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SADI-S vs OAGB as a revisional procedure after sleeve gastrectomy. Sistematic Review

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Abstract

Background. Due to the possibility of gastric sleeve failure, and the increased need for an effective revisional procedure, SADI-S and OAGB are analyzed as effective options with low morbidity. Goal. The review aims to analyze the available literature on SADI-S and OAGB as revisional procedures in gastric sleeve failure. Method. An exhaustive review of the literature carried out until May 2022 concerning studies in English and Spanish on SADI-S and OAGB, with the objectives of evaluating the efficacy of revisional procedures, morbidity, resolution of comorbidities, and mortality. Result. Eighteen studies were analyzed including 1,120 patients in whom the primary procedure was LSG, 751 patients underwent OAGB, and 369 underwent SADI-S as a revision procedure. The TWL% was 28.1% and 29.3% and the EWL% was 60.9% and 69.7% for OAGB and SADI-S, respectively. The morbidity rate was 11.6% for OAGB and 16.9% for SADI-S with a mortality of 0% and 0.67%, respectively.

Keywords:

- OAGB
- SADI-S
- Revisional surgery
- Failed sleeve gastrectomy

Introduction

Laparoscopic vertical gastrectomy (VG) is the most frequently performed bariatric procedure in the world. As more long-term data are collected, there has been evidence of treatment failure rates in terms of percentage of weight loss, weight regain, and the failure to resolve comorbidities. Different revisional procedures have been proposed to optimize the surgical management of these patients. Gastric bypass of an anastomosis (OAGB) and duodenum-ileal bypass of an anastomosis with vertical gastrectomy (SADI-S) have been proposed as effective and simplified procedures, in contrast to roux en-Y gastric bypass and biliopancreatic shunt. The objective of this systematic review is to collect information from individual studies and attain an overview of the surgical scenario, within the context of the revisional surgery of laparoscopic vertical gastrectomy considering these two procedures as safe, applicable and effective.

Partial or inadequate response from VG

Bariatric surgery has proven to be the method of choice for the management of obesity associated (or not) with diabetes mellitus and/or other comorbidities. Within the broad spectrum of surgical procedures available, laparoscopic vertical gastrectomy is one of the most popular procedures worldwide. Its development has been considerable since its original design in 1988 as the first step in performing a biliopancreatic shunt. The first International Consensus for Vertical Gastrectomy, developed in 2007, established the use of VG as a single procedure, and was subsequently recognized by the American Society for Metabolic and Bariatric Surgery (ASMBS). [1.2] Since 2011, VG has been the most frequently performed bariatric procedure worldwide, accounting for 53.6% of all registered surgeries, followed by Roux En Y Gastric Bypass (RYGB) with 30.1%. [3]

In the evolution of bariatric surgery, development has taken place in the knowledge of the techniques used to manage obesity, from its beginnings with the adjustable gastric band, to complex procedures such as the biliopancreatic shunt. This extensive distribution of techniques provides more complete data on the beneficial effects of these techniques, as well as their potential side effects and unexpected complications. Thus, the wide casuistry of VG has revealed

a higher rate of therapeutic failure than initially expected, leading to an increase in revisional procedures (RP) after VG failure. The most common causes for revision due to VG failure are insufficient weight loss, weight regain, poor control of associated comorbidities and post-surgical complications. However, a consensus on the quantitative criteria necessary to define VG failure has yet to be reached, meaning that the indications for revisional surgery are still variable. Therefore, it is difficult to perform follow up or to examine and compare series. [1]

One of the most frequent indications of a PR is insufficient weight loss and subsequent weight regain, affecting between 22% and 70% of post-VG patients. [4-9] Weight regain has a multifactorial etiology, including gastric dilation resulting in the exhaustion of the restrictive component of VG. Other causes are inadequate gastric tube calibration when performing gastrectomy and an inappropriate postoperative diet. Variation in percentages may be explained by the absence of objective criteria established to define insufficient weight loss and weight regain, using limits of body mass index (BMI), percentage change of BMI, percentage of total weight lost (TWL), Excess Weight Loss Percentage (EWL), Percent Weight Loss Regain, or Total Weight. [6.9-13.34]

Gastroesophageal reflux disease (GERD) is also a frequent indication of revisional surgery after VG. This includes both the persistence of an existing preoperative condition and the development of de novo GERD after VG In studies with 5 years of follow-up, GERD has been found in 32.4% to 76% of patients. [4.5,14.15] Diagnostic and follow-up methods vary, from making the diagnosis according to the presence or not of symptoms, the use of pH-metry, endoscopy, manometry, and biopsy, situating these methods in distinct classifications. The long-term risk of development of Barrett's esophagus, found in up to 18.8% in follow-ups at 5 years post VG is of special interest. [5] It is also necessary to add the revisional procedures performed due to a lack of resolution of aggregate pathologies, such as diabetes mellitus (DM), chronic arterial hypertension (HTA) and dyslipidemia (DL). Considering the above, studies with follow-ups of between 3 - 5 years have shown rates of conversion of VG for up to 36% at 10 years. [1.3,7,10,16-18]

Review Procedures

Revisional procedures are considered to entail higher risk than primary procedures since they involve performing surgery on an altered anatomy and most likely, involve greater technical difficulty. Revisional surgeries have been observed to require up to twice the operative time and hospital stay as well as more complications such as bleeding, desertions, and suture failure, reaching morbidity rates of up to 41% in RP as compared to 15% in primary procedures. [18-21] Therefore, it is necessary to weigh the benefits of a second intervention against its risks, while also maximizing efforts to reduce complications. There are 5 main revision procedure options for VG failure. The most technically simple procedure is the re-sleeve, in which a new vertical gastrectomy is performed on the previous VG. It is technically the least demanding yet is accompanied by less favorable outcomes and potentially serious complications such as fistula. Another option is the biliopancreatic shunt or duodenal switch (BPD), but this is a technically complex procedure accompanied by significant side effects and postoperative complications, making it less than 2% of all bariatric procedures performed worldwide. [3] Recently, procedures have been proposed to achieve a malabsorptive effect, reducing the technical complexity of BDP and RYGB, in order to reduce the associated morbidity and mortality. These procedures are the OAGB and SADI-S, using a minimally invasive approach, either laparoscopic or robotic. [1,18,22-24]

SADI-S

Biliopancreatic shunt is considered a technically complex procedure and it is accompanied by difficult postoperative management with significant short- and long-term complications. SADI-S was introduced in 2007 by Dr. Sanchez Pernaute as a less technically complex variant than BPD, reducing the number of anastomosis, but retaining the malabsorptive effect with its consequent weight loss and systemic metabolic effects. Weight loss rates comparable to BPD have been observed, with EWL losses of up to 100% and progressive weight losses over more than 2 years and a lower rate of acute and chronic postoperative complications. [24-26] The SADI-S is an option to be performed as a primary procedure, as a two-step programmed procedure and as a RP, mainly after VG failure. There have been no significant differences found in weight loss or development of complications between primary or revisional procedures and they have similar rates of resolution of associated comorbidities. [14.27]

OAGB

Currently the gold standard for VG failure management is the RYGB, which adds a malabsorptive component to the VG, thus increasing weight loss and resolving the wide range of possible post-VG complications. It is probably the best surgical option for symptomatic relief of GERD in most cases, if disregarding the restrictive action of pylorus and relieving the high-pressure system created after VG. [11.18, 26] OAGB has been proposed as a simplified analogue of RYGB by emulating the digestive effects of RYGB. Here, only one anastomosis is used to achieve the symptomatic relief of GERD. However, the theoretical risk of increased biliary reflux is assumed, and although superior gastrointestinal symptoms such as GERD are not found, there is an increased risk of Barret's esophagus. Like SADI-S, OAGB may also be used as a primary or revisional procedure, without finding statistically significant differences in weight loss and complications. [1.7,28]

Objective

The primary objective of this systematic review is to evaluate and compare the effectiveness of SADI-S and OAGB as revision procedures for VG failure. As secondary objectives, the resolution of comorbidities, postoperative complications, and mortality will be evaluated.

Method

Search methodology

This review was designed according to PRISMA guidelines. An electronic search was performed in the Pubmed, Scopus and Google academic databases with the last search taking place in March 2022. The search was performed using the following keywords: Vertical gastrectomy failure "O" revisional bariatric surgery of vertical gastrectomy "O" revisional bariatric surgery "O" SADIS-S "O" duodeno-jejunal bypass of an anastomosis "O" ileal duodeno bypass "O" biliopancreatic

Table-1 Characteristics of selected studies on SADI-S and OAGB

Authors	Country	Type of study	Year	n	Control (months)	SADI-S/ OAGB
Debs et al [1]	France	Retrospective observational	2020	77	12	OAGB
De la Cruz et al [5]	Germany	Retrospective observational	2020	84	36	SADI-S/ OAGB
Moszkowicz et al [6]	France	Retrospective observational	2013	21	42	OAGB
Chiapeta et al [7]	Germany	Multi-center retrospective OBS	2018	34	12	OAGB
Poghosyan et al [9]	France	Retrospective observational	2019	72	24 - 60	OAGB
Pizza et al [11]	Italy	Retrospective observational	2021	59	>24	OAGB
Jamal et al [12]	Kuwait	Prospective	2020	56	24	OAGB
Bruzzi et al [14]	France	Retrospective observational	2015	30	60	OAGB
AlSabah et al [15]	Kuwait	Retrospective observational	2018	31	12	OAGB
Sanchez et al [17]	Spain	Retrospective cohort	2020	51	60	SADI-S
Bashah et al [25]	Qatar	Retrospective observational	2020	91	>12	SADI-S/ OAGB
Dijkhorst et al [26]	Holland	Multi-center retrospective OBS	2018	66	24	SADI-S
Rayman et al [28]	Israel	Multi-center retrospective OBS	2021	144	29	OAGB
Balibrea et al [29]	Spain	Prospective	2016	30	24	SADI-S
Musella et al [33]	Italy	Multi-center retrospective OBS	2019	104	36	OAGB
Ceha et al [39]	Holland	Retrospective observational	2018	32	>12	SADI-S
Liagre et al [40]	France	Retrospective observational	2021	106	>24	SADI-S
Bhandari et al [41]	India	Retrospective observational	2019	32	36	OAGB

**OAGB: Gastric bypass of an anastomosis, SADI-S: Ileal duodenum bypass of an anastomosis with vertical gastrectomy*

bypass "O" duodenal bypass of a Duodeno-jejunal anastomosis Or "duodenal bypass of a duodenal anastomosis Or Duodeno duodenal bypass" Duodeno duodenal bypass of a duodenal anastomosis "O Duodeno duodeno Duodeno duodenal bypass of "O" SADI-S in vertical gastrectomy failure "O" Comparison OAGB and SADI-S "O" OAGB vrs SADI-S "O" OAGB "O" SIPS "O" OAGB in vertical gastrectomy failure "O" Gastric bypass with single anastomosis "O" Mini Gastric Bypass "O" Pile Preservation Surgery with Gastric Bypass "O" We identified 6505 articles related to the search. Duplicate documents were deleted, resulting in 3239 articles. By reviewing the title and the abstract, 127 articles relevant to the topic were identified. We included those that met the inclusion criteria of being original studies, performed on humans, in which SADI-S and/or OAGB were performed after VG, with follow-up periods equal to or greater than 12 months in which weight evolution, comorbidities, complications and mortality are reported. We eliminated articles that did not have a follow-up period of at least 12 months, primary procedures other than laparoscopic VG, duplicate patient groups, bibliographic reviews, case reports, comments and descriptions of surgical technique, obtaining 29 eligible articles. A score of 1 to 3 was assigned according to the number of citations, theoretical relevance for the current review, and quality of the study, choosing articles with a score of 6 or more, for a final total of 18 articles.

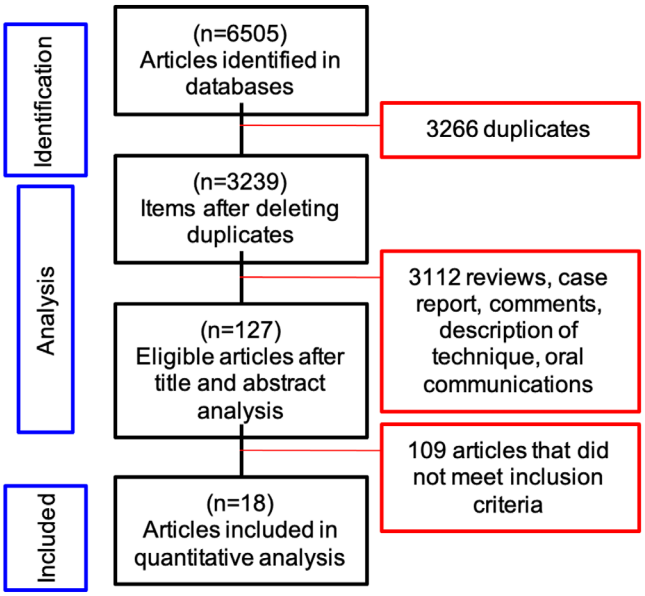


Fig 1

Data extraction

Information extracted from original articles includes basic study data such as year, design, country, and patient group studied, from which preoperative weight and weight data were extracted at 12 months following the procedure. Pre-operative weight was taken as pre-operative weight to RP. The study included number of patients, surgical technique data, weight loss, TWL, EWL, time elapsed from VG to revisional procedure, resolution of comorbidities, acute and chronic complications, and mortality.

Results

Characteristics of the studies

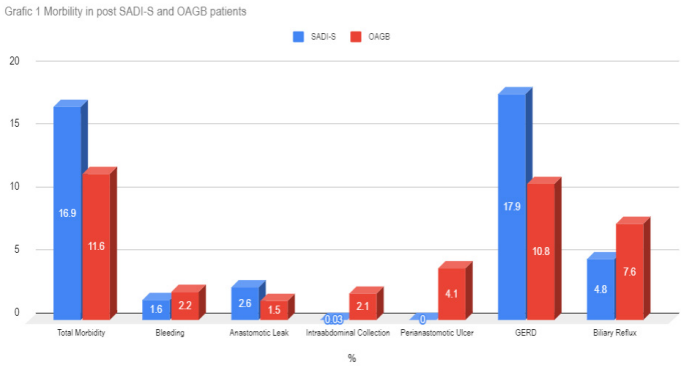
The selected articles have a publication date from 2013 to 2021, with 83% of them being published in 2018 or later. We selected 4 multicenter studies, 2 prospective studies, 1 cohort and the rest were retrospectively analyzed databases obtained prospectively. No prospective randomized study meeting the inclusion criteria was identified. We included 1120 patients in the analysis in which 369 SADI-S and 751 OAGB were performed on patients who had previously undergone a VG. Weight and BMI prior to SADI-S were on average 123 kg and 46.2 kg/m2 respectively, while weight and BMI prior to the OAGB were 116 kg and 42.7 kg/m2 respectively. The average time between VG and SADI-S was 39.7, while average time between VG and OAGB was 47.8 months. TWL values for SADI-S and OAGB were 29.3% and 28.1% respectively.

Table 2 - Weight progression in post SADI-S and OAGB patients

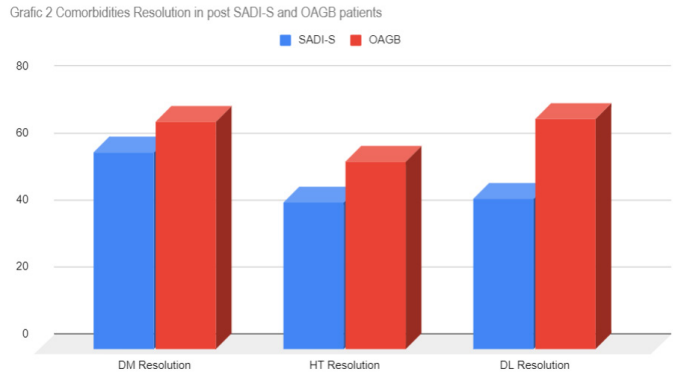
	SADI-S	OAGB
# of cases	369	751
Time between VG and RP (months)	39.7	47.8
Pre-PR Weight (kg)	123	116
BMI prior to RP	46.2	42.7
TWL %	29.3	28.1
EWL%	69.7	60.9

**VG laparoscopic vertical gastrectomy, RP revisional procedure, TWL total weight loss, EWL loss of excess weight in one year, OAGB: Gastric bypass of an anastomosis, SADI-S: Ileal duodenum bypass of an anastomosis with vertical gastrectomy*

Of all of the articles reviewed, 14 reported the percentages of global morbidity which include Claven-Dindo II complications or higher. The incidence of upper gastrointestinal discomfort, steatorrhea, nutritional deficit, diarrhea, internal hernia and others was eliminated from the analysis due to the heterogeneity of the reports and the diagnostic criteria applied in each article. The overall morbidity rate was 16.9% for SADI-S and 11.6% for OAGB. Fifteen (15) of the articles reviewed reported mortality at 30 days, whereas mortality was 0% in the OAGB group and 0.67% in the SADI-S group



In 13 of the articles analyzed, the resolution index of HTA, DM, or dyslipidemia is reported, along with the diagnostic criteria of resolution of each study. High variability was observed in the cure rate of comorbidities with DM resolution rates from 22% to 94%, HTA resolution from 27% to 56% and DL resolution from 31% to 66% in SADI-S. It is also observed in the post-OAGB indices with 16 to 100%, 20% to 81%, and 60% to 80% of DM, HTA and DL resolution, respectively. Patients who had an improvement in pathology were not included in this count.



Discussion

Weight loss

When assessing the evolution of the weight curve of patients undergoing an RP, it is observed that both SADI-S and OAGB achieved significant short- and medium-term weight loss, with similar TWL one year after the RP. This is consistent with the literature, which has concluded that both procedures are effective for the management of weight regain and no weight loss after VG. [25] It is evident that SADI-S has higher percentages of EWLs than OAGB, although the pre-SADI-S weight and BMI are slightly higher than in the OAGB group, in line with the general idea of the potential effect of the malabsorptive component of SADI-S on weight loss. However, it is difficult to obtain conclusive information since no randomized studies permit the adequate evaluation of this aspect. It was also observed that patients undergoing SADI-S continued to lose weight after one year of surgery and reached nadir in the weight curve at 20 - 24 months after surgery, also showing lower weight regain rates. [26,29,30] Meta-analysis evaluating EWL achieved with revisional RYGB series report rates from 32 to 66%, similar to the rates obtained in this review. [31,32,44]

Resolution of comorbidities

In this review, a high variability in the resolution rates of pathologies was observed. It is inferred that one possible explanation is variability in diagnostic criteria, as HTA resolution was defined in the selected studies as blood pressure <140/80 mmHg, <135/85 mmHg, <130/90 mmHg, or <130/80 mmHg at also variable control intervals. The healing criteria for DM were also variable. DM cure was defined as HbA1c <6.5%, HbA1c <6% in combination with fasting glucometers <126 mg/dL, <110 mg/dL, and/or <100 mg/dL without pharmacological treatment for these pathologies, in some studies fulfilling a minimum period of 1 year. [2.4,11,16,17,27,33] It has been observed that patients who underwent an OAGB had higher cure rates for all of the studied pathologies. It should be noted that patients who persisted with their pathology after VG were used as the base, so the total percentage of patients achieving remission of DM, HTA and DL are higher.

One of the most important inflection points in revisional surgery is GERD, since it is a very frequent indication for RP. However, it is an aspect of bariatric surgery that has yet to be fully understood. Doubts remain as to the relationship

of GERD with VG and its subsequent management. In this sense, some pathophysiological mechanisms have been proposed that promote the appearance of GERD post VG. One of the most important is the decrease in effectiveness in the mechanism of the cardia sphincter, secondary to dissection of the gastroesophageal junction and angle of His. This anatomical alteration may or may not be associated with the presence of a hiatal hernia. Other mechanisms, such as dilation of the reservoir, the creation of a high-pressure system, the twisting of gastroplasty or stenosis, among others, may favor the appearance and persistence of GERD in the post-VG patient, overcoming the possible protective effects of weight loss. It is estimated that in 5-year controls, up to 76% of patients may present GERD symptoms and 31% may present esophagitis in endoscopies. [34-36] No consensus exists on pre- and post-operative diagnostic criteria, hindering registration and comparison between studies. In this review, a higher percentage of patients with GERD in the SADI-S was observed, with 17.9% vs 10.85% in the OAGB. However, no detailed report has shown how many of these cases were GERD prior to VG, Post-VG or post-PR, so it is difficult to reach decisive conclusions. Both procedures are considered an option for reflux management, however the OAGB has a slight advantage as it extends beyond the pylorus and relieves the high-pressure system created in the VG. Despite this, OAGB is not exempt from the appearance of de novo GERD, and up to 7.4% of patients may present GERD after surgery. [1,17,37]

Another long-term effect with a potential impact on esophageal physiology is biliary reflux. This poses the same diagnostic challenges as GERD, with the added fact that patients suffering from it have less evident symptoms. Diagnostic criteria include endoscopy, pH-metry, and pathological anatomy in which foveolar dysplasia, metaplasia and/or dysplasia could be found in up to 17% at 2 years post-operation. [17] Of the selected articles, 5 of those relevant to the OAGB reported the appearance of biliary reflux, and only one of those referred to SADI-S. It was observed that 4.8% of patients who had been post-operated on with SADI-S had biliary reflux as compared to 7.8% in OAGB. GERD, and biliary reflux represent one of the main causes of revision of these two procedures, with RYGB being the main option for this. A similar overall revision rate was observed for both procedures, reaching 4.9% for SADI-S and 3.4% for OAGB. These percentages are observed in follow-up periods of over one year. Other causes of revision are insufficient weight loss, weight regain, intolerable upper and lower gastrointestinal symptoms, steatorrhea, malnutrition and excessive weight loss.

Nutritional deficiencies

A very relevant aspect in bariatric surgery is the malabsorptive effect of the procedures and their consequent side effects, with one of the most important being malnutrition and vitamin deficiencies. The difference in the metabolic effects of these procedures is not comparable since consensus has yet to be reached on the recommended lengths of common, food and bile loops. This leads to a high variability in surgical technique, even within the same study. Dietary loops between 75 cm and 200 cm and biliopancreatic loops in SADI-S from 100 cm to 350 cm have been reported in OAGB. [1.5,15,25,26,29,37,38] The extent of the malabsorptive effect of SADI-S, as a potential trigger for major nutritional deficiencies, has been reported in OAGB. It is perhaps one of the main elements preventing the widespread use of this technique. To the extent that experience has been gained in the technique, the length of the loops has been modified, specifically decreasing the length of the biliopancreatic loop, in order to reduce this negative effect, and thereby reduce the adverse nutritional effects. All of this, without compromising its effectiveness on weight loss.[9] Another important aspect refers to the fact that, in many groups, the administration of vitamin supplements has been systematically protocolized in the immediate postoperative period. It is expected that supplements, drugs, dosage, duration, follow-up and reporting are extremely variable, making between study comparison impossible. Despite this, zinc absorption has been particularly affected in patients with SADI-S, and close monitoring and administration of vitamin supplements is recommended.[14-17,25,39]

Complications

As for global morbidity rates, a slightly higher percentage was observed in the group subjected to SADI-S with 16.9% and 11.6% in the OAGB. When individually evaluating the complications classified as early and late according to their onset over the 30 postoperative days, it has been observed that the SADI-S presents less postoperative bleeding and intra-abdominal collections, while OAGB presented less anastomotic leakage. In some studies, it has been shown

that the rate of early complications, specifically anastomotic leakage, was higher if PR was accompanied by another procedure, such as cholecystectomy, anti-reflux procedure, adhesiolysis or others. Thus, when SADI-S was associated with cholecystectomy, fistula rates reached up to 13.2% as opposed to 3.8% in patients without cholecystectomy. [40] Over the long term, SADI-S had lower rates of anastomotic peri ulcer and biliary reflux than OAGB. Upper gastrointestinal symptoms occurred more frequently in the OAGB group, which may be attributed to the preoperative presence of GERD. While it is true that OAGB is used for management in patients with a history of GERD, it has been proposed that SADI-S may also be a viable option for the management of patients with upper gastrointestinal symptoms and GERD. [5.7,41] Mortality rates are low for both, at 0.67% and 0% for SADI-S and OAGB respectively. In quality criteria guidelines, a specialized center with a high volume of patients should obtain mortality rates of less than 0.5% in bariatric procedures, however, an increase in this rate could be expected in the revisional procedures subgroup. In comparison, mortality rates of 0.2% and 1.3% have been reported in primary and revisional RYGB, respectively. [31.42-44]

Limitations

The main limitation of this review is the non-randomized nature of most of the studies consulted. These results are distorted by selection bias, in which the choice of the procedure to be used is based on the patient's clinical evolution, the learning curve of the hospital center and continuous series of procedures. No consensus has been reached for the diagnosis of the main indications of RP, so an analysis in the curve of weight and evolution of GERD is difficult to perform. There is also a high variability in terms of the diagnostic criteria of associated pathologies as well as their criteria for healing, definition and follow-up of complications.

Conclusions

Both OAGB and SADI-S are viable and effective for management in VG failure, obtaining weight loss rates similar to those obtained with RYGB, and having acceptable morbidity and mortality rates. Therefore, they are considered effective and safe revisional procedure options.

A consensus should be reached on the objectives of bariatric surgery and the definition of procedural failure in order to better guide follow-up and indications of revisional procedures

Randomized studies on OAGB and SADI-S are necessary to clarify their differences and specific benefits, in order to refine their indications in bariatric surgery.

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