Gastrectomy [SADI-S]. Group (B): 18 patients assigned for Sleeve Gastrectomy.
Conclusion: There was drop of Hb level and iron level from baseline in both groups more in SADI patients. This drop was significant with hemoglobin and highly significant with iron. In addition longer OR time and longer hospital stay.

Keywords: SADI; sleeve; iron; hemoglobin.

1. INTRODUCTION

There are many causes for iron deficiency, the first one related to inadequate intake due to inappropriate diets before doing the surgery, most of which unfortunately are unconscious and vegetarian diets [1]. The second one refers to inadequate absorption due to diarrhea, reduction in gastric juice secretion and gastrointestinal problems, or drugs intake such as cimetidine or ranitidine, pancreatinand proton pump inhibitors, all of which aid in absorbing iron. However, it seems that prolonged use of these drugs can be more potent in reducing the iron absorption under conditions when the iron intake is at its lowest level [2]. The third reason is Surgical-related bleeding and complications related to it. Most of the iron absorption occurs in the duodenum and the upper part of the jejunum, which is facilitated by some factors, such as ascorbic acid, citric acid and gastric acid, and some factors such as phytate and tannin inhibits its absorption. Iron is controlled by controlling the amount of iron absorbed. At maximum, about 20 percent of the consumed iron in a diet containing meat is absorbed and less than this amount is absorbed by having a vegetarian diet. Normally, the body's total iron content is a constant amount throughout life [3]. The first bariatric procedure was the jejunocolic bypass followed by the jejunoileal bypass, which resulted in evident weight loss but serious life threatening complication rates. These procedures along with several others have fallen out of favor over the years, due to failure rates, health risks, and severe deficiencies [4]. Currently, laparoscopic Roux-en-Y gastric bypass (RYGB) and laparoscopic sleeve gastrectomy (LSG) are the most effective for surgical treatment of morbid obesity [5]. SADI-S compared with DS abolish the Roux-en-Y gastric bypass by doing an omega loop, and because of the intact pylorus, bile diversion is not needed as the natural barrier remains in place. Pylorus provides control of solid stool emptying, reducing the chances of dumping syndrome and assisting in the maintenance of a physiologically based rate of gastric emptying [6].

SADI-S benefits over DS included reduction of the operative risk by eliminating one anastomosis with potentially similar weight loss and health benefits [7].

2. PATIENTS AND METHODS

- **Group (A):** 18 patients assigned for Single Anastomosis Duodeno-ileal bypass – Sleeve Gastrectomy [SADI-S].

- **Group (B):** 18 patients assigned for Sleeve Gastrectomy.

2.1 Study Sample

The study consisted of 36 patients which were randomized into 2 groups. Patients were enrolled in the study after giving written informed consent.

- **Group (A):** 18 patients assigned for Single Anastomosis Duodeno-ileal bypass – Sleeve Gastrectomy [SADI-S].

- **Group (B):** 18 patients assigned for Sleeve Gastrectomy.

2.2 Inclusion Criteria

1. Patients who had BMIs of 40 Kg/m^2 or more, or between 35 Kg/m^2 and 40 Kg/m^2 with obesity related comorbidities that could be improved if they lose weight.
2. Age (18-65) years old.
3. Patients were generally fit for anesthesia and surgery.

2.3 Exclusion Criteria

1. Previous gastric or duodenal surgery.
2. Endocrine disorders excluding diabetes mellitus.
3. Psychiatric illness.
4. Recent diagnosis of malignancy.
5. Heavy smokers and alcoholics.
6. Associated comorbidity
7. Surgical Technique

2.4 Positioning

Patients were placed in supine, legs spread (French position), in a steep Fowler (reverse Trendelenburg) position, and the table was slightly tilted right side down for an adequate visualization of the gastroesophageal (GE) junction. The patient was secured to the table. Additionally, above knee elastic stockings was employed to prevent venous thromboembolism Pneumoperitoneum was created by direct Veress needle at Palmer's point.

A 15 mmHg CO_2 abdominal pressure was set for all the procedure with 5-6 trocars set up.

The first trocar (10-12 mm) was placed 2-3 cm to the left of the midline 15-18 cm caudal from the xiphoid for the placement of a 10 mm/30 degrees lens.

Both sides of the camera 5- 10 cm away at the same line were placed two 12 mm trocars for both working hands of the surgeon.

The assistant placed a 5 trocar lateral in the left side of the patient (anterior axillary line) 2-3 cm from the last costal bone.

Another 5/10 mm trocar was placed at the xiphoid to liver retraction.

A 10-mm, 30° scope is used. The left lobe of the liver is retracted to expose the entire GE junction and the lesser curve.

The procedure started by cutting the small branches of the gastroepiploic arcade and opening the lesser sac. Then, dissection was carried out along the greater curve, staying very close to it, dividing the branches of both gastroepiploic arteries, until short gastric vessels were divided using an advanced bipolar cutting device or the ultrasonic scalpel. The assistant retracted the omentum laterally during the maneuver and kept repositioning the instrument superiorly to improve exposure of the vessels and avoid bleeding. The remainder of the gastrocolic ligament (without gastroepiploic vessels transection) was severed distally up to 2 cm proximal to the pylorus. The objective of cutting the omentum right by the edge of the greater curve is to minimize the amount of fat attached to the stomach, to make its extraction from the abdomen easier at the end of the operation. The stomach was then lifted to expose its posterior aspect, and all lesser sac attachments of the stomach were freed. This allowed the appropriate positioning of the mechanical suture.

The gastrophrenic ligament was divided and the angle of Hiss was exposed to determine the presence of a hiatal hernia, adding the full exposure of the left crus to complete the dissection.

Stomach division started 4 cm proximal to the pylorus, to preserve a part of the gastric emptying mechanism of the antrum. Prior to the creation of the sleeve, the anesthetist introduced a 36-Fr bougie to guide the stapling and maintain an adequate lumen of the gastric sleeve. The bougie was placed prior to stapling, guiding it to reach the pylorus, and positioned close to the lesser curve. Care was taken not to divide the stomach too close to the incisura angularis to avoid kinking or stenosis at this level. Green (4.8 mm) stapler cartridge was used for the first two firings and blue for the rest. In any case, all of them were 60 mm in length.

Dividing fundus as close as the GE junction as possible, without actually compromising the esophagus 0.5 cm away from the GE junction.

Additionally, the perigastric fat was mobilized, permitting better identification of the esophago-gastric junction. The anesthetist removed the bougie under direct vision to check the final shape of the sleeve. The stomach was removed through one of the 12-mm ports. The integrity of the staple line was tested with the instillation of 50–100 ml of methylene blue in saline solution. Drain was inserted at the operative bed.

2.5 Laparoscopic Single Anastomosis Duodeno-ileal bypass–Sleeve Gastrectomy Group

For the sleeve gastrectomy part of the procedure (with the operating table under Anti- trendlenburg

position and the surgeon positioned between the legs of the patient):

Devascularization of the greater curvature of the stomach with a Harmonic scalpel™ or a Bipolar Ligasure device™.

The stomach was then tubularized over a suitable sized oral bougie with linear staplers, commencing 5-6 cm proximal to the pylorus.

Then, For the Single Anastomosis Duodeno-ileal bypass part:

The dissection of the greater curvature of the stomach was prolonged through the first portion of the duodenum down to the gastroduodenalartery.

The first part of duodenum was divided with a linear blue cartridge stapler, then the table was changed to the horizontal position and the surgeon moved to the left-hand side of the patient.

The ileocecal valve was identified and 250 cm was measured upwards. The selected ileal loop was ascended ante-colically without division of the greater omentum and stapled iso-peristaltic end-to-side duodeno-ileal anastomosis was completed using a 35 mm blue cartridge.

A standardized supplementation regime was prescribed to all of the patients.

A standard supplementation therapy regimen included a daily dose of calcium citrate 1500 mg and multivitamins pills containing post bariatric surgery recommended doses of beta carotene; vitamins A, E, C, B1, B2, B6, B12, and D; folic acid; phosphorus; iodine; iron; magnesium; manganese; potassium; chlorine; zinc; and nickel.

1. Approval by the institution ethical committee
2. Individual Consent Process:

Informed consent was taken after explaining the study objective and the procedures to potential participants. Participation was voluntary and we informed the participants that the decision would not affect the quality of care they receive.

2.6 The Statistical Analysis

- Data were statistically described in terms of mean ± standard deviation (± SD), frequencies (number of cases) and relative frequencies (percentages) when appropriate.
- The normal distribution of continuous variables of the demographic data was evaluated with the use of the Kolmogrov-Smirnov test. Comparison of numerical variables between the study groups was analyzed with the independent-samples t test (when the data showed normal distribution) and using Mann-Whitney U test for data which was not normally distributed.
- For comparing categorical data as all complications Chi square (c^2) test was performed, and for small sample sizes, Fisher's Exact Test was used as appropriate.
- For comparison of serial measurements within each group repeated measures Mixed ANOVA was used.
- Statistical significance was set at a probability value (P value ≤ 0 .05). The Statistics Package for Social Science (version 22; SPSS Inc) was used for all statistical analyses.

3. RESULTS

The records of postoperative of iron and hemoglobin were calibrated against the two procedures.

3.1 Hemoglobin

At 12 months after surgery, mean Hb level in SADI-S group was 10.1 g/dl ± 0.69 and in the Sleeve gastrectomy group was 10.7 g/dl ± 0.87 which was significant difference between both groups.

Forty-one percent(n=7) of SADI-S has normal Hb levels, the remainder has anemia and they were counseled about the importance of healthy food and daily iron supplements ,however; in OADS/SADI-S group, three patients needed readmissions for correction of anemia by blood transfusion.

One of them is a female patient, 45-year old, and was admitted three times for correction of anemia. EGD and colonoscopy showed no ulcers or any underlying pathology 6,10,12 months postoperative.

Another one of them, who has had abortion six months after surgery and got pregnant after that,

was readmitted twice for correction of acute anemia by blood transfusion after failure of iron administration and for nutritional support.

Table 1. Summarizes the relevant patients' baseline characteristics of the patients who had SADI-S Group or LSG group

Groups variables	(SADI-S) mean (SD) or frequency (%)	(LSG) mean (SD) Or frequency (%)	Test of significance	P-value
Age	32.58 (6.45)	31.17 (4.99)	T (34) 0.82	0.42
Gender	Male 4 (22.2%) Female 14 (77.8%)	Male 7(38.9%) Female 11 (61.1 %)	$X^2(1, N= 36) = 1.18$	0.28
Heidht (m)	1.63 (0.06)	1.66 (0.05)	T (34) 1.19	0.24
Weight (KG)	130.6 (17.2)	131.5 (13.17)	T (34) 0.17	0.86
BMI	49.7(5.8)	48.1(5.4)	T (34) 0.86	0.39

These data shows that there was no statistical significant difference between the 2 groups regarding baseline characteristics

Table 2. Comparison between group A (SADI-S) and group B (LSG) postoperative effect on hemoglobin and iron

	Group A (SADI-S) Mean (SD)	Group B (LSG) mean (SD)	Test of significance	P-value
Preoperative Hemoglobin(g/dl)	12.27 (1.24)	12.1 (1)	u	0.5
Hemoglobin after 6 months	10.2 (1)	10.8 (0.6)	t (34) = 2.11	0.042
Hemoglobin after 12 months	10.14 (0.7)	10.7 (0.8)	t (34) = 2.15	0.039
Preoperative serum iron (mcg/dl)	65.6 (12.2)	69.78 (16.4)	t (34) = 0.87	0.39
Serum iron after 6 months	43.22 (9)	59.2 (13.9)	t (34) = 4.1	≤0.001
Serum iron after 12 months	38.7 (4.3)	48.4 (6.8)	t (34) = 5.1	≤0.001

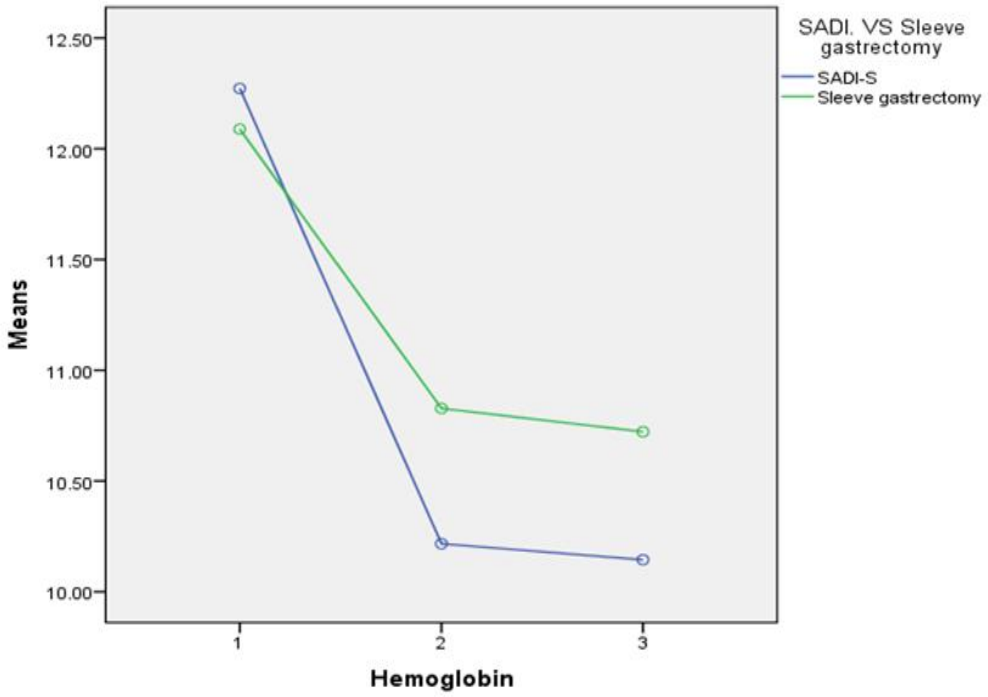

Fig. 1. Hb level across 3 time points between both groups

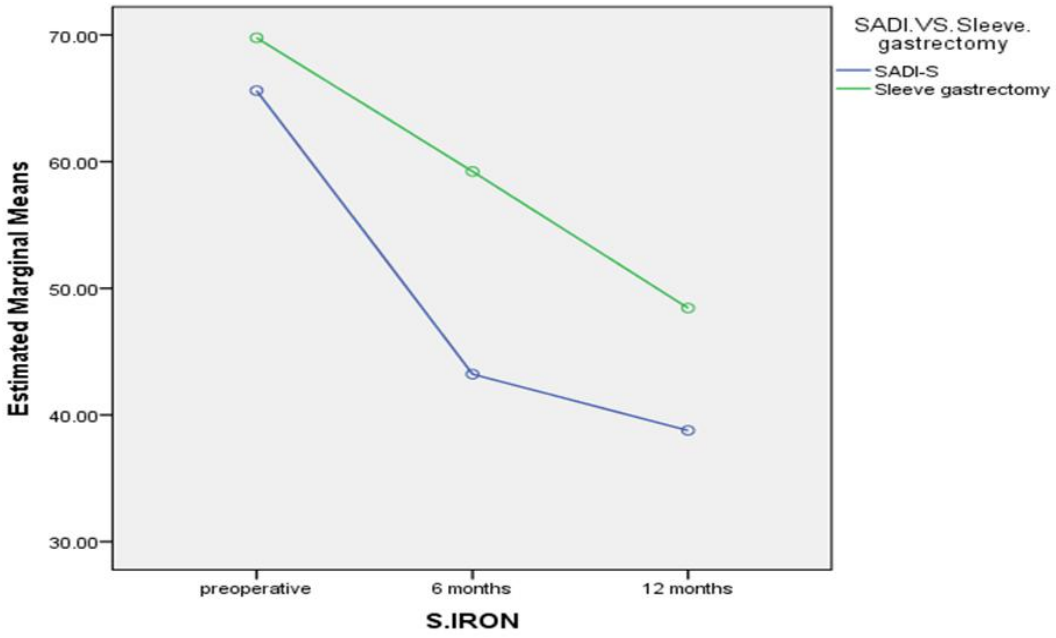

Fig. 2. S. Iron across 3 time points between both groups

3.2 Serum Iron

There was drop of S. iron level from baseline preoperative levels and different Serum iron measures at 6,12 months in the SADI group and significant decrease of S. iron between preoperative levels and 6 and 12 months follow up level at the sleeve gastrectomy group. Table 1 showed significant difference between the two groups in S. IRON level, both after 6,12 months (P≤0.001).

4. DISCUSSION

Surgery for the body mass index >50 kg/m^2 carries higher morbidity [8]. The main objective of bariatric surgery is maximizing weight loss, while maintaining or achieving nutritional equilibrium, and preventing micronutrient and protein loss [9] Biliopancreatic bypass fashioned by Scopinaro in 1979 [10]. The classic design is a laparoscopic or robotic technique combining sleeve gastrectomy with creating a 100 cm common channel with a 200 cm alimentary limb in two anastomosis, Roux-en-Y configuration [11]. This operation has a steep learning curve and some reports at least 50 procedures before proficiency is obtained [12].

Single anastomosis duodenoileal bypass with sleeve gastrectomy (SADI-S) was noticed into bariatric surgery by Sanchez-Pernaute et al. [13] as a modification of the biliopancreatic diversion with duodenal switch. Since then, the group has modified and improved their technique for optimal results [14].

Patients undergoing WLS have nutritional deficiencies before surgery [15] that can be exacerbated by the procedures. Even patients undergoing purely restrictive procedures are at risk for nutritional deficiencies due to poor eating habits as well as food intolerances and eating restrictions [16].

We agree that all malabsorptive procedures as duodenal switch usually require strict medical care especially postoperatively as most of the Intestinal tract is bypassed. This heightened risk underscores the importance of lifelong follow-up of WLS patients, and the need for clinicians to have a high index of suspicion for nutritional-related abnormalities. Patients may suffer malnutrition due to incompliance and/or operation complications [17].

Although multivitamins typically contain the U.S. Recommended Daily Allowance for most vitamins and minerals such as iron and calcium, the available data show that multivitamins alone do not consistently protect patients from metabolic deficiencies after either RYGB or BPD. The one exception is folate, which can be maintained at normal levels in patients who

regularly take multivitamins after RYGB [18]. In our study the mean operative time was 189.9± 31.4 min in SADI- S group and 97.5± 35.2 min in LSG group with p-value of ≤0.005. There is a statistical difference as SADI-S took more time. This may be explained by: The duodenal dissection took some more time to avoid injury of the duodenum, the gastroduodenal artery or even the common bile duct. The duodeno-ileal anastomosis took more time as, the duodenoileostomy was fashioned as end to side anastomosis to avoid stapling the pyloric ring in case of side to side anastomosis. Similarly Lin et al. [18] reported a mean operation time (min) 95.8 ± 27.8 in LSG. Unlike Topart et al. [19] who reported a mean operative time in SADI-S 100.8 minutes (range 69.9-181.7)., while Gebelli et al. 2016 reported a mean Surgical time 115 min (80-180) in SADI-S [20].

In our study the mean hospital stay was 2.9 days ± 1 in SADI-S group and 1.8 days ± 0.42 in LSG group with statistical significance between both groups (P-value ≤0.001).On the other hand studies reported a longer hospital stay. Moon et al. [21] reported a mean hospital stay of 4.1 ± 2.7 days in SADI-S [22]. Also Nelson et al. [22] reported a mean length of hospital stay of 4.3± 2.6 days (range, 3-24). Six patients had a prolonged hospital stay (longer than five days) due to decreased oral intake (n=3), a telectasis (n=1), postoperative bleeding (n=1), and duodeno- ileal obstruction with perforation of the small bowel (n=1) [23]. While in LSG, Lin et al. [18] reported length of postoperative hospital stay (days) 3.9 ± 1.4 [19]. Our study shows shorter hospital stay which could be because of patients' smooth recovery as we had no intra-operative or early post-operative complications.

At 12 months after surgery, mean Hb level in SADI-S group was 10.14 g/dl ± 0.69 and in the LSG group was 10.8 g/dl ± 0.87 which was significant difference between both groups.

Fifty-three percent (n=9) of LSG patients has normal Hb levels at 12 months after the operation and the rest has anemia.

Forty-one percent (n= 7) of OADS/SADI-S has normal Hb levels, the remainder has anemia and they were counseled about the importance of healthy food and daily iron supplements as it was ferropenic anemia because of the drop in Serum iron (S. iron) level from preoperative mean 65.6 µg/dl /dl to 43.22, 38.7 µg/dl/dl at 6,12 months postoperative in the SADI group respectively. And significant decrease of S. iron from preoperative mean 69.87 µg/dl/dl to 59.2, 48.4 µg/dl /dl at 6,12 months follow up postoperative in the LSG group.

However; in OADS/SADI-S group, three patients needed readmissions for correction of ferropenic anemia by blood transfusion after failure of correction by iron administration.

One of them is a female patient, 45-year old, and was admitted three times for correction of anemia. EGD and colonoscopy showed no ulcers or any underlying pathology.

Another one of them, who has had abortion six months after surgery and got pregnant after that, was readmitted twice for correction of acute anemia by blood transfusion and for nutritional support.

In contrary, Nelson et al. [22] reported that 25% (n=6) of the 24 patients who achieved longer than one year follow-up had low hemoglobin levels. These patients were instructed to take or increase their iron intake without the need for blood transfusion. Also Sanchez-Pernaute et al. [23] reported that ten percent of the patients had abnormally low values of hemoglobin or hematocrit and 22% of the patients had abnormally low values of iron. Patients with ferropenic anemia were mainly fertile young women. The mean hemoglobin value was 13.6 g/dl (range: 10.8–17); iron, 73.4 µg/dl (range: 22–148) at 12 months after surgery [24].

On the other hand, Lin et al. [18] reported that 4.8% of patients who underwent LSG suffered from anemia.

Obviously we have a much higher rate of ferropenic anemia among our patients in both groups especially in SADI-S which can be attributed to:

The low compliance to maintain the nutritional and healthy food instructions and low socioeconomic state to keep with regular supplements needed.

5. CONCLUSION

There was drop of Hb level and iron level from baseline in both groups more in SADI patients. This drop was significant with haemoglobin and highly significant with iron. In addition longer OR time and longer hospital stay.

CONSENT

It is not applicable.

ETHICAL APPROVAL

We got approval from our faculty ethical committee prior to start the study with a written consent from every patient.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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