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Cardiovascular Risk Factors After Single Anastomosis Duodeno-Ileal Bypass with Sleeve Gastrectomy (SADI-S): a New Effective Therapeutic Approach?

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Abstract Obesity and its associated comorbidities entail a significantly increased cardiovascular mortality. Therefore, approaching obesity control must include among its aims the reduction of the associated comorbidities and the higher cardiovascular mortality risk and not only weight loss. Many observational studies indicate that bariatric surgery (BS) is associated with a better long-term survival than standard care. Furthermore, in general, these epidemiological studies included patients who underwent gastric bypass (GB), not biliopancreatic diversion/duodenal switch (BPD/DS), so the potential additional benefit of this latter technique remains unknown. In this regard, in theory, derivative techniques are usually associated to a higher rate of long-term improvement of metabolic comorbidities, so their potential impact on cardiovascular morbidity and mortality could be even greater than what has been published up to date. In 2007, our group proposed a simplification of the bariatric technique based on the duodenal switch, which we termed "single anastomosis duodeno-ileal bypass with sleeve gastrectomy" or SADI-S. In this review, and 10 years later, we describe some of the main results of those patients who underwent this procedure, specifically regarding their outcome on metabolic comorbidities and cardiovascular risk. Considering the findings presented in this review, in which a significant improvement of all metabolic comorbidities was observed, we may confidently suggest that SADI-S seems comparable to a BPD/DS procedure in the mid-term outcome. After all, the SADI-S procedure was conceived as a simplified version of the BPD/DS technique and not necessarily intended to maximize the improvement of cardiovascular and metabolic comorbidities, which is already sufficiently optimal. In this regard, in our experience, we have encountered a new satisfactory result, which combines more pros than cons. In fact, as we have seen, after a follow-up of 3 years, the outcomes of weight loss and improvement of blood pressure, lipid profile, and insulin resistance seem to be better with SADI-S than with Roux-en-Y gastric bypass (RYGB), and this difference may be probably still relevant in the long-term evaluation. Summary: Mid-term follow-up of patients who underwent SADI-S has proven that this procedure seems, at least, as effective as other malabsorptive techniques such as BPD/DS and significantly reduces the four main cardiovascular risk factors to a higher extent than RYGB. One of the main advantages inherent to this intervention modality is that it truly simplifies any of the prior derivative procedures and that it may be specifically adapted and individualized to each patient, according to his BMI and associated metabolic comorbidities.

Keywords Cardiovascular risk · Bariatric surgery · Duodenal switch · SADI-S · Biliopancreatic diversion

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Introduction

Obesity and its associated comorbidities entail a significantly increased cardiovascular mortality. In fact, more than 60% of worldwide deaths from cardiovascular disease, chronic kidney disease, and diabetes in 2010 were attributable to four preventable cardiometabolic risk factors: increased blood pressure, serum glucose, body mass index (BMI), and total cholesterol [1]. The fact that higher BMIs involve an increased risk for cardiometabolic disease seems straightforward; however, the underlying causal associations remain unclear. In this regard, in a cross-sectional study from a population-based cohort study including 119,859 UK Biobank participants, using a Mendelian randomization approach, BMI showed a significant genetic association with a higher risk of hypertension, type 2 diabetes, and coronary heart disease [2]. Moreover, the specific location of fat deposits, for instance in the visceral area, seems to be more relevant for the development of metabolic alterations and for the increase in obesity-associated mortality than the total amount of body fat itself [3•]. Therefore, approaching obesity must include among its aims the reduction of the associated comorbidities and the higher cardiovascular mortality risk and not only weight loss.

In 2004, Buchwald et al. [4] performed a systematic review and meta-analysis of 136 studies with a total of 22,094 patients with morbid obesity who underwent bariatric surgery (BS). They remarked how diabetes was completely resolved in 76.8% of patients, hyperlipidemia improved in 70% or more, and hypertension was resolved in 61.7%. Biliopancreatic diversion/duodenal switch (BPD/DS) and gastric bypass (GB) were more efficacious procedures than gastric banding or vertical banded gastroplasty.

Consequently, the pronounced improvement or even the reversal in diabetes, hypertension, hyperlipidemia, and obesity itself should markedly increase life expectancy. In this regard, several studies evaluating the long-term effects of bariatric surgery have demonstrated a significant reduction in total mortality paralleling weight loss. For instance, the Swedish Obesity Subjects (SOS) study involved 2010 obese subjects who underwent BS [GB (13%), banding (19%), and vertical banded gastroplasty (68%)] and compared them with 2037 matched obese control subjects who received the usual conventional care. Their findings showed that in comparison to conventional treatment, bariatric surgery was associated with a long-term reduction in overall mortality (primary endpoint) [adjusted hazard ratio (HR) = 0.71, 95% confidence interval (CI) 0.54–0.92; $P = 0.01$], during an average of 10.9 years of follow-up [5]. Similarly, Christou et al. [6] demonstrated that weight loss surgery (mainly GB) in 1035 patients compared with 5746 matched controls, with a 5-year follow-up, reduced the relative risk of death by 89% (relative risk 0.11; 95% CI, 73%–96%). Also, in a retrospective cohort in Utah of 7925 patients who had undergone GB surgery and 7925 severely obese control subjects, who were followed for 7.1 years, adjusted long-term mortality from any cause in the surgery group decreased by 40% (HR 0.60 (95% CI, 0.45–0.67; $p < 0.001$), as compared with that in the control group [7]. In addition, in the retrospective Veterans Affair study, 2500 patients who underwent bariatric surgery (74% GB) were compared to 7462 matched severe obese control subjects during a 14-year follow-up [8]. Adjusted analysis between BS and all-cause mortality showed significantly lower mortality after 1 to 5 years (HR, 0.45 [95% CI, 0.36–0.56]) and 5 to 14 years (HR, 0.47 [95% CI, 0.39–0.58]).

All these observational studies indicate that BS is associated with a better long-term survival than usual care. But the evaluation must include the specific analysis concerning the improvement of metabolic comorbidities and their role in the reduction of cardiovascular and total mortality in obese patients undergoing BS and not only the mere evaluation of BMI [9]. Furthermore, in general, these epidemiological studies included patients who underwent GB, not BPD/DS, so the potential additional benefit of this latter technique remains unknown. In this regard, in theory, derivative techniques are usually associated to a higher rate of long-term improvement of metabolic comorbidities, so their potential impact on cardiovascular morbidity and mortality could be even greater than what has been published up to date.

In 2007, our group proposed a simplification of the bariatric technique based on the duodenal switch, which we termed "single anastomosis duodeno-ileal bypass with sleeve gastrectomy" or SADI-S [10]. With this approach, a higher proportion of patients could become potential candidates to a derivative technique. In this review, and 10 years later, we describe some of the main results of those patients who underwent this procedure, specifically regarding their outcome on metabolic comorbidities and cardiovascular risk.

SADI-S: Reviewing the Procedure

SADI-S is a simplification of the DS in which a sleeve gastrectomy is followed by an end-to-side duodeno-ileostomy performed at a variable and known distance from the ileocecal valve, usually 250 to 300 cm (Fig. 1). The operation is, in fact, a biliopancreatic diversion, since it is mainly based on a controlled malabsorption. The restrictive component, created through the sleeve gastrectomy, is performed over a wide 54 French gastric bougie. This rather more physiologic approach than the original DS had already been introduced by Hess and was subsequently surpassing the traditional Scopinaro's procedure. The pyloric preservation eludes the occurrence of alkaline reflux into the stomach or the esophagus, thus avoiding the need to perform a Roux-en-Y of the duodenal switch. And this, on its side, potentially avoids the occurrence of internal herniation; in fact, up to now, with almost 300 patients operated over more than one decade, and a follow-up rate of 85%, no patient has ever presented with an internal hernia. On the other hand, the reduction to one anastomosis changes the original configuration of most bariatric operations with three

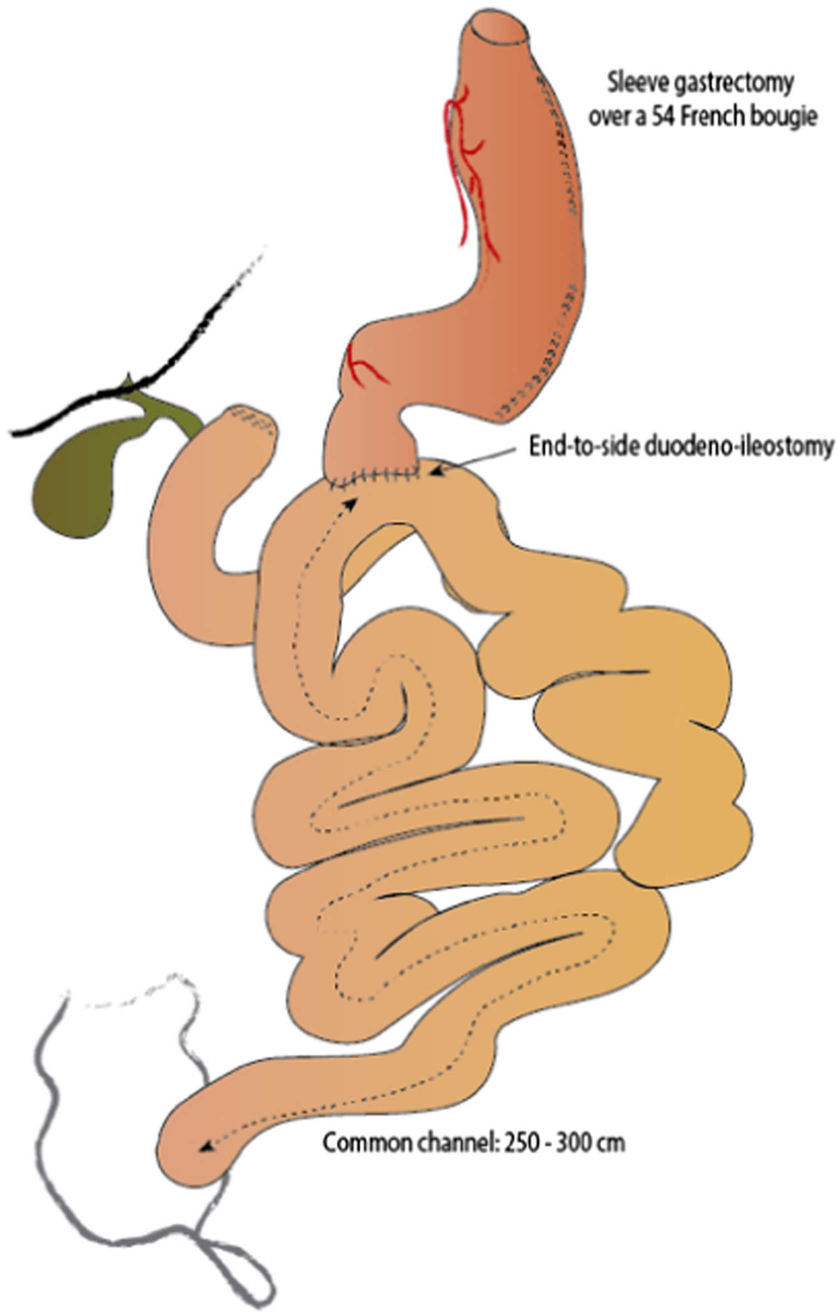

Fig. 1 Schematic representation of the single anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S). A sleeve gastrectomy is followed by a duodeno-ileal diversion at 250–300 cm from the ileocecal junction

limbs, i.e., alimentary, biliopancreatic, and common, into two, the biliopancreatic and the absorptive channel. The common limb of the biliopancreatic diversion is enlarged, from 50 to 100 to 250–300 cm, and the alimentary limb is eliminated. The result is that SADI-S becomes an easier, quicker, and more physiologic biliopancreatic diversion than the original DS, with a reduction in postoperative complications and an improvement in postoperative quality of life, without jeopardizing weight loss or metabolic results after the reduction to one anastomosis.

The initial SADI-S was performed with a 2-m common limb, which entailed a twofold increase in the absorptive channel of the standard DS and the aforementioned elimination of the alimentary limb.

Fifty patients were operated during 2007 and 2008, with a mean excess weight loss well above 95%, a malnutrition rate of 8%, and four patients requiring revisional surgery for recurrent malnutrition. Failure rate, i.e., the inability to achieve a 50% excess weight loss (EWL), occurred in 6% of patients. The operation was considered effective but not so safe, since a close follow-up was essential to avoid severe nutritional complications. In September 2009, the initial SADI-S was modified by elongating the common limb to 250 cm or even 300 cm. Absolute results after a 5-year follow-up demonstrated an 87% EWL, a 5% failure rate, a 3.4% rate for revisional surgery to overcome undernutrition (half of these cases occurred because of errors in limb measurement), and a good quality of life, when compared to traditional BPD, Scopinaro's procedure, or standard DS, as the mean number of bowel movements is 2.1/day [11, 12••].

What Can We Expect from SADI-S Regarding Weight Loss and Improvement of Metabolic Comorbidities?

To evaluate the impact of this biliopancreatic diversion procedure on metabolic outcomes, we revised 109 SADI-S procedures and 149 Roux-en-Y gastric bypass (RYGB) performed in our center in patients without diabetes. Table 1 summarizes anthropometric data and the outcomes after a 3-year follow-up. We here explain each of the variables evaluated:

– *Changes in body weight*: Both techniques allow a significant weight loss after 3 years of follow-up. However, those patients who underwent SADI-S achieved a greater reduction in total body weight (TBW) in comparison to those who underwent RYGB (38.7 ± 10.7 vs 28.7 ± 9.7%; $p = 0.0001$).
– *Blood pressure*: Blood pressure is reduced after both types of procedures, but statistical significance is only reached for the group who underwent SADI-S. In fact, from baseline hypertension rates of 72 and 78% in the RYGB and SADI-S groups, respectively, remission occurred in 57 and 63.8% of patients, respectively, 3 years after the bariatric intervention.
– *Lipid profile*: Significant reductions occurred for serum levels of triglycerides and HDL-c in those patients who underwent RYGB, while serum levels of triglycerides, total cholesterol, and LDL-c were all significantly reduced in patients after SADI-S-HDL-c. In this regard, after a follow-up of 3 years, serum triglycerides were below 150 mg/dl in 92 and 95% of patients after RYGB and SADI-S, respectively ($p = 0.51$); 96% of patients in the RYGB group vs 85% in the SADI-S group had serum HDL-c > 40 mg/dl ($p = 0.019$); and 45 and 83% of patients after RYGB and SADI-S, respectively, achieved serum LDL-c levels < 100 mg/dl ($p = 0.0001$).
– *Glucose and insulin profile*: Serum levels of glucose, insulin, and the homeostatic model assessment-insulin resistance (HOMA-IR) index all improved after both types of bariatric procedures, but data were more favorable for the derivative procedure.

Table 1 Patients' demographic, anthropometric, and biochemical characteristics at baseline and after a follow-up of 3 years, according to the type of bariatric procedure performed

	RYGBP ($n = 149$)		SADI-S ($n = 106$)		
	Preop	3 years	Preop	3 years	*p* value RYGBP vs SADIS 3 years
Sex (% female)	64.2		58.5		
Age (years)	48.5 ± 10.1		46.2 (11.7)		
BMI	42.1 ± 6.1	29.9 ± 5.5	45.9 (6.4)	28.1 ± 4.6	
TWL (%)		28.7 ± 9.7		38.7 ± 10.7	0.0001
EWL (%)		72.3 ± 25.7		87.6 ± 21.9	0.001
SBP (mmHg)	140.8 ± 19.8	132.6 ± 16.3	144.1 ± 14.1	128.1 ± 15.3	0.0092
DBP (mmHg)	83.2 ± 11.8	78.9 ± 11.5	86.1 ± 11.6	76.4 ± 9.2	0.464
Fasting glucose (mg/dl)	98.5 ± 15.0	89.0 ± 11.1	97.6 ± 8.6	82.4 ± 14.1	0.534
Insulin (μUI/ml)	25.8 ± 8.9	10.5 ± 4.1	25.4 ± 4.5	5.3 ± 2.9	0.001
HOMA-IR	6.2 ± 2.3	3.3 ± 1.0	8.6 ± 5.5	1.6 ± 0.7	0.001
Total cholesterol (mg/dl)	196.8 ± 36.3	181.2 ± 42.6	191.1 ± 39.6	149.3 ± 28.1	0.0001
HDL-cholesterol (mg/dl)	53.1 ± 11.8	64.8 ± 11.7	50.6 ± 13.3	52.1 ± 11.9	0.0001
LDL-cholesterol (mg/dl)	116.9 ± 31.7	105.9 ± 27.9	106.5 ± 31.8	82.3 ± 22.5	0.0001
Triglycerides (mg/dl)	147.6 ± 79.9	90.6 ± 46.1	171.7 ± 111.2	82.8 ± 36.7	0.284

Values show mean ± standard deviation or number (percentage). *P* values are shown for analysis of variance (continuous variables)

RYGB Roux-en-Y gastric bypass, *SADIS-S* single anastomosis duodeno-ileal bypass with sleeve gastrectomy, *Preop* preoperative, *BMI* body mass index, *TBW* total body weight, *EWL* excess of weight loss, *SBP* systolic blood pressure, *DBP* diastolic blood pressure, *HOMA-IR* homeostatic model assessment-insulin resistance, *HDL-c* high-density lipoprotein-cholesterol, *LDL-c* low-density lipoprotein-cholesterol

Can SADI-S Be Successful for Type 2 Diabetes Remission?

Table 2 shows the outcomes of patients with type 2 diabetes after a follow-up of 3 years and three bariatric procedures: 97 patients after SADIS-S, 97 after RYGB, and 77 after BPD/DS. If we look at baseline characteristics, the three groups were matched for age and BMI, but patients who underwent RYGB were more frequently women, had a shorter duration of diabetes, and insulin use was less frequent than those who underwent derivative techniques.

Amelioration of glucose homeostasis and insulin resistance was more evident in patients after derivative procedures than after RYGB. In this regard, interestingly, patients with type 2 diabetes who underwent SADI-S exhibited similar improvements regarding serum glucose and insulin levels and the HOMA-IR index than those who underwent BPD/DS. In fact, complete diabetes remission rates after a 3-year follow-up, according to ADA criteria (i.e., serum glucose < 100 mg/dl, HbA1c < 6%, and no diabetes medication) [13], were 55.2, 70.4, and 75.8% for RYGB, BPD/DS, or SADI-S, respectively.

Changes in the lipid profile exhibited a similar outcome in patients with type 2 diabetes than in those without it. In this regard, there was a significant reduction of triglycerides and an increase in HDL-c in patients who underwent RYGB, while, after BPD/DS and SADIS-S, a significant decrease of triglycerides, total cholesterol, and LDL-c could be evidenced, with no significant change in HDL-c, after the 3-year follow-up.

A Critical Overview of SADI-S—What Have We Learned?

It seems clear that any bariatric procedure that enables significant weight loss, i.e., reduction of at least 20% of total body weight, will undoubtedly entail an improvement in metabolic comorbidities in the short-term follow-up. However, up to now, RYGB and BPD/DS are the only two techniques that have specifically demonstrated an improvement, and even remission, of metabolic comorbidities in the long-term [4].

In view of the four major cardiovascular risk factors involved in cardiovascular morbidity and mortality, and considering the findings presented in this review, in which a significant improvement of all metabolic comorbidities was observed, we may confidently suggest that SADI-S seems comparable to a BPD/DS procedure in the mid-term outcome. After all, the SADI-S procedure was conceived as a simplified version of the BPD/DS technique and not necessarily intended to maximize the improvement of cardiovascular and metabolic comorbidities, which is already sufficiently optimal. In this regard, in our experience, we have encountered a new satisfactory result, which combines more pros than cons. In fact, as we have seen, after a follow-up of 3 years, the outcomes of weight loss and improvement of blood pressure, lipid profile, and insulin resistance seem to be better with SADI-S than with RYGB, and this difference may be probably still relevant in the long-term evaluation.

As a variant of a BPD/DS, SADI-S causes a significant fat malabsorption, which enables that hypercholesterolemia and hypertriglyceridemia may be almost resolved after this intervention. Indeed, LDL-c levels fell below 100 mg/dl in more than 80% of patients who underwent SADI-S, while merely in 45% of those who underwent RYGB. The fact that HDL-c levels did not change significantly after SADI-S may be explained by the overall reduction of all fractions of cholesterol-transporting lipoproteins. However, HDL-c did seem to increase after RYGB paralleling the decrease of triglyceride levels. Should this be a concern? Nowadays, current international guidelines on the management and treatment of dyslipidemias suggest that serum levels of LDL-c, but not necessarily those of HDL-c or triglycerides, should be the core target [14, 15••], mainly because this is the lipoprotein which is considered to be the one most related to cardiovascular disease [16]. In this regard, in a recent systematic review and meta-analysis, the relative risk for major vascular events (a composite of cardiovascular death, acute myocardial infarction or other acute coronary syndrome, coronary revascularization, or stroke) per 1-mmol/L (38.7 mg/dl) reduction in LDL-C level was 0.77 (95% CI, 0.71–0.84; $p < 0.001$) [17]. However, beyond achieving a quantitative change in serum levels of lipoproteins, it would be desirable to be aware of their specific qualitative characteristics or modifications, including the size of HDL-c and LDL-c fractions, since their impact on cardiovascular risk may be different [18].

Regarding insulin sensitivity, amelioration is evident after significant weight loss following any of the three types of bariatric procedures, RYGB, BPD/DS, and SADI-S. However, it seems that derivative techniques lead to a higher degree of improvement, mainly expressed through the surrogate marker HOMA-IR index. This probably occurs due to an overall greater weight loss with derivative interventions, but fat and bile salt malabsorption could surely contribute to a further decrease in fat deposits in visceral and ectopic areas, especially concerning the pancreas and the liver, favoring an enhancement of pancreatic insulin secretion and a greater peripheral insulin sensitivity [19]. And achieving a significant decrease in serum insulin levels becomes one of the key objectives of bariatric surgery, regardless of the specific type of procedure [20], since the incidence rate of cardiovascular events seems to be greater in patients who exhibit higher serum levels of baseline insulin [9].

Furthermore, type 2 diabetes remission after bariatric surgery, even regardless of baseline BMI, has become a popular issue among both clinicians and patients. The concern in diabetes remission obviously lies, among other reasons, on the potential associated improvement, or even reversal, of the associated micro- and macrovascular complications [21]. But interestingly, way before weight loss is achieved and diabetes

Table 2 Baseline characteristics and outcomes after a follow-up of 3 years of patients with type 2 diabetes who underwent Roux-en-Y gastric bypass (RYGB) (n = 97), biliopancreatic diversion/duodenal switch (BPD/DS) (n = 77), and single anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S) (n = 97)

	RYGB	DBP/DS	SADI-S	p value
n	97	77	97	
Age (years)	50.8 ± 9.8	50.7 ± 11.4	50.5 ± 9.6	
Female (%)	64.6	53.4	55.6	
Duration T2D (year (range))	4 (1–8)	6 (2–11)	8 (4–16)	
Insulin-treated (%)	32.7	40.2	46.6	
BMI (kg/m^2)				
Baseline	46.5 ± 6.6	46.1 ± 7.1	44.3 ± 6.6	
3 years	31.8 ± 5.1	29.6 ± 6.2	28.2 ± 5.3	
%TBW	30.3 ± 7.1	35.2 ± 10.5	35.5 ± 6.7	0.02
Fasting glucose (mg/dl)				
Baseline	161.1 ± 59.3	172.5 ± 57.9	164.4 ± 65.4	
3 years	107.5 ± 33.6	102.9 ± 21.9	97.6 ± 17.1	0.392
HbA1c (%)				
Baseline	7.4 ± 1.9	7.9 ± 1.9	7.5 ± 1.7	
3 years	5.7 ± 0.9	5.3 ± 0.7	5.2 ± 0.2	0.01
Insulin (µUI/mL)				
Baseline	28.8 ± 9.7	31.8 ± 20.9	23.4 ± 15.8	
3 years	10.6 ± 6.4	5.2 ± 3.7	5.4 ± 3.2	0.001
HOMA-IR				
Baseline	9.6 ± 6.7	11.7 ± 7.6	8.2 ± 6.1	
3 years	5.4 ± 3.2	1.6 ± 0.9	1.3 ± 0.8	0.001
% Complete remission 3 years	55.2	70.4	75.8	0.04
Lipid profile				
Total cholesterol (mg/dl)				
Baseline	195.9 ± 36.5	185.1 ± 41.3	185.5 ± 40.6	
3 years	185.4 ± 39.3	144.3 ± 29.4	140.0 ± 28.2	0.001
HDL-cholesterol (mg/dl)				
Baseline	50.6 ± 11.1	46.4 ± 10.7	46.6 ± 12.3	
3 years	62.2 ± 15.3	47.3 ± 10.1	47.8 ± 11.1	0.001
LDL-cholesterol (mg/dl)				
Baseline	110.7 ± 30.9	105.1 ± 26.5	102.7 ± 30.9	
3 years	102.2 ± 30.2	76.2 ± 25.5	74.5 ± 22.4	0.001
Triglycerides (mg/dl)				
Baseline	178.3 ± 101.4	213.0 ± 185.7	205.6 ± 116.6	
3 years	101.9 ± 46.0	108.5 ± 66.6	102.6 ± 45.5	0.001

Values show percentages, median (range), or mean ± standard deviation, accordingly. *P* values are shown for analysis of related samples, comparing baseline and 3-year follow-up values, and chi-square test for categorical values (remission rates between the three types of procedures)

T2D type 2 diabetes mellitus, *BMI* body mass index, *TBW* total body weight, *HOMA-IR* homeostatic model assessment-insulin resistance

remission can be documented, a significant improvement in glucose metabolism can be evidenced in the immediate post-operative period. The underlying mechanisms involve the highly restrictive energy intake, the effect of incretin-based gastrointestinal hormones, the impact of bile salts on glucose and insulin metabolism, and modifications in gut microbiota [22]. These and other potential physiopathologic mechanisms are still trending in numerous scientific meetings and publications and are beyond the scope of this review.

Our group has deeply analyzed diabetes remission rates after different bariatric techniques, and we have here reported original results on the outcome of patients, which had already been included in previous publications [23••], after a follow-up of 3 years after undergoing RYGB, BPD/DS, and SADI-S. As we already did, we considered the stricter criteria to define diabetes remission [13]. We found that patients who underwent SADIS-S and BPD/DS achieved similar rates of diabetes remission, which were significantly higher than those obtained by patients after RYGB, and the overall metabolic improvement, especially concerning glucose, insulin, and lipid homeostasis, behaved similarly, in agreement with previous studies [24]. It is worth remarking that these results are particularly appealing, because the profiles of patients who end up in a derivative procedure are precisely those whose diabetes exhibits a longer duration and with a higher proportion of insulin use. For instance, complete diabetes remission rates for non-insulin-dependent patients after a 3-year follow-up were 77.1, 89.7, and 96.4%, for RYGBP, BPD/DS, and SADI-S, respectively, while they were 30.4, 50, and 56%, respectively, for insulin-dependent.

In line with these observations, our group suggested that diabetes remission, although desirable and targeted, should not be the only and foremost goal after bariatric surgery [25], and the overall evaluation of patients after bariatric surgery, especially in the long-term follow-up, should not be limited exclusively to the outcome of diabetes. In this regard, in our opinion, combined metabolic control, including blood pressure, lipid profile, and insulin resistance, would be a success in itself, especially if target recommendations are met [26], and even if patients still face minimal hypoglycemic treatment or mild transitional biochemical flaws, which would otherwise exclude them from the strict definition of remission. Therefore, we proposed the term "optimal metabolic control," rather than the stricter "diabetes remission," for the long-term evaluation of bariatric patients [27].

Some studies evaluating the outcome of obesity-associated comorbidities after BS have reported results on hypertension and dyslipidemia that could paradoxically position derivative techniques at a lower eligible position [28], mainly limiting them to those patients with higher BMIs (> 45 kg/m^2). But if technical issues are overcome thanks to an upward learning curve [29], the SADI-S procedure could indeed ease the approach, increase its versatility, and broaden its application to a greater number of patients with a greater variability of baseline characteristics.

Conclusions

Mid-term follow-up of patients who underwent SADI-S has proven that this procedure seems, at least, as effective as other malabsorptive techniques such as BPD/DS and significantly reduces the four main cardiovascular risk factors to a higher extent than RYGB. One of the main advantages inherent to this intervention modality is that it truly simplifies any of the prior derivative procedures and that it may be specifically adapted and individualized to each patient, according to his BMI and associated metabolic comorbidities.

We agree with the current consensus on single anastomosis duodenal switch procedures [30] that data on the outcomes of SADI-S may be yet preliminary for the time being. Indeed, we still need further clinical investigations, with more studies including a greater number of patients, and an overall long-term evaluation. However, we do venture to suggest that SADI-S may be an interesting surgical approach in specific settings, with highly relevant beneficial outcomes.

Final Comments

SADI-S still has some scientific limitations, as it does not have long-term follow-up or randomized controlled trials that may provide level 1 evidence of its superiority over standard approved operations. So, based on our research, we list below some perceived advantages when compared to Roux-en-Y gastric bypass and duodenal switch.

Advantages of SADI-S

Over gastric bypass SADI-S has the following benefits: better weight loss, as a malabsorptive operation; better metabolic results due to the distal anastomosis and fat malabsorption; is easy to dismantle in case of complications; is more physiologic due to pyloric preservation; has no internal hernia expected as there is no mesenteric opening; and has no stomal problems, as ulcers or stricture, because the anastomosis is in the duodenum. These advantages are more relevant in very overweight patients (BMI > 50) and very metabolic patients, especially as a revisional surgical approach after failed sleeve gastrectomy.

Over duodenal switch SADI-S has demonstrated to induce the same metabolic and weight loss results than classical DS with a simpler procedure. The longer common limb decreases intestinal movements and fecal and anal problems.

Compliance with Ethical Standards

Conflict of Interest Antonio Torres, Miguel A. Rubio, Ana M. Ramos-Leví, and Andrés Sánchez-Pernaute declare no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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