Comparative Study between Single Anastomosis Sleeve Jejunal Bypass, Sleeve Gastrectomy and One Anastomosis Gastric Bypass: A Prospective Randomized trial

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Abstract

Background: A variety of bariatric procedures are being practiced nowadays. Laparoscopic sleeve gastrectomy (LSG) and one anastomosis gastric bypass (OAGB) are two commonly practiced bariatric procedures. Recently, single anastomosis sleeve jejunal bypass (SASJ) has emerged as a novel effective procedure with a decreased risk of malnutrition due to the presence of two pathways for food. Herein, we compared outcomes of these three procedures regarding short-term weight loss, complications, comorbidity resolution and quality of life.

Patients and methods: We included a total of 60 cases in this prospective randomized study, and they were divided into three equal groups; SASJ, LSG and OAGB groups. The three procedures were performed by the same surgical team adapting standardized techniques. Weight loss parameters were our primary objectives, while secondary outcomes included post-operative complications, nutritional status, improvement/resolution of comorbidities and quality of life.

Results: Operative time was significantly prolonged in the SASJ group, compared to the other two groups. Nevertheless, the incidence of post-operative complications did not significantly differ between the three groups, apart from GERD, that was more encountered in LSG group (20% of cases). Percentage of total weight loss (%TWL) were comparable among the 3 procedures; (SASJ 39.4 and 56.85%), (LSG 46.05 and 65.6%) and (OAGB 43 and 61.4%) at 6 and 12 months respectively. Comorbidity improvement, quality of life and nutritional status didn't differ among the three study groups.

Conclusion: SASJ bypass is an effective bariatric procedure regarding weight loss and comorbidity resolution, with a safe perioperative outcome comparable to OAGB and LSG.

Introduction

Obesity has become a global health problem [1]. Obesity is associated with multiple comorbidities including type 2 diabetes mellitus, hypertension, obstructive sleep apnea (OSAS), and degenerative joint disease [2]. Moreover, obesity has been identified as a risk factor for cardiac death [3].

Currently, bariatric surgery is considered to be the most effective treatment of morbid obesity that can achieve effective and sustained weight loss, together with improvement of obesity related comorbidities and quality of life [4, 5]. Laparoscopic sleeve gastrectomy (LSG) and one anastomosis gastric bypass (OAGB) are two commonly practiced bariatric procedures around the world [6, 7, 8].

Although LSG appears simpler in comparison to other bariatric techniques due to its shorter learning curve [9], it has two main drawbacks; it increases the risk of post-operative reflux [10], along with higher incidence of weight regain compared to other malabsorptive procedures [11]. Likewise, OAGB, which is a variant of Roux-en-Y gastric bypass (RYGB), has become a popular bariatric procedure. Nevertheless, it has some limitations like bile reflux, malabsorption and marginal ulceration. Additionally, endoscopic

access after surgery to the excluded stomach and duodenum may be technically challenging in case of remnant gastric, duodenal or distal biliary pathology [12, 13].

To avoid limitations of the previous two procedures, an ideal bariatric procedure has to combine the restrictive and malabsorptive effects. In addition, it should preserve the normal gastric and duodenal food pathway to decrease the risk of malabsorptive complications [14, 15].

Single anastomosis sleeve jejunal bypass (SASJ) has emerged as a recent procedure that involves the performance of LSG with a loop gastrojejunostomy created between the sleeve and jejunum two meters distal to the ligament of Treitz [16]. This procedure is a modification of the sleeve gastrectomy and transit bipartition procedure, but with more advantages. It includes less anastomoses and thus, less risk of leakage. Moreover, the mesentery is not divided, which decreases the risk of post-operative internal herniation [17]. Some consider it a modified single anastomosis sleeve ileal bypass (SASI), with a shorter biliopancreatic limb [16].

This study was conducted aiming to assess the efficacy of SASJ bypass as a novel bariatric procedure in terms of weight loss, complications and effect on comorbidities compared to the outcomes of two of the most popular bariatric procedures; LSG and OAGB within one year after operation.

Patients And Methods

This prospective randomized study was conducted at University hospital over the period of two years, starting from December 2018 till December 2020. The study was approved by the local ethical committee and Institutional Review Board (IRB) of the university.

Sample size was calculated using Theoretical optimal values of pilot trial reported by Whitehead, A. L. [18] with the weight changes after intervention as the primary outcome. A sample size of 18 patients is needed to achieve 80% power (1-β or the probability of rejecting the null hypothesis when it is false) in the proposed study and detect an effect size of 0.4 (medium effect size) with a significance level (α or the probability of rejecting the null hypothesis when it is true) of 5%. 10% drop-out patients are expected, so a number of 20 patients were planned to be enrolled in each of the three study groups.

Total number of 60 patients, aged between 16 and 60 years, with BMI > 40 kg/m^2, or BMI > 35 kg/m^2 with the presence of obesity related comorbidity (diabetes mellitus, hypertension, OSAS, osteoarthritis) were enrolled in this study. Exclusion criteria included previous upper abdominal procedures, reflux symptoms and major unstable psychiatric illness.

An informed written consent was signed by all patients, after complete explanation of the idea of the study, along with the benefits and drawbacks of each procedure. Detailed history taking, physical examination, routine preoperative laboratory investigations, abdominal ultrasonography and upper GI endoscopy were performed for all cases. Furthermore, preoperative quality of life was assessed by Quality of Life for Obesity Surgery (QOLOS) Questionnaire [19]. It consists of two sections, the first entails

36 items, while the second entails 20 items. Every item is graded using a 1 to 5 Likert scale. Higher scores indicate better quality of life.

The 60 cases were randomly allocated into three equal groups (20 cases each); SASJ, LSG and OAGB groups. Randomization was done in the operating room at the time of induction of anesthesia using sealed envelope technique. All cases were performed by laparoscopy under general anesthesia. The three procedures were performed by 5 ports, one for the camera, two working and two assistant ports.

For the LSG group (20 cases), we started the procedure by devascularization of the greater gastric curve 4 cm proximal to pylorus. Devascularization was done via either a harmonic scalpel or a ligasure device. Dissection was continued proximally till reaching the left diaphragmatic crus. Afterwards that the stomach was resected along the greater curvature via an endostapler over a 36-Fr bougie.

For the SASJ group (20 cases), sleeve was created in the same way like LSG but starting devascularization of greater gastric curve 6 cm proximal to pylorus. After creating the sleeve, two meters of the small bowel were counted starting from the ligament of Treitz, and an antecolic isoperistaltic gastrojejunostomy (4-cm wide) was created with the antrum via linear stapler, and the anterior wall defect was closed by sutures.

In the OAGB group (20 cases), dissection started just distal to the crows' foot till reaching the lesser sac. A long narrow gastric pouch was created by the endostapler. After that, a longitudinal gastrojejunostomy (4-cm wide) was created at 200 cm distal to the Treitz ligament as the SASJ group.

For all procedures, intraoperative methylene blue test was done and an abdominal drain was inserted at the gastric staple line. After operation, all cases were transferred to the internal ward, and started oral intake 6 hours after surgery. Most cases were discharged on the 1st or 2nd POD. Frequent fluid intake and mobilization were encouraged. Patients were recommended to receive a liquid diet for the first week, followed by soft diet for the following three weeks. Thereafter, a long-term solid diet (hypo-caloric, protein-enriched) was recommended. Daily oral supplements of multivitamins and weekly administration of the intramuscular vitamin B12 were commenced for all cases.

Regular follow up was scheduled for all cases for one year after surgery; weekly in the first month, then monthly in the first postoperative year. During these visits, patients were clinically and biochemically assessed. Any post-operative complications were noted and recorded. Weight changes were recorded as the percentage of excess weight loss (%EWL) and percentage of total weight loss (%TWL).

Our primary outcomes were the %EWL and %TWL, while secondary outcomes included post-operative complications, improvement/resolution of comorbidities and quality of life. Diabetes resolution was defined according to Buse et al. as the presence of normal glucose and Hba1c levels in the absence of antidiabetic medications [20], whereas resolution of OSAS was defined by STOPBANG questionnaire with score less than 2 after operation [21]. Hypertension improvement was defined as blood pressure < 140/90 with reduction of medication dose, without its cessation [22]. De novo GERD was defined as the post-

operative development of reflux symptoms in patients not suffering from it [23], and reflux was confirmed by endoscopy in these cases. Post-operative quality of life was assessed by the same QOLOS questionnaire used preoperatively.

Statistical analysis

Data analysis was performed by Statistical Package for the Social Sciences (SPSS 24.0, IBM/SPSS Inc., Chicago, IL) software. Categorical data were expressed as frequencies and percentages (%) while in the quantitative data, we used mean and standard deviations (SD). To compare three groups with categorical variables, Chi-Square test (or Fisher's exact test) were used. To compare three groups with normally distributed quantitative variables, one way analysis of the variance test (one-way ANOVA) was used and Kruskal Wallis test was used if the data were abnormally distributed. P values < 0.05 are considered significant. Sensitivity, specificity, positive and negative predictive values and diagnostic accuracy were estimated to reflect the diagnostic ability of a test.

Results

Preoperative demographic data didn't show significant difference among the 3 treatment groups. The mean age of the included cases was 41.75, 39.25 and 43.1 years in the SASJ, LSG, and OAGB groups respectively. Females represented 85, 70, and 55% of the included cases in the three groups respectively. BMI had mean values of 51.11, 56.22, and 53.68 kg/m2 in the same groups respectively.

Diabetes mellitus was present in 55, 50, and 45% of cases, while hypertension was present in 40, 55, and 40% of cases in the study groups respectively. In addition, OSA was reported by 20, 30, and 30% of cases in the same groups respectively. As regard pre-operative quality of life, QOLOS questionnaire had mean values of 69.25, 70.25, 70.70 in the study groups respectively. These data are summarized at table (1).

Operative time showed significant difference between the three study groups ($p < 0.001$). It was significantly prolonged in the SASJ group, compared to the other two groups. However, intraoperative blood loss didn't vary among the 3 study groups, as shown in table (2).

Apparently, there was no significant difference between the three groups regarding complication rates, apart from post-operative GERD, that was more encountered with LSG procedure. Four cases were diagnosed with GERD based on endoscopic findings, all of which underwent LSG. Postoperative upper endoscopy revealed Grade A reflux esophagitis in three of them and no esophagitis in the fourth patient. The incidences of other complications are listed at table (3).

At one-year follow up, no significant difference was noted between the three groups regarding laboratory parameters and nutritional status. It is worthy to be mentioned that two cases developed iron deficiency anemia during the follow up period; one case in the OAGB group (5%), and the other one was in the SASJ group (5%). Both cases managed with iron therapy.

Furthermore, post-operative dumping symptoms were reported in only one case in the SASJ group (5%). Vitamin D deficiency was detected in two cases (10%) in the SASJ and OAGB groups versus no cases in the LSG group. Hypocalcemia was diagnosed in 15, 0, and 10% of cases in SASJ, OAGB and LSG respectively. However, none of these nutritional parameters showed statistical significance among the three study groups

Regarding one-year weight loss, no significant difference was observed among 3 study groups in terms of %TWL or %TWL Table (4). Likewise, post-operative QOLOS questionnaire assessment revealed no significant differences between the three groups regarding either sections of this questionnaire.

The resolution of diabetes and OSAS showed no significant difference between the three groups. Table (5) illustrates these results.

Discussion

To the best of our knowledge, there is a paucity of studies in literature comparing these three bariatric techniques, and that represents a strength point of our study.

In our study, operative time showed significant difference between the three study groups ($p < 0.001$). It was significantly prolonged in the SASJ group (106.75 minutes), compared to the other two groups (81.0 and 104.0 minutes in LSG and OAGB groups respectively).

This prolonged operative time of SASJ could be attributed to its relative novelty and complexity as it comprises creation of a gastric sleeve, counting 2 meters of the jejunum and performing a GJ anastomosis afterwards. However, our results are within the normal limits reported in the literature. Khalaf and Hamed reported that the mean operative time of the SASI procedure was 98.8 minutes [24]. Romero et al. reported that operative time had a mean value of 116.3 minutes (range, 60–270 minutes) [25]. Another study reported much prolonged operative time for the SASJ procedure, which had a mean value of 192.8 minutes [26].

Regarding postoperative complications, we didn't find any significant difference among the 3 study groups. Our study reported the safety of the SASJ procedure regarding the early post-operative course, as no cases with leakage, peritonitis or bleeding were encountered. In another study, bleeding was encountered in 3.7% of cases while staple line leakage occurred in 0.3% of cases [24].

Our findings showed that SASJ succeeded to achieve 6 and 12-month EWL of 53.47 and 77.61% respectively, and that was not significantly different from either OAGB or LSG ($p > 0.05$). In the same SASJ group, %TWL had mean values of 39.4 and 56.85% at the same time points respectively. Regarding % EWL in other studies, Sewefy and Saleh reported that the included cases achieved 85% EWL at one-year follow up [16]. Additionally, Alamo et al. presented significant weight loss amounts in their assessment as 31.9%, 56.9%, and 76.1% of weight loss, were achieved during 3, 6, and 12 months after the surgery, respectively [27].

Sayadishahraki and his colleagues also confirmed our findings, as they reported no significant difference between different bariatric procedures regarding 3- and 6- month %EWL. Of note, these authors added an additional group the included patients undergoing RYGB. At 3-month follow up visit, patients had mean %EWL of 33.01, 41.24, 33.50, and 33.92% in the RYGB, SASJ, OAGB, and LSG groups respectively. Six-month visit readings were as follows; 50.54, 54.54, 52.48, and 50.70% in the same four groups respectively [28]. Not only do these authors confirmed the comparable effects of these different procedures on short term weight loss, but they also reported weight loss results near to ours.

Furthermore, Khalaf and Hamed reported that % EWL had mean values of 58.7 and 86.9%, while %TWL had mean values of 29.5 and 44.2% at 6-and 12-month follow up visits respectively [24].

Regarding resolution of diabetes in our study, only two out of the eleven cases diagnosed with DM in the SASJ group showed no resolution at one-month follow up. All of these eleven cases showed complete resolution at 3-month follow up, and remained with the same condition during the study period. Remission of T2DM after the SASJ procedure could be explained by both decreased calorie intake along with rapid delivery of the food elements to the distal bowel leading to early satiety and release of antihyperglycemic hormones [29].

This rapid improvement of diabetes was also confirmed by the study of Sayadishahraki and his coworkers who reported that all of the patients showed improved diabetes mellitus during the 6-month study and ceased medication, and also insulin therapy. These authors tested the same three procedures of ours along with RYGB [28].

Moreover, Mahdy et al. conducted their research on 61 patients, who have undergone SASI (single-anastomosis sleeve ileal) procedure, which has the same principle as SASJ, in order to assess its results on diabetic mellitus type 2 patients. Study follow up period was one year. Eventually, they presented marvelous short-term outcomes as all patients had complete resolution of diabetes in the first month postoperatively except five patients who had resolution after 3 months and required the gradual withdrawal of insulin and hypoglycemic drugs [29]. In the same context, other authors reported that normalization of blood glucose occurred within two months after surgery in all diabetic patients [16], and this confirms the efficacy of this procedure in such cases.

Arslan et al. reported also a dramatic decrease in glycosylated hemoglobin levels from 9.58 down to 6.56% three months following surgery [26]. All these previously mentioned studies confirmed our findings regarding the effectiveness of SASJ procedure in improving diabetes on the short-term outcome.

In the current study, all cases diagnosed with OSAS before operation showed complete resolution within 6 months after operation. Khalaf and Hamed reported that patients with OSAS showed improvement in 33.3%, while the remaining cases showed complete resolution [24].

In contrary to LSG, no single patient had de novo GERD after SASJ procedure. This observation may be explained by the impact of adding an anastomosis between the distal gastric sleeve and the ileum which

may reduce the intragastric pressure, thus decreasing the risk of GERD. However, 20% of our cases developed GERD in the LSG group. There is an ongoing debate whether sleeve gastrectomy may worsen GERD if present pre-operatively, develops de novo GERD or improves it [30]. In a large study from Italy with a 5-year follow-up, postoperatively erosive esophagitis was detected in 21% of patients, while Barrett's metaplasia was encountered in 17%. Interestingly, GERD symptoms were experienced only by 33% of patients with grade C esophagitis, and by 57% of patients with grade D esophagitis [31]. Others have shown different results. For example, in a prospective study, Rebecchi et al. showed that the SG improved reflux symptoms in most of patients with morbid obesity with pre-operative GERD, while de novo reflux was uncommon [32].

Apart from this ongoing debate, reported low incidence of postoperative GERD after SASJ represents a major merit of this new procedure over LSG.

We reported no significant difference between the three groups regarding post-operative laboratory parameters; neither after 6 months nor after 12 months.

Conversely, other authors reported significant difference between different bariatric surgeries regarding post-operative serum albumin ($p < 0.001$). The included cases had mean albumin levels of 4.14, 4.1, 4.52, and 4.86 gm/dl in the RYGB, SASJ, OAGB, and LSG groups respectively [28]. Although statistical analysis showed a significant difference regarding that parameter, all values were within the normal limits, and we think these differences are clinically irrelevant.

When it comes to the manifestations of malnutrition associated with bariatric procedures, it is really important to analyze if there is an obvious difference in the nutritional status among all study groups. Our results didn't show significant difference between 3 bariatric procedures in terms of Iron deficiency anemia, hair loss, neuropathy, vitamin D deficiency and hypocalcemia. This indicates that all of the three procedure have comparable nutritional complication profile.

Nevertheless, apparently, SASJ is not an innocent procedure, and the presence of two pathways does not necessarily mean to wean cases from multivitamin and mineral supplementation. This was also confirmed by Sayadishahraki et al. who reported that vitamin D deficiency was detected in 76% of SASJ cases, while zinc deficiency was detected in 12% of cases. Additionally, vitamin B12 was present in 20% of cases, whereas ferritin deficiency was diagnosed in 24% of cases [28]. Romero et al. reported that one out of 83 cases had dropped in hemoglobin at 11 months post-surgery due to iron deficiency and hypermenorrhea and therefore required blood transfusion. Another patient had hypoalbuminemia [25]. Kermansaravi et al. revised SASI bypass to SG in 2/24 patients (8.3%) due to excessive weight loss and hypoalbuminemia [33].

The presence of a double-outlet for the gastric content can be a blessing or a curse for the SASJ procedure. Double-outlet provides a credit over malabsorptive procedures by preserving easy endoscopic access to the duodenum and biliary system. Contrarily, one cannot precisely estimate the ratio of fluid passing through either pathways. The distribution of fluid passing through multiple outlets is ruled by

many factors, including intraluminal pressure, velocity of the contents, its density, outlet spacing, diameter ratio, and frictional forces [24].

In contrast to our findings, other authors reported that after six months of surgery, 95.3% of all patients had stopped taking oral supplements and multivitamins with no significant postoperative nutritional complications at one year follow up [17]. Additionally, others reported vitamin and mineral deficiency, and anemia were not observed after SASJ during the short follow up period (3 months) [26].

Post-operative health related quality of life showed no significant difference between the three study groups ($p > 0.05$). The success of a bariatric intervention does not only relate to weight loss, but is also determined by its effect on quality of life, behaviors of eating disorders, food tolerance, and resolution of co-morbidities. It is expected that after bariatric surgery quality of life improves due to weight loss, better function, and resolution of co-morbidities, however, the occurrence of side effects may hinder that. Such side effects include recurrent vomiting, regurgitation, or poor postoperative nutrient absorption [34, 35]. As we reported comparable outcomes between the three procedures, it would be expected to have comparable quality of life reported by our patients.

Our study has some limitations; firstly, it is a single center study that included a relatively small sample size. However, given the fact that SASJ bypass procedure is a relatively new technique with very few published data supporting its beneficial outcomes, it was really difficult to convince our patients to participate in our randomized controlled trial. Given their popularity and well established outcomes, most of our patients requested to have either LSG or OAGB and not SASJ bypass which is not familiar to them. Thus, Randomization and preoperative patient consent (both approved and revised by IRB) couldn't help us to increase sample size and include more patients within our study. Secondly, relative short term follow up period (one year) which may not be long enough to evoke significant difference between study groups in terms of weight loss, improvement of comorbidities and development of long-term complications especially nutritional ones. We assumed that follow up for the first postoperative year represents preliminary results that may give an idea about early outcomes of a relatively new procedure like SASJ bypass in comparison to LSG and OAGB. Results of our pilot study may represent a starting point that encourages us and maybe other authors to further research with larger sample size and a longer follow up.

Conclusion

SASJ bypass is an effective bariatric procedure regarding weight loss and comorbidity resolution, with a comparable safe perioperative outcome as OAGB and LSG. However, nutritional supplementation is recommended after it to avoid the risk of nutritional deficiency, as the presence of two pathways is not protective for that complication.

Declarations

All authors have no conflicts of interest or financial ties to disclose.

Ethical Approval

The study was approved by the local ethical committee and Institutional Review Board (IRB) of the university. An informed written consent was obtained from all participating patients.

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References

1. Endalifer ML, Diress G. Epidemiology, Predisposing Factors, Biomarkers, and Prevention Mechanism of Obesity: A Systematic Review. J Obes. 2020;2020:6134362.https://doi.org/10.1155/2020/6134362.
2. Upadhyay J, Farr O, Perakakis N, Ghaly W, Mantzoros C. Obesity as a Disease. Med Clin North Am. 2018;102(1):13-33.https://doi.org/10.1016/j.mcna.2017.08.004.
3. Koliaki C, Liatis S, Kokkinos A. Obesity and cardiovascular disease: revisiting an old relationship. Metabolism. 2019;92:98-107.https://doi.org/10.1016/j.metabol.2018.10.011.
4. Panteliou E, Miras AD. What is the role of bariatric surgery in the management of obesity? Climacteric. 2017;20(2):97-102.https://doi.org/10.1080/13697137.2017.1262638.
5. Ruban A, Stoenchev K, Ashrafian H, Teare J. Current treatments for obesity. Clin Med (Lond). 2019;19(3):205-12.https://doi.org/10.7861/clinmedicine.19-3-205.
6. Wang FG, Yu ZP, Yan WM, Yan M, Song MM. Comparison of safety and effectiveness between laparoscopic mini-gastric bypass and laparoscopic sleeve gastrectomy: A meta-analysis and systematic review. Medicine (Baltimore). 2017;96(50):e8924.https://doi.org/10.1097/md.0000000000008924.
7. Kansou G, Lechaux D, Delarue J, Badic B, Le Gall M, Guillerm S, et al. Laparoscopic sleeve gastrectomy versus laparoscopic mini gastric bypass: One year outcomes. Int J Surg. 2016;33 Pt A:18-22.https://doi.org/10.1016/j.ijsu.2016.07.051.
8. Abdel-Rahim MM, Magdy MM, Mohamad AA. Comparative study between effect of sleeve gastrectomy and mini-gastric bypass on type 2 diabetes mellitus. Diabetes Metab Syndr. 2018;12(6):949-54.https://doi.org/10.1016/j.dsx.2018.06.001.
9. Chung AY, Thompson R, Overby DW, Duke MC, Farrell TM. Sleeve Gastrectomy: Surgical Tips. J Laparoendosc Adv Surg Tech A. 2018;28(8):930-7.https://doi.org/10.1089/lap.2018.0392.
10. Popescu AL, Ioniţa-Radu F, Jinga M, Gavrilă AI, Săvulescu FA, Fierbinţeanu-Braticevici C. Laparoscopic sleeve gastrectomy and gastroesophageal reflux. Rom J Intern Med. 2018;56(4):227-32.https://doi.org/10.2478/rjim-2018-0019.

11. Capoccia D, Guida A, Coccia F, Guarisco G, Testa M, Leonetti F, et al. Weight Regain and Diabetes Evolution After Sleeve Gastrectomy: a Cohort Study with over 5 Years of Follow-Up. Obes Surg. 2020;30(3):1046-51.https://doi.org/10.1007/s11695-019-04350-0.
12. Mahawar KK, Parmar C, Graham Y. One anastomosis gastric bypass: key technical features, and prevention and management of procedure-specific complications. Minerva Chir. 2019;74(2):126-36.https://doi.org/10.23736/s0026-4733.18.07844-6.
13. Scavone G, Caltabiano DC, Gulino F, Raciti MV, Giarrizzo A, Biondi A, et al. Laparoscopic mini/one anastomosis gastric bypass: anatomic features, imaging, efficacy and postoperative complications. Updates Surg. 2020;72(2):493-502.https://doi.org/10.1007/s13304-020-00743-4.
14. Angrisani L, Santonicola A, Iovino P, Vitiello A, Higa K, Himpens J, et al. IFSO Worldwide Survey 2016: Primary, Endoluminal, and Revisional Procedures. Obes Surg. 2018;28(12):3783-94.https://doi.org/10.1007/s11695-018-3450-2.
15. Chao GF, Varban OA, Ghaferi AA. Using Quality-of-Life Measures to Determine the Ideal Bariatric Procedure. JAMA Surg. 2021;156(2):146-7.https://doi.org/10.1001/jamasurg.2020.5667.
16. Sewefy AM, Saleh A. The outcomes of single anastomosis sleeve jejunal bypass as a treatment for morbid obesity (Two-year follow-up). Surg Endosc. 2020.https://doi.org/10.1007/s00464-020-08029-x.
17. Salama TMS, Sabry K, Ghamrini YE. Single Anastomosis Sleeve Ileal Bypass: New Step in the Evolution of Bariatric Surgeries. J Invest Surg. 2017;30(5):291-6.https://doi.org/10.1080/08941939.2016.1241841.
18. Whitehead AL, Julious SA, Cooper CL, Campbell MJ. Estimating the sample size for a pilot randomised trial to minimise the overall trial sample size for the external pilot and main trial for a continuous outcome variable. Stat Methods Med Res. 2016;25(3):1057-73.https://doi.org/10.1177/0962280215588241.
19. Müller A, Crosby RD, Selle J, Osterhus A, Köhler H, Mall JW, et al. Development and Evaluation of the Quality of Life for Obesity Surgery (QOLOS) Questionnaire. Obes Surg. 2018;28(2):451-63.https://doi.org/10.1007/s11695-017-2864-6.
20. Buse JB, Caprio S, Cefalu WT, Ceriello A, Del Prato S, Inzucchi SE, et al. How do we define cure of diabetes? Diabetes Care. 2009;32(11):2133-5.https://doi.org/10.2337/dc09-9036.
21. Seet E, Chua M, Liaw CM. High STOP-BANG questionnaire scores predict intraoperative and early postoperative adverse events. Singapore Med J. 2015;56(4):212-6.https://doi.org/10.11622/smedj.2015034.
22. Puzziferri N, Roshek TB, 3rd, Mayo HG, Gallagher R, Belle SH, Livingston EH. Long-term follow-up after bariatric surgery: a systematic review. Jama. 2014;312(9):934-42.https://doi.org/10.1001/jama.2014.10706.
23. Casella G, Soricelli E, Giannotti D, Collalti M, Maselli R, Genco A, et al. Long-term results after laparoscopic sleeve gastrectomy in a large monocentric series. Surg Obes Relat Dis. 2016;12(4):757-62.https://doi.org/10.1016/j.soard.2015.09.028.

24. Khalaf M, Hamed H. Single-Anastomosis Sleeve Ileal (SASI) Bypass: Hopes and Concerns after a Two-Year Follow-up. Obes Surg. 2021;31(2):667-74.https://doi.org/10.1007/s11695-020-04945-y.
25. Romero RJ, Colorado-Subizar R, De Uriarte-Lorente M, Barradas-Lagunes M, Bravo-De Ávila P, Romero-Espejo JJ. Single Anastomosis Sleeve Ileal Bypass (SASI Bypass): Short-Term Outcomes and Concerns. Obes Surg. 2021;31(5):2339-43.https://doi.org/10.1007/s11695-020-05145-4.
26. Arslan E, Sipahi M, Banli O. Early Results of Laparoscopic Sleeve Gastrectomy With Loop Bipartition. Surg Laparosc Endosc Percutan Tech. 2018;28(6):385-9.https://doi.org/10.1097/sle.0000000000000541.
27. Alamo M, Sepúlveda M, Gellona J, Herrera M, Astorga C, Manterola C. Sleeve gastrectomy with jejunal bypass for the treatment of type 2 diabetes mellitus in patients with body mass index <35 kg/m2. A cohort study. Obes Surg. 2012;22(7):1097-103.https://doi.org/10.1007/s11695-012-0652-x.
28. Sayadishahraki M, Rezaei MT, Mahmoudieh M, Keleydari B, Shahabi S, Allami M. Single-Anastomosis Sleeve Jejunal Bypass, a Novel Bariatric Surgery, Versus Other Familiar Methods: Results of a 6-Month Follow-up-a Comparative Study. Obes Surg. 2020;30(2):769-76.https://doi.org/10.1007/s11695-019-04266-9.
29. Mahdy T, Al Wahedi A, Schou C. Efficacy of single anastomosis sleeve ileal (SASI) bypass for type-2 diabetic morbid obese patients: Gastric bipartition, a novel metabolic surgery procedure: A retrospective cohort study. Int J Surg. 2016;34:28-34.https://doi.org/10.1016/j.ijsu.2016.08.018.
30. Mandeville Y, Van Looveren R, Vancoillie PJ, Verbeke X, Vandendriessche K, Vuylsteke P, et al. Moderating the Enthusiasm of Sleeve Gastrectomy: Up to Fifty Percent of Reflux Symptoms After Ten Years in a Consecutive Series of One Hundred Laparoscopic Sleeve Gastrectomies. Obes Surg. 2017;27(7):1797-803.https://doi.org/10.1007/s11695-017-2567-z.
31. Genco A, Soricelli E, Casella G, Maselli R, Castagneto-Gissey L, Di Lorenzo N, et al. Gastroesophageal reflux disease and Barrett's esophagus after laparoscopic sleeve gastrectomy: a possible, underestimated long-term complication. Surg Obes Relat Dis. 2017;13(4):568-74.https://doi.org/10.1016/j.soard.2016.11.029.
32. Rebecchi F, Allaix ME, Giaccone C, Ugliono E, Scozzari G, Morino M. Gastroesophageal reflux disease and laparoscopic sleeve gastrectomy: a physiopathologic evaluation. Ann Surg. 2014;260(5):909-14; discussion 14-5.https://doi.org/10.1097/sla.0000000000000967.
33. Kermansaravi M, Kabir A, Pazouki A. 1-Year Follow-up of Single Anastomosis Sleeve Ileal (SASI) Bypass in Morbid Obese Patients: Efficacy and Concerns. Obes Surg. 2020;30(11):4286-92.https://doi.org/10.1007/s11695-020-04781-0.
34. Freeman RA, Overs SE, Zarshenas N, Walton KL, Jorgensen JO. Food tolerance and diet quality following adjustable gastric banding, sleeve gastrectomy and Roux-en-Y gastric bypass. Obes Res Clin Pract. 2014;8(2):e115-200.https://doi.org/10.1016/j.orcp.2013.02.002.
35. Tack J, Deloose E. Complications of bariatric surgery: dumping syndrome, reflux and vitamin deficiencies. Best Pract Res Clin Gastroenterol. 2014;28(4):741-9.https://doi.org/10.1016/j.bpg.2014.07.010.

Tables

Table (1)

Preoperative data (demographics, comorbidities and quality of life) in the study groups.

		SASJ group (n= 20)	LSG group (n= 20)	OAGB group (n= 20)	P
Age (years)		41.75 ± 10.427	39.25 ± 11.050	43.10 ± 11.657	0.539
Gender	**Male**	15.0% (3)	30.0% (6)	45.0% (9)	0.117
	Female	85.0% (17)	70.0% (14)	55.0% (11)	
Height (m)		166.70 ± 12.495	167.75 ± 11.960	165.60 ± 8.611	0.831
Weight (kg)		143.80 ± 30.216	157.95 ± 33.366	148.30 ± 17.827	0.271
BMI (kg/m^2)		51.11 ± 5.764	56.22 ± 10.802	53.68 ± 5.482	0.123
Diabetes mellitus		55.0% (11)	50.0% (10)	45.0% (9)	0.819
Hypertension		40.0% (8)	55.0% (11)	40.0% (8)	0.545
OSAS		20.0% (4)	30.0% (6)	30.0% (6)	0.711
QOLOS		69.25 ± 6.843	70.25 ± 7.188	70.70 ± 6.062	0.784

***SASJ,*single anastomosis sleeve jejunal bypass; *LSG,* laparoscopic sleeve gastrectomy; *OAGB,* one anastomosis gastric bypass; *BMI,* body mass index; *OSAS,* obstructive sleep apnea syndrome; *QOLOS,* quality of life for obesity surgery questionnaire

Table (2)

Operative time and blood loss in the study groups.

	SASJ group (n= 20)	LSG group (n= 20)	OAGB group (n= 20)	P
Operative duration (minutes)	106.75 ± 22.842	81.00 ± 11.192	104.00 ± 9.679	**0.001**
Blood loss (ml)	122.50 ± 41.279	125.00 ± 34.412	125.00 ± 38.044	0.972

***SASJ,*single anastomosis sleeve jejunal bypass; *LSG,* laparoscopic sleeve gastrectomy; *OAGB,* one anastomosis gastric bypass

Table (3)

Post-operative complications in the study groups.

	SASJ group (n= 20)	LSG group (n= 20)	OAGB group (n= 20)	P
Overall complications	40.0% (8)	50.0% (10)	65.0% (13)	0.281
Leakage	0.0% (0)	0.0% (0)	0.0% (0)	1
Peritonitis	0.0% (0)	0.0% (0)	0.0% (0)	1
Pulmonary embolism	0.0% (0)	0.0% (0)	0.0% (0)	1
Bleeding	0.0% (0)	5.0% (1)	0.0% (0)	0.362
Infection	5.0% (1)	5.0% (1)	5.0% (1)	1
GERD	0.0% (0)	20.0% (4)	0.0% (0)	**0.014**
Hair loss	30.0% (6)	35.0% (7)	50.0% (10)	0.400
Neuropathy	5.0% (1)	5.0% (1)	5.0% (1)	1
Dumping	5.0% (1)	0.0% (0)	0.0% (0)	0.362
Vitamin D deficiency	10.0% (2)	0.0% (0)	10.0% (2)	0.343
Hypocalcemia	15.0% (3)	0.0% (0)	10.0% (2)	0.217

***SASJ,*single anastomosis sleeve jejunal bypass; *LSG,* laparoscopic sleeve gastrectomy; *OAGB,* one anastomosis gastric bypass; *GERD,* gastroesophageal reflux disease

Table (4)

Weight loss and quality of life outcomes in the study groups.

	SASJ group (n= 20)	LSG group (n= 20)	OAGB group (n= 20)	P
%TWL				
Three months	29.45 ± 9.411	34.45 ± 11.052	32.35 ± 7.916	0.259
Six months	39.40 ± 12.812	46.05 ± 15.480	43.00 ± 11.041	0.290
Twelve months	56.85 ± 17.043	65.65 ± 20.999	61.40 ± 14.670	0.301
%EWL				
Three months	39.99 ± 4.880	39.95 ± 5.770	40.62 ± 5.119	0.902
Six months	53.47 ± 6.413	53.12 ± 7.641	53.87 ± 7.080	0.946
Twelve months	77.61 ± 9.052	76.06 ± 10.102	77.14 ± 9.112	0.868
QOLOS 1				
Six months	98.00 ± 12.299	104.85 ± 9.691	102.90 ± 15.522	0.224
Twelve months	118.45 ± 18.343	129.50 ± 14.240	125.80 ± 24.226	0.194
QOLOS 2				
Six months	75.20 ± 11.138	79.85 ± 6.800	76.65 ± 8.798	0.262
Twelve months	78.95 ± 9.676	82.15 ± 6.659	80.35 ± 7.652	0.461

** *SASJ,*single anastomosis sleeve jejunal bypass; *LSG,* laparoscopic sleeve gastrectomy; *OAGB,* one anastomosis gastric bypass; *%TWL*, percentage of total weight loss; *%EWL,* percentage of excess weight loss.

Table (5)

Improvement/ resolution of obesity related comorbidities.

	SASJ group (n= 20)	LSG group (n= 20)	OAGB group (n= 20)	P
Diabetes				
One month	10.0% (2)	5.0% (1)	0.0% (0)	0.349
Three months	0.0% (0)	0.0% (0)	0.0% (0)	1
Hypertension				
Three months	30.0% (6)	55.0% (11)	35.0% (7)	0.233
Six months	30.0% (6)	40.0% (8)	25.0% (5)	0.583
Twelve months	25.0% (5)	30.0% (6)	20.0% (4)	0.766
OSAS				
One month	15.0% (3)	25.0% (5)	25.0% (5)	0.675
Three months	0.0% (0)	15.0% (3)	0.0% (0)	0.100
Six months	0.0% (0)	0.0% (0)	0.0% (0)	1

***SASJ,*single anastomosis sleeve jejunal bypass; *LSG,* laparoscopic sleeve gastrectomy; *OAGB,* one anastomosis gastric bypass ; *OSAS,* obstructive sleep apnea syndrome