

Special Article - Bariatric Surgery

Mini-Gastric Bypass for Bariatric Surgery Increasing Worldwide

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Abstract

Introduction: *Mini-Gastric Bypass* (MGB) originated in 1997 as a simple, rapid and mainly malabsorptive bariatric operation; it is now increasing rapidly.

Methods: History, technique, variations and world literature are reviewed.

Results: Reports now find the MGB to be a superior operation with respect to safety, short learning curve, resolution of co-morbidities (especially diabetes), durable weight loss and ease of revision or reversal.

Conclusion: The authors regard MGB as a very favorable operation and present a review.

Keywords: Mini-gastric bypass; Surgical technique; One-anastomosis gastric bypass; Diabetes; Quality of life; Weight loss

Introduction

Mini-Gastric Bypass (MGB or Malabsorptive Gastric Bypass) was devised by Robert Rutledge in USA in 1997. As a trauma surgeon, he was faced with an abdominal gun-shot wound where a duodenal exclusion with a Billroth II anastomosis was an appropriate reconstruction. This was the inspiration that led Rutledge to the MGB on consenting bariatric patients, constructing a *long* lesser curvature channel which prevents reflux [1,2]. In the USA, there was some skepticism against the MGB.

In 2001, the first author (MD) spent 15 days as a guest in Dr. Rutledge's O.R. and pre- and post-operative clinic, inspecting his substantial follow-up. The MGB has since increased throughout the world [3-14]. With the decrease in gastric banding, the MGB in 2015 became the third most common bariatric operation internationally [15].

Technique of MGB

The laparoscopic MGB (Figure 1) has two components: 1) a lesser-curvature *long* gastric pouch, serving as a slightly restrictive conduit; 2) a 180-200 cm jejunal bypass with a wide antecolic Gastrojejunal (GJ) anastomosis, which leads to carbohydrate and especially fat malabsorption.

Creation of the pouch

After making a window into lesser sac, the lesser curvature of the stomach is stapler-divided at a right-angle 2-3 cm distal to the crow's foot. Next, a 28-38 Fr bougie is passed by the anesthesiologist and the stomach is then stapler-divided cephalad parallel to lesser curvature. At the Gastro-Esophageal (GE) junction, the surgeon divides the gastric sleeve a few mm *lateral* to the angle of His; the cardia and left crus are explicitly avoided and *not* dissected, unlike in the Laparoscopic Sleeve Gastrectomy (LSG) [16-18].

Thus, a low-pressure gastric conduit is constructed [19], unlike the high-pressure conduit of the LSG [20].

Creation of the malabsorptive jejunal bypass

Attention is turned to the left gutter. The greater omentum is retracted medially to identify ligament of Treitz. The jejunum is run to 200 cm (Hargroder) or 180 cm (Peraglie) distal to Treitz' ligament. Hargroder uses the width of his paddle retractor (3.5", 8.75 cm) to measure the 200 cm. Peraglie traces the jejunum with 2.5 cm grasps hand-over-hand to 180 cm.

In super-obese patients, 250 cm of proximal jejunum may be bypassed. However, with lower BMI with co-morbidities such as diabetes, a shorter jejunal limb (150 cm) may be bypassed [21-24].

At the selected site, the tip or adjacent posterior wall of the gastric pouch is anastomosed antecolic to the jejunum (can be fully-stapled, hand-sewn or hybrid-end-to-side or side-to-side), constructing a wide anastomosis under easy view. Attention is given to avoid a twist at the GJ anastomosis. The GJ anastomosis should be at least 300 cm proximal to the ileocecal valve, to avoid protein malnutrition.

If a Hiatal Hernia (HH) is present, it is not dissected and repaired at the time of the MGB operation. If needed, HH repair can be performed 12-18 months later. Experience has shown that the MGB is very effective in resolving GE Reflux Disease (GERD). This is due to traction that the GJ provides on the gastric pouch, reducing the cardia into the abdomen, plus the decreasing post-operative intra-abdominal obesity.

However, if a large HH is present with adherence to the gastric fundus, it is dissected and repaired at the time of MGB; otherwise, a large bulbous fundus could be left.

The non-obstructed pouch allows slight restriction but adequate oral intake, accompanied by fat/carbohydrate malabsorption. Because the patient avoids carbohydrate which could produce rapid dumping, the intake has mainly fat malabsorption. The pouch in the MGB develops minimal dilatation, because there is no outlet narrowing by a stoma or pylorus [19]. There is slight increase in the number of stools per day (generally from 1 to 2).

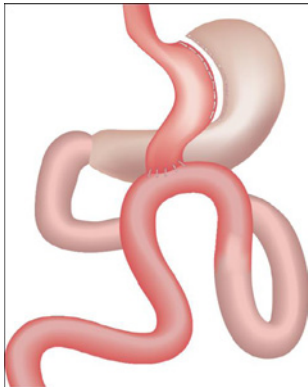


Figure 1: MGB created by horizontal division distal to crow's foot and then vertical division upwards (~18 cm) to the left of the angle of His. A 3 cm wide antecolic gastrojejunostomy is performed 200 cm (varied with BMI) distal to Treitz' ligament, providing malabsorption.

Modifications of the MGB

Prasad and Bhandari perform the MGB using robotics, which is very feasible [25,26].

Greco and Tacchino have performed >1,300 MGBs by Single-Incision Laparoscopic Surgery (SILS) [27]. They subsequently reported their modification of the MGB called the "ileal food diversion" [28]; they construct a larger gastric pouch, turning the staple-line toward the greater curvature leaving the fundus in place and perform the gastro-intestinal anastomosis 300 cm proximal to ileocecal valve, leaving a 300 cm common channel. This modification results in a "non-restrictive" MGB that functions like a Scopinaro biliopancreatic diversion.

After standard MGB, if ever necessary for inadequate or excess weight loss, the MGB can be modified by moving the GJ anastomosis distally or proximally, as a brief simple procedure [29]. The MGB can also be easily reversed in rare cases of intractable hypoalbuminemia or significant excess weight loss; reversal entails stapler-division along the GJ anastomosis (carefully inspecting the jejunal side), linear anastomosis of the gastric pouch to the matched bypassed stomach and closing the defect at the bottom of the gastric pouch with running suture [24].

The One-Anastomosis Gastric Bypass (OAGB)

This paper deals with the MGB. However, in 2002, after reading Rutledge's initial paper showing simplicity and safety of the MGB [1], Miguel Carbajo and Manuel Garciacaballero in Spain (who had been performing the RYGB for >10 years) began their variant of the MGB—the OAGB (or BAGUA-*Bypass Gastrico de Una Anastomosis*) (Figure 2), which has a similar malabsorptive component [30]. Because of suspicion by others of potential reflux and cancer, they designed a MGB variant with a side-to-side anastomosis of the biliopancreatic limb to the gastric pouch (rising on the remnant stomach), to facilitate emptying of biliopancreatic juice toward the efferent limb and thus prevent reflux [31]. The common limb (distal to the bypass) must always be ≥ 300 cm, to prevent malabsorption. In >2,500 patients, Carbajo has not needed to revise any OAGB for reflux.

Thousands of OAGBs have been performed in Spain and Mexico and it currently represents ~23% of the single anastomosis gastric



Figure 2: OAGB with gastric pouch (~15 cm) and an antecolic 2.5 cm latero-lateral anastomosis between pouch and afferent jejunal loop which is suspended above the anastomosis by an initial continuous suture which secures the loop to the gastric pouch's staple-line, with final fixation of the loop's apex to the bypassed stomach. Biliopancreatic limb averages 250-350 cm (diagram by Arturo Valdes Alvarez of Saltillo, Mexico).

bypasses. The MGB itself, with the *long* gastric conduit, has a GE bile reflux problem in <1.0% [14] (which may be treated conservatively or by Braun jejunojunctionostomy or RYGB). There has been no reported study comparing the OAGB to the MGB with respect to GE reflux. The OAGB takes slightly longer to perform and is slightly more difficult to reverse than the MGB.

Revision to MGB for Lap-Band or LSG Failure

After the lap-band or LSG, the MGB is being used as a salvage for weight regain [4,32]. In long-term follow-up after LSG, sleeve dilatation and weight regain are frequently found [33]. Also, GE reflux may be troublesome in >30% of LSG patients [34].

In revision of LSG to MGB, the surgeon must not construct a short gastric pouch (like the small pouch of the RYGB). A short high gastric pouch with bile near esophagus could lead to bile reflux esophagitis, like after the old Mason horizontal loop gastric bypass [35]. For the MGB, a *long* gastric conduit must be constructed to *below* crow's foot.

Discussion

In 2014, a consensus conference of MGB surgeons was held at IFSO Montreal [36], under the leadership of Pradeep Chowbey (President of OSSI, Past President of IFSO), Jean-Marc Chevallier (President of SOFCO), Robert Rutledge, K.S. Kular and M. Deitel. A SurveyMonkey® questionnaire was filled out by 73 experienced MGB-OAGB surgeons, who reported prior experience with the other operations-RYGB, banding and LSG. This is an academic group who carefully record their data. The survey identified 24,983 MGBs, with average pre-operative BMI 46.1 (range 35-63) [36]. Mean operating time was 60.7 minutes (range 35-127). Average hospital stay was 3 days (range 1-5) and decreased with experience. Leak was reported in 0.03% -6 patients (usually at the GJ), which is less than the troublesome proximal leaks following LSG [18]. Patients were usually ambulatory a few hours after surgery. Post-operative bleeding was reported in 7 patients (0.035%) and appears to be avoided by holding the stapler compressed for >30 seconds before firing. With hypertension, it may be advisable to reinforce the staple-line.

It was found that after MGB, EWL at 1 year was 76%, 2 years 85%, 3 years 78%, 4 years 75%, 5 years 70%, later 69%. The 30-day mortality was very low-0.2%. Many of the MGB patients were high-risk.

In USA, the second author of this paper (DEH) has had no operative deaths (i.e. within 30 days) in 1,450 patients over 13 years of MGB; the third author (CP) has had no operative deaths out of 1,800 MGBs over 13 years. Both surgeons were trained by Rutledge. There have been deaths of patients for other reasons in later years. Dr. Rutledge with 6,385 MGBs has had three operative deaths-the last in 2004. Peraglie found no deaths in his super-obese patients [23] and those age >60 [37].

GE reflux was found pre-operatively in 15.3±14.2% (SD) and post-operatively in 4.6±14.2% [36], i.e. GERD improved after the MGB, as demonstrated by Tolone [19]. About 1.5% of patients noticed bilious vomiting once every 3 months. The underlying cause may be an ulcer or a short pouch. With the long conduit, it was rare for a Braun jejunostomy or RYGB to become necessary for bile reflux (0.1%). Marginal ulcers were reported in 1.6±1.8% (range 0-5), which is slightly less than after RYGB [38]. Bowel obstruction due to internal hernia was not seen in most practices.

If GE bile reflux does occur, patients should be questioned about smoking and NSAIDs (which are prohibited), eating late at night and lots of fried foods [24]. If true bile reflux does develop, it may be managed with either initial medical therapy or surgical therapy with addition of a Braun enteroenterostomy (ensuring 300 cm of common limb distally) or conversion to RYGB. It is noted after MGB (as after RYGB) that alcohol is absorbed fairly rapidly. If persisting dyspepsia occurs, *H. Pylori* or pouch kinking should be ruled out.

H. Pylori (HP) stool antigen or breath test is checked pre-operatively and treated if positive. HP is eradicated with helikitt control before surgery. However, Rutledge has found that re-infection with HP may negate the value of pre-operative eradication therapy.

Intake requirements

If there is indigestion, a Proton Pump Inhibitor (PPI) is prescribed. A PPI is important in treating marginal ulcer, as is eradication of *H. Pylori* if present.

After MGB, supplements consist of multi-vitamins, calcium (preferably dairy or calcium citrate), yoghurt; vitamin D₃ 1,000 IU 2-3 times daily and an intestinally-absorbed iron supplement (Proferrin®-heme intestinal peptides). The duodenum where iron absorption normally occurs is bypassed in the MGB (as in the RYGB). Thus, in 5% of menstruating women, iron deficiency develops and requires increased oral iron or rarely IM or IV iron [39]. If B₁₂ levels fall, replacement by sublingual crystalline B₁₂ or injection becomes necessary.

Fruits and salads are well tolerated. Foods containing protein are important, e.g. meats, seafood, nuts and dairy. Patients prevent "dumping" (weakness, sweating and diarrhea) by avoiding high-glycemic foods. No intractable hypoglycemia has been reported. Fried, greasy, fatty foods cause cramps and diarrhea (steatorrhea) and are thus avoided.

Vegetarians must take protein-legumes (lentils, beans, chick peas, peanuts and quinoa), yoghurt, milk, soy (tofu) or whey protein, bran,

brown rice, etc. Vegetables have incomplete protein, but inclusion of multiple vegetables provides total amino acid requirements. In vegetarians and the elderly, it is advisable to bypass less than 200 cm of jejunum to avoid hypoalbuminemia [22].

Fear of development of cancer

After RYGB, lap-band or LSG, carcinoma of the gastric pouch and lower esophagus was reported in 46 patients [40-42]. After LSG, Barrett's esophagus may occur [43]. After MGB, no carcinoma in the gastric pouch or esophagus has been reported. However, in the Far East where the incidence of gastric carcinoma remains high, one gastric carcinoma in Taiwan 9 years after MGB has been reported in the bypassed stomach (but not in the pouch) [44]. Although some workers have compared the MGB to the Billroth II operation performed for peptic ulcer and cancer for 100 years, studies for development of gastric carcinoma after the Billroth II found a decreased incidence [45-47], even though *H. Pylori* was unknown and thus untreated. Furthermore, after performing >1,000 Vagotomy and Pyloroplasties (V&P) by the first author (MD) in the 1960s-70s for then-prevalent duodenal ulcer (with post-operative bile in the distal stomach), no gastric carcinoma has developed.

There was also fear of development of gastric cancer because of effects of bile and irritants on the rat's stomach. However, Frantz [48] showed that bile led to hyperplasia and neoplasia in the proximal two-thirds of the unique rodent's stomach (which is *squamous-cell*), but not in the distal glandular third (which corresponds to the human stomach).

Comparison with other bariatric operations

After LSG [32] and RYGB [49-51], weight regain has been found in the long-term. Comparative studies have documented more durable weight loss after the MGB [3,13,22,52-55]. Also, better quality of life has been found after MGB [56,57]. Regarding diabetes type 2, Lee reported greater elevation of GLP-1 after MGB than after RYGB [55].

Diabetes, hypertension and lipid abnormalities have shown superior remission after MGB [58,59]. Diabetes has resolved in 70-94% [22,60,61]. Kular found in diabetic patients with BMI <35 that HbA1c at 7 years after MGB was 5.7±1.8% [62]; earlier intervention resulted in higher remission rates. In the Indian population, co-morbidities of the metabolic syndrome often present at BMI 27. About 700 Canadians of Indian descent with metabolic syndrome (especially type 2 diabetes) have undergone MGB in India, with excellent resolution.

After the Spanish OAGB (BAGUA), the same resolution of type 2 diabetes and other co-morbidities has been found [63,64], including in the massively obese adolescent [65].

Conclusion

MGB has been fairly rapid and technically simpler and safer than other mainstream bariatric operations. Leaks or bleeding are rare. The jejunal bypass length is modifiable with the degree of BMI and the MGB has shown durable weight loss and co-morbidity resolution. The single non-obstructing antecolic GJ anastomosis constructed in easy view provides a technically easy option for revision or reversal. The MGB patient should be monitored for possible development of hypoalbuminemia and iron deficiency. The MGB and the OAGB are

now mainstream in most countries.

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