

## Bariatric and metabolic Surgeries: A brief history of development

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### Abstract

Obesity and obesity-related-comorbidities are increasing worldwide. Bariatric surgery plays a key role in treatment of morbid obesity and its related diseases. Bariatric procedures have been evolved in decades from initial procedures to modern and standard procedures. This evolution is ongoing to reach better and more persistent results with lower complications' rates. In this manuscript we tell a brief history of this development.

**Keywords:** Obesity, Bariatric surgery, History, Obesity surgery

### Introduction

Bariatric and metabolic procedures are established as the most effective interventions for treatment of obesity and its related comorbidities such as Type-2 Diabetes Mellitus (T2DM), Hypertension (HTN), musculoskeletal problems and cancers (1, 2).

About 30 to 40 percent of populations worldwide are obese, so in the absence of treatment for obesity, the burden of curing these diseases is a major challenge for any country's health system (3).

It seems that about one million bariatric/metabolic surgeries have been performed till now (4) and the established position of these surgeries is result of a long way from initiation trials and errors to developed procedures.

Generally bariatric surgeries are classified into three groups: restrictive, mal-absorptive and combined (5).

In 1963 Payne and Dewind created jejunocolic bypass. This procedure then was abolished due to liver failure and gram negative and aerobic bacterial over-growth (6,7).

Jejunioleal bypass was the next procedure that was developed as revisional procedure and over time, there have been a lot of changes (6-8).

These two procedures had the maximum weight loss in first year after operation, but diarrhea, related anal discomfort, electrolyte imbalance, vitamin deficiencies and multitude additional complications such as anemia, joint disease, fatigue, renal disease, fatty liver and cirrhosis made these procedures abandoned (7).

Advantages and disadvantages of initial surgeries led to

obvious changes in subsequent bariatric procedures (8). In 1967 Mason and Ito performed partial gastrectomy for treatment of gastric ulcer and created an anastomosis between upper one-third of stomach and the loop of jejunum. That procedure was not effective for treatment of gastric ulcer but had dramatic effect in patient's weight loss (9). Thus, Mason modified his method by minimizing the anastomosis size, because of patients' weight regain after 6 month (9). Mason's procedure led to excess weight loss and disappearing or improving the obesity-related comorbidities. Over time, his method changed to gastric partition technique (horizontal gastroplasty) and was performed in some patients in 1970 by Mason with modification of Alden's procedure. His seven years follow-up showed lower mortality rate compared to other procedures. Unfortunately, the pouch began to expand and patients had weight regain (10, 11). Thus, he educated his patients to eat less for a sufficient weight loss (12).

Patients were suffered from gastro-esophageal reflux, so Alden invented Roux-en-Y Gastric Bypass (RYGB) afterwards, that for the first time was performed laparoscopically by Wittgroove and Clark in 1994 (13). The effect of RYGB on T2DM was proved in 1995 by McDonald and Pories (14,15), then confirmed by Schauer (16).

Nowadays, it is accepted that RYGB could resolve Gastroesophageal Reflux Disease (GERD) in more than 90%, T2DM about 80%, hyperlipidemia about 70% and HTN about 50-65% (17).

Tretbare and his colleagues in 1975 introduced vertical gastric plication (10). Mason in early 1980s did this procedure with Marlex mesh and called Vertical Banded Gastroplasty (VBG) and introduced as a restrictive procedure; an alternative for RYGB and JIB. It had up to moderate weight loss about 50% in addition to weight regain in many patients during 5 to 10 years follow-up (18).

In 1978 Winkinson created a new restrictive procedure with putting a 2cm Marlex mesh in upper stomach to decrease the gastric expansibility (17).

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Molina performed this procedure with Dacron graft in 1980 and Kuzmak performed with 1cm Silicon band in 1983 (17).

These procedures created no ideal diameter of band, thus, were unsuccessful. Slippage of band, erosion, nausea and vomiting due to intolerance to food and dilatation of esophagus were the most complications (17).

Three years later in 1985 with adding an adjustable source, by Hallberg and Forsell in Sweden and Kuzmak in the US, Adjustable Gastric Banding (AGB) was invented and approved in 2001 in the common form. In 1986 Kuzmak reported improvement in weight loss and in reducing complication in new version compared to previous ones (19-22). The first laparoscopic adjustable gastric banding was performed by Broadbent in 1993 (23).

For gaining adequate weight loss and decreasing the complications and weight regain after both jejunoileal and jejunojejunal bypass, Nicola Scopinaro introduced Biliopancreatic Diversion (BPD) in 1979 that was performed by a distal gastrectomy and gastro-ileal bypass with a common channel of 50cm. Patient's average weight loss in 6 and 12 months after surgery was 26 and 34%. He had no other important complication in his one year follow-up (7, 24-26).

Marceau and his colleagues reported the first results of new type of BPD. They did it by vertical gastrectomy instead of distal gastrectomy of Scopinaro's approach and the 100cm common channel. They excluded duodenum by stapling device and did not transect duodenum (27).

Because of post-gastrectomy syndrome in BPD and for improving outcomes, Hess in 1988 suggested Biliopancreatic Diversion with Duodenal Switch (BPD/DS) as an alternative for Jejuno-ileal Bypass (JIB). They have reached to 80% of excess weight loss during 24 months. They reported degrees of weight regain but never reached to their basal weight. The worst result of them was a patient with only 35% excess weight loss (28, 29).

In 1999 Rabkin did the first hand-assisted laparoscopic DS (30) and Ganger did first completely laparoscopy approach of BPD/DS in 1999 (31). The first operation with robotic assisted was done in 2000 (7) but now, this procedure includes 2.2% of all surgeries for obesity, because of difficult technique and nutritional complications (32).

Magnestrase & Mill procedure was performed by Johnson in 1987 as a simple restrictive procedure and an alternative for RYGB and VBG (31-33). The mortality rate was zero and they reported complications in 4% of their patients (mild heartburn was common in their study). Mean excess weight loss was 68% one year after surgery (31). In another study by Carmichael et.al most numerous of patients were satisfied from this operation. They reached 12 to 99% (with median of 58%) of excess weight loss during 5 years after surgery (33).

This procedure was changed to sleeve gastrectomy (SG) by removal of greater curvature by Ganger (29).

At first, SG was used as the first stage of the two-stage surgery for morbid obese patient with BMI greater than 60. It had 33% excess weight loss in average (37kg) (29, 33, 34). Finally, sleeve gastrectomy was accepted in 2008 as a

one-stage bariatric surgery (35). Nowadays SG is the most popular surgery performing in the world (4, 33).

SG alone has good results of weight loss and resolution of morbidities. In a study accomplished by Grubnik et.al excess weight loss was 78.9% two years after SG (36). The conversion rate in one study showed between 20% and 35% (37-40). Resolution or improvement rates of T2DM and HTN are 37% and 29% (41, 42).

In a study with a follow-up of 11 years, Arman et al. have examined the remission of comorbidities after SG and found that preoperative arterial HTN was resolved or at least improved in 28.6% (two out of seven) of their patients, while one patient had developed it de novo (38).

Aminian et al. found that, comparing results of SG at five years in patients with T2DM, remission of diabetes had decreased from 41% to 26% (43).

However, a long-term study with a follow-up of eight years and a large cohort (120 patients) showed rather high remission rates for both T2DM (74%) and arterial HTN (77%) after SG (44).

Boza et al. found new-onset reflux in 26.7% of their SG patients after five years in a study of 161 patients with a follow-up rate of 70% (45).

During a time studies showed that most of the patients need PPIs and have severe reflux symptoms (46). Boza et al. reported 26.7% new-onset reflux after SG in their patients five years after surgery (46).

In 1997, Rutledge defined One Anastomosis Gastric Bypass (OAGB) or Mini-gastric Bypass (MGB). It was easier procedure than RYGB. Resolve of comorbidities and weight loss of this procedure, is more than previous ones. Lee et al. reported about 72% excess weight loss in years follow up (3). Resolution of T2DM was 92%, HTN 90%, sleep apnea 90%, hypertriglyceridemia 100%, hypercholesterolemia 93%, gastroesophageal reflux disease 77%, arthritic pain 72% and urinary incontinence 81% in Rutledge's study in 2001 (47). OAGB was approved as a standard bariatric/metabolic procedure by IFSO in 2018 (48).

Santoro introduced sleeve gastrectomy with transit bipartition (SG + TB) in 2012 that was similar to DS but without complete exclusion of duodenum for decrease nutritional mal-absorptions (49, 50).

Mui et al. introduced the laparoscopic sleeve gastrectomy with loop bipartition or Single Anastomosis Sleeve-ileal Bypass (SASI) in 2013 as a modification of Santoro's procedure that included a loop gastro-ileostomy at the antrum, 250cm from the ileocecal valve without division of the first part of duodenum after SG (51). T. Mahdy in 2016 performed the first study with clinical sufficiency for SASI. Excess weight loss in 6 months and one year after surgery was 75% and 90%, respectively. All their patients had complete resolution of T2DM. HTN was cured in 86%, hypertriglyceridemia improved in 97% (52).

Sleeve Gastrectomy with Duodeno-jejunal Bypass (SG/DJB) was presented in Asia in 2009 by Kasama et al. because of high prevalence of gastric cancer in East Asia and limitation for gastric remnant study in RYGB. This procedure is suitable for weight loss and T2DM remission. In this study weight loss was not as well as LRYGB, but

the excess BMI loss percent was similar. Their T2DM, hyperlipidemia and HTN improvement was 92.9%, 100% and 58.7%, respectively (53).

Torres in 2007 recommended Single Anastomosis Duodeno-ileal Bypass (SADI) as a modified form of BPD/DS, especially for patients with weight regain after SG. This method is under investigation for being approved (33, 54). They reported 100% excess weight loss of their patients at 3 years follow-up in 2010. Eight and five percent of them had clinical hypoalbuminemia at one and two year's follow-up, respectively. They also reported vitamin D3 deficiency 30 and 40% at one and three years. All diabetic patients of their study achieved normal glucose level. They reached to 100% control of hyperlipidemia (55).

Some other new methods such as Sleeve Gastrectomy with Jejunal Bypass (SGJB) (56), Sleeve Banded Gastrectomy (33, 57), Single Anastomosis Sleeve-jejunal Bypass (SASJ) (58), have been presented and these are under investigation, too.

The bariatric/metabolic surgery achieved its important role and position in treatment of obesity and obesity-related comorbidities, but the updates are underway.

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