Chapter 61
The Evolution of Single-Anastomosis Duodenal Switch

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61.1 Introduction

61.1.1 The Journey to the Duodenal Switch

The first attempt of surgically induced weight loss was made in the 1950s as the jejunoileal bypass. It worked well as a weight loss operation but had high rates of life-long complications such as renal failure, diarrhea, nephrolithiasis, liver disease, intestinal bacterial overgrowth, severe malnutrition, and immune complex-mediated arthritis-dermatitis [1]. In the 1960s, Drs. Mason and Ito developed the Roux-en-Y gastric bypass (RYGB). This eliminated many of the complications associated with the jejunoileal bypass and resulted in its worldwide adoption as the procedure of choice until very recently [2]. While the RYGB was performed often, it also had a unique set of complications such as marginal ulcers, perforations, strictures, internal hernias, dumping syndrome, and weight regain. Seeing the large numbers of RYGB patients with weight regain led Scopinaro in 1976 to develop the biliopancreatic diversion (BPD) [3]. The BPD required a hemi-gastrectomy and long Roux limb connection to the stomach with a 50-cm common channel. Dr. Nicola Scopinaro designed the BPD to have a strong malabsorptive component for long-term weight loss maintenance [4].

The first Roux-en-Y duodenal switch (DS) was a modified version of the BPD and was performed by Dr. Douglas Hess in 1986 [5]; it initially consisted of vertical sleeve gastrectomy (VSG) (instead of a hemi-gastrectomy) with a Roux limb brought up to the proximal duodenum (instead of the stomach). The total alimentary limb length was 40% of the small bowel length, with a common channel length of

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approximately 75–150 cm. The original DS was designed to preserve pyloric function to reduce the risk of dumping syndrome postoperatively.

The DS, as Hess performed it, had fewer marginal ulcers and dumping syndrome when compared to the RYGB, better long-term weight loss, and improved diabetes resolution [6]. Despite the many favorable peer-reviewed papers published, it was not widely accepted initially due to fears of long-term vitamin and protein deficiencies [7].

61.1.2 The Initiation of the Single-Anastomosis Duodenal Switch

In 2007, two surgeons from Spain altered the DS to eliminate the Roux limb [8]. Drs. Torres and Sanchez-Pernaute performed this proximal end (of the duodenum)-to-side (of distal ileum) bypass to preserve pyloric function while reducing the need for two anastomoses and to decrease operation times and operative complexity. The SG was performed with a 54-French gastric bougie, and the single anastomosis was hand-sewn, 4 cm distal of the pyloric sphincter to the ileum approximately 200 cm proximal to the ileocecal valve. This eliminated the existence of a Roux limb, and the patient was left with a 200-cm common channel alimentary limb and the afferent biliopancreatic limb. This procedure later changed to a common channel with a length of 250 cm reducing the rate of hypoproteinemia from 8 to 2% [9].

The procedure nomenclature has only recently been standardized as the single-anastomosis duodeno-ileostomy with sleeve gastrectomy (SADI-S). This name covers all single anastomotic procedures where the stomach has been "sleeved" (regardless of bougie size), the pylorus retains its functionality to manage enteric food flows (to reduce dumping syndrome), and there is a single anastomosis of the proximal duodenum to the distal small bowel regardless of the length of the bypassed bowel.

61.1.3 Ever-Evolving Variations

While most surgeons focus on Torres's pioneering work, Dr. Kazunori Kasama in Japan, also in 2007, introduced a novel procedure called "duodenojejunal bypass with sleeve gastrectomy" (DJB-SG), another derivative of the original DS procedure [10]. Unlike SADI-S by Drs. Torres and Sanchez-Pernaute, there were two anastomoses instead of one. Also, one of the two anastomoses was created using the duodenum and jejunum.

Dr. Wei-Jei Lee further modified the DJB-SG by Dr. Kasama in China. In July 2011, Dr. Lee used a loop limb instead of a Roux-en-Y configuration, eliminating

one anastomosis (jejuno-jejunostomy) and named it "loop duodenojejunal bypass with sleeve gastrectomy (LDJB-SG)" [11]. The same concept of creating an anastomosis using a loop limb instead of a Roux-en-Y configuration was also used by Dr. Chih-Kun Huang for patients with type 2 diabetes (T2D) in October 2011 [12]. These derivatives of the original DS, the DJB-SG and loop DJB-SG, are mostly performed in the eastern part of the world like Japan, India, and China (Table 61.1) [8, 10–33].

Table 61.1 Articles on derivatives of DS

No	Surgery	First author (reference)	Country	First surgery (month, year)	First article (year)
1	DJB-SG	Kasama et al. [10]	Japan	2007	2009
2	DJB-SG	Raj et al. [13]	India	UA	2012
4	Loop DJB-SG	Huang et al. [12]	Taiwan	Oct., 2011	2013
3	Loop DJB-SG	Lee et al. [11]	China	2011	2014
5	DJB-SG	Ruan et al. [14]	China	Dec., 2011	2017
6	DJB-SG	Lin et al. [15]	China	Mar., 2012	2019
7	DJB-SG	Vennapusa et al. [16]	India	May, 2013	2020

No	Procedure	First author	Country	First surgery (month, year)	First article (year)
1	SADI-S	Sanchez-Pernaut et al. [8]	Spain	UA	2007
2	SADI-S	Mitzman et al. [17]	U.S.A.	June, 2013	2016
3	SADI-S	Gebelli et al. [18]	Spain	Nov., 2014	2016
4	SADI-S	Nelson et al. [19]	U.S.A.	Dec., 2013	2016
5	SADI-S	Neichoy et al. [20]	U.S.A.	Oct., 2013	2018
6	SADI-S	Surve et al. [21]	Australia	UA	2018
7	SADI-S	Dijkhorst et al. [22]	Netherlands	UA	2018
8	SADI-S	Heneghan et al. [23]	U.K.	UA	2018
9	SADI-S	Enochs et al. [24]	U.S.A.	Apr., 2014	2020
10	SADI-S	Yashkov et al. [25]	Russia	May, 2014	2020
11	SADI-S	Surve et al. [26]	Australia	Jan., 2017	2020
12	SADI-S	Robert et al. [27]	France	Oct., 2018	2020
13	SADI-S	Andalib et al. [28]	Canada	June, 2016	2021
14	SADI-S	Badshah et al. [29]	Qatar	Aug., 2017	2021
15	SADI-S	Admella et al. [30]	Spain	2014	2021
16	SADI-S	Wang et al. [31]	China	June, 2017	2021
17	SADI-S	Ruano-Campos et al. [32]	Spain	Mar., 2018	2021
18	SADI-S	Pereira et al. [33]	Portugal	Feb., 2015	2021

DS Roux-en-Y duodenal switch, *DJB-SG* duodenal-jejunal bypass with sleeve gastrectomy, *UA* unavailable, *SADI-S* single-anastomosis duodeno-ileal bypass with sleeve gastrectomy

In 2013, Drs. Cottam and Roslin in the USA altered the SADI-S further to enhance the restrictive component, utilizing a 40-French gastric bougie and increasing the common channel length to 300 cm [34, 35]. This variation was called the "stomach-intestinal pylorus-sparing surgery" (SIPS) [17]. The long-term outcomes show 78–95% excess weight loss occurring at 18 months postoperatively that are maintained out to 6 years [36]. The complication profile seems less than the RYGB and DS procedures [25, 37]. Compared to SADI-S, the weight loss between SG and RYGB is significantly different, with better weight loss with SADI-S [36, 37]. The SADI-S or DS has also been found to be safe and effective for failed weight loss following a failed AGB, RYGB, or SG [38–41].

In 2018, the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) accepted the SADI-S procedure as a standard of care, and in 2020, the American Society for Metabolic and Bariatric Surgery (ASMBS) has also accepted SADI-S as a standard of care as long as there is a program with proper nutritional supplementation and follow-up [42, 43].

With international recognition, it stands to reason those comparisons between the eastern hemisphere and the western hemisphere duodenal bypass procedures should occur. In 2021, Li et al. compared the outcomes of the SADI-S between the East and West [44]. According to Li et al. western hemisphere surgeons use larger bougies and have shorter common channels. This results in better weight loss and diabetes resolutions. However, this should lead to more nutritional complications, but there are currently not enough papers to support this conclusion. Surgical complications are the same between the two hemispheres.

The SADI-S approach to weight management is gaining popularity in many different parts of the world. There have been articles published from Spain, the USA, the Netherlands, China, Japan, Taiwan, Egypt, Brazil, Portugal, Italy, Russia, Canada, Australia, and Qatar (Table 61.1). The future of the SADI-S as a standalone procedure seems secured. Surgeons are increasingly being trained to do this laparoscopically and robotically. With any procedure that bypasses much of the small bowel, attention must be focused on vitamins B1 and B12; folate; iron; vitamins A, D, E, and K; and zinc [45]. Since this procedure is carbohydrate malabsorptive, patients need to be educated on eating a high fat and protein diet to avoid diarrhea and malodorous gas. There are still studies being conducted with respect to hormonal and physiological markers related to complications that will require further extensive follow-up [46].

61.2 Conclusions

The duodenal switch has undergone many significant changes simultaneously worldwide while keeping low complication rates when compared to Roux-based approaches. Now that all worldwide societies have approved the SADI-S, we expect many more rapid modifications around the work that will reduce both short- and long-term complications associated with this procedure while simultaneously improving weight loss outcomes.

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