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Mini-gastric bypass: Prevention and management of complications in performance and follow–up

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ABSTRACT

The mini-gastric bypass (MGB) has proven to be a safe, rapid and effective weight-loss procedure. However, as with all abdominal operations, complications may still occur, and should be prevented if possible and treated appropriately. The authors discuss experience with the MGB.

1. Introduction

The MGB is a laparoscopic bariatric operation that combines a long gastric conduit and a jejunal bypass with a wide gastro-jejunostomy (GJ) (Fig. 1). The MGB was devised 22 years ago by Robert Rutledge [1,2], and has increased internationally [3–7] as a low-risk, rapid and effective operation. This paper relates experience with the MGB, which has superior resolution of co-morbidities and quality of life when compared to other bariatric operations such as the Roux-en-Y gastric bypass (RYGB) [8–10] and sleeve gastrectomy (SG) [10–12]. The MGB is also easy to revise in the uncommon event where revision is required.

1.1. Technique

The lesser curvature of the stomach is identified at junction of the body and antrum, opening lesser sac. The bottom of the MGB pouch is created by stapler-division perpendicular to the lesser curvature *below* the crow's foot. The staple-line of the gastric channel is continued upward parallel to the lesser curvature alongside a 32–40 Fr bougie passed by the anesthetist.

The pouch extends to the left of the cardia. Unlike the creation of the gastric pouch in the Sleeve Gastrectomy (SG) operation which has occasional proximal leaks [13], in the MGB the angle of His and left crus are *not* dissected; division is to the left of the cardia to avoid a leak.

Tolone et al. [14] demonstrated that the MGB has a low-pressure channel without gastro-esophageal (GE) reflux [15]. On the contrary, studies on the SG by Mion [16] and Doulami [17] demonstrate that the SG has a high-pressure channel with GE reflux, resulting in Barrett's esophagus [18–23].

If at the MGB operation a hiatal hernia (HH) is present, the HH is generally not repaired at this time (unless the HH contains a large fundus). The GJ anastomosis maintains downward reduction of a HH, added to by resolution of the patient's obesity [7].

The greater omentum is retracted medially to identify the ligament of Treitz. A point generally 180–200 cm distal to Treitz' ligament is identified, and a *wide* (4–6 cm) antecolic GJ is performed. There must be no twist in the gastric conduit.

A nasogastric tube is generally not used. Post-operatively, the patient should be monitored for at least a few hours. The intensive care unit is rarely needed, depending on the age, BMI, and comorbidities of the patient. Patients are often discharged within 1–2 days [24], if they can stay for a period within driving distance of the hospital. Routine follow-up is at 1 month, then every 3 months for the first 2 years, and then yearly.

The MGB is being performed increasingly as a revision for weight regain after the SG. However, again a *long* channel to below crow's foot must be created to inhibit bile reflux. Excess weight loss (EWL) at 1 year was 75.8%, 2 years 85%, 3 years 78%, 4 years 75%, 5 years 70%, later 70%. Post-operative leak was reported in 0.03% (5 patients) (usually at the GJ) [24], which is less than the dreaded proximal leaks following the SG [19].

In this paper, we do not discuss the OAGB, which is a related excellent operation (Fig. 2), and is also being widely performed [25–28].

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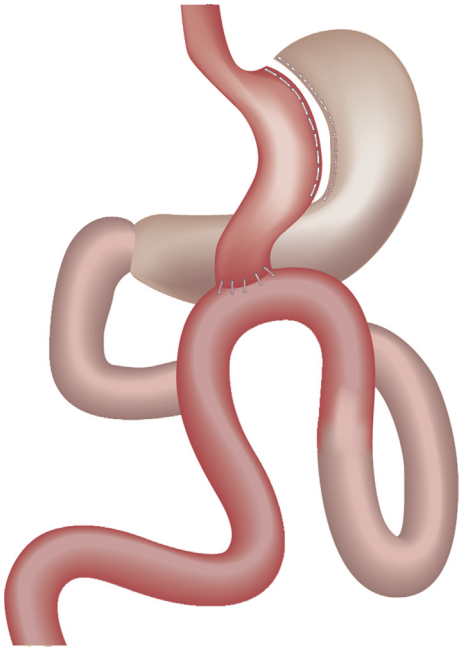

Fig. 1. The mini-gastric bypass (MGB). A long, lesser curvature, mildly restricting but not obstructing gastric conduit (starting from below crow's foot), is anastomosed in easy view (antecolic) to the jejunal loop, providing malabsorption.

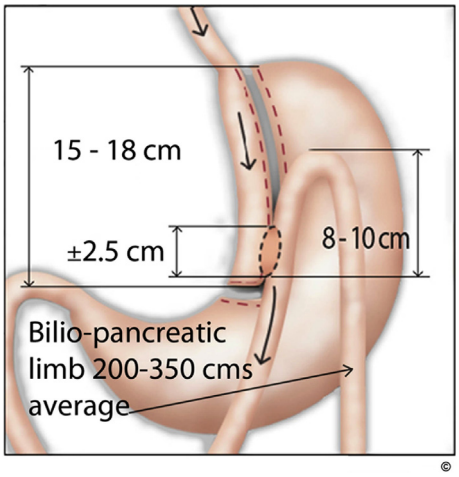

Fig. 2. One anastomosis gastric bypass (OAGB). Antecolic latero-lateral anastomosis between pouch and afferent loop which is suspended above the anastomosis by a continuous suture, with final fixation of the loop's apex to the bypassed stomach (Carbajo).

1.2. Mechanism of action of the MGB

The MGB anatomy (non-restrictive gastric pouch with non-obstructive antecolic GJ and 20–30% proximal jejunal bypass), results in fat and carbohydrate malabsorption and dietary modification. The jejunal length to the GJ may be tailored, depending on the BMI [29]. In the super-obese [30], very tall, or revision cases, many surgeons move the GJ beyond 200 cm distal to Treitz' ligament, and measure the entire length of the small bowel. In vegetarians, the elderly, or when used for type 2 diabetes, or in lower BMI patients, the jejunal bypass may be constructed at 150–180 cm. In the event of late weight regain or inadequate or excess weight loss, the GJ may be moved distally or proximally as a brief operation [31]. Rarely the patient presents with severe malnutrition; in this instance, reversal by side-to-side anastomosis of the pouch to the bypassed stomach (with takedown of the GJ), is indicated. Regarding type 2 diabetes, this resolved at 1 year in 91.4 ± 4.9% (range 82–96) [10].

1.3. Early complications

Studies have documented that as the complexity of operations increases and operative time lengthens, the risk of complications increases. The nature of the MGB (i.e. a straightforward, short operation, relatively easily mastered) lessens the type and frequency of complications.

Potential early complications include bleeding, infection, leak (not proximal), abscess, respiratory complications (atelectasis, pneumonia, aspiration, pulmonary embolism), and urinary infection and retention. In the second author's series [2] and in his 6400 MGBs, the early complication rate was < 5.0%. In the reports of Noun [3], Kular [5] and Lee [12], the incidence of early complications was likewise very low.

The routine course of the MGB patient is admission on the day of surgery, an operative time ~45 min with experience, and advancement of diet and ambulation in the early hours post-operatively. Pain is usually minor and well-controlled, and vital signs and O_2 saturation return to normal shortly after the operation. The management of the rare patient who has symptoms of fever, bleeding, infection or other general surgical complications leads to urgent re-exploration.

Because early complications such as pneumonitis, pulmonary embolism, and urinary tract infection are rare because of the short low-risk operation, central lines, arterial lines and urinary catheters are not used. However, if the patient is not doing well post-operatively, there is risk of an intra-abdominal complication. It has been found that delaying exploration while monitoring complete blood counts, plain x-rays, CT scan, Gastrografin® swallow, etc. are often misleading, and even when negative do not rule out intra-abdominal pathology. Thus, a protocol has been developed that has resulted in favorable overall outcomes, and is *as follows*:

For essentially any patient who shows significant signs of an abnormal recovery in the first 48 h, recommend urgent laparoscopic re-exploration. Existing diagnostic tests can be falsely negative, and the morbidity of laparoscopic re-exploration is minimal, as the ports are already in place. The consequences of missing or delayed diagnosis of a leak can be very major for the patient's health and the costs of care.

1.3.1. Fever

Fever in the post-MGB patient is unusual due to the short operative time, minimal dissection, and little trauma. In the rare cases in which a febrile course occurs, if leak or other intra-abdominal process cannot be ruled out, we recommend urgent laparoscopic re-exploration.

1.3.2. Bleeding

In the prospective randomized trial of Lee et al. [8,12], bleeding after MGB was 10 times lower than after RYGB. Bleeding is rare but can occur. Patients are taken off all drugs and foods that may affect coagulation. In symptomatic patients, the protocol of urgent re-exploration is applied, as well to avoid missing a leak.

1.3.3. Prevention of bleeding

Pre-op: A thorough history and physical examination to identify bleeding events and review medications (no salicylates, consider timing of anti-coagulation administration).

Intra-op: The nature of the MGB, the location of dissection (avascular planes), and no tension leads to a low risk of complications and bleeding.

Post-op: For fever, peritoneal irritation or hypovolemia after MGB, urgent re-exploration is indicated, and consider not being dissuaded by CBC, x-rays or other tests.

1.3.4. Infection, leak, abscess

As stated above, the incidence of this complication is very low in all reported MGB series, but when it does occur, it can be devastating to the patient, his or her family and the physician and surgeon. Again, the protocol for patients who show even minimal signs or symptoms of an intra-abdominal process is to proceed immediately to re-exploration.

1.3.5. Respiratory complications

The short operation, minimal anesthetic drug use, and the anesthetic techniques lead to very low rates of respiratory complications, including atelectasis, pneumonia and aspiration. Symptoms of atelectasis, treated with pulmonary toilet, are rare, but in the event that the symptoms are of even moderate intensity or length, the patient is per protocol considered for laparoscopic re-exploration.

1.3.6. Pulmonary embolism (PE)

The lack of clear warning symptoms for post-operative PE are well described. The occurrence of the PE at a later time is also well known. Again, the minimally invasive nature of the MGB may be the reason for the extremely low rate of PE following MGB. Standard prophylaxis includes sequential leg compression devices, TEDs and, depending on the surgeon's preference, pre-operative anti-coagulant. Minimization of trauma, early post-operative mobilization and ambulation, likely lead to the very low incidence of PE.

1.3.7. Urinary tract infection (UTI) and retention

Because the operative time is short with minimal hemodynamic effects, no Foley catheter is utilized, and UTI and retention are extremely uncommon.

1.3.8. Wound infection

Wound infection after MGB and later ventral port-site hernia (0.3%) have been rare [24].

1.4. Late complications

1.4.1. Complications of bowel surgery – stricture, obstruction

Bariatric surgery is GI surgery and the well-known complications of stricture and small bowel obstruction (SBO) can occur. Internal hernia and SBO have been very rare, in contrast to reports of RYGB [32]. In the MGB Consensus Study [24], 0.02% of the 37,094 MGBs developed an internal hernia. Still this can occur, and the patient should be warned to look for symptoms, and the patient's physicians and surgeon should be vigilant to recognize this very rare complication. Stricture is also rare, since, in contrast to the recommendation of many RYGB surgeons, the GJ in the MGB is designed to be a wide anastomosis. Thus, stricture rates are reported to be well under 1% [24], which is similar in the authors' series.

1.4.2. Dyspepsia/gastritis and fear of bile reflux

One of the biggest fears of surgeons who do not offer the MGB is “bile reflux”.

However, long-term studies of the MGB demonstrate that this fear is unfounded. Reflux is rare; rates of bile reflux are < 5% in all published series. Should bile reflux become an issue, patients should first be questioned about smoking, alcohol, improper food choices, eating late at night, chocolate, fried foods, and not leaving enough time prior to lying down. Non-MGB surgeons who may see MGB patients with any form of dyspepsia, often erroneously diagnose “bile reflux” and may even perform conversion to RYGB. In our Consensus Study, pre-operatively GE reflux was found in 15.3% and post-operatively in 4.72%, i.e. GERD improved after MGB [24]. Fromm has emphasized that symptoms are erroneously attributed to bile reflux [33]. Experienced MGB surgeons presented with post-operative MGB dyspepsia or frank ulcer recognize this as *acid-peptic pathology* – not bile reflux. The treatment protocol is straightforward: eliminate ulcerogenic agents (cigarettes, salicylates, excess alcohol, etc.), prescribe proton pump inhibitors (PPIs), dietary modifications and probiotics (yoghurt), and eliminate *H. pylori* if present [9,32]. This anti-acid regimen (not anti-bile) is routinely effective. MGB should not be performed in inveterate smokers and substance abusers.

1.4.3. Anemia

Anemia is common after MGB, similar to or less than the rates reported in the RYGB [29]. The anemia occurs primarily in young menstruating women, and occurs only rarely in males. This anemia is largely related to menstrual blood loss, in addition to bypass of the duodenum where most iron is absorbed. Thus, the primary intervention is to treat the menstrual blood loss. Additional treatment includes Proferrin® tablets (bovine intestinal heme polypeptide which is readily absorbed in the intestine) and, if necessary, intravenous iron [7].

1.4.4. Marginal ulcer

Acid-peptic disease can result in marginal ulcer at rates that are slightly less than after the RYGB. The treatment is the same (anti-acid peptic therapy) as described above [34]. Interestingly, Spain and India have had almost no ulcer occurrence after MGB.

1.4.5. Diarrhea, flatus and food intolerance

After MGB, there is fatty food intolerance with increased bowel movements and occasional visible fat in the stool (steatorrhea). Treatment is simple dietary modification by decreasing the fat content in the patient's diet.

1.4.6. Dumping

Postprandial dumping, both early and late, is part of the post-gastrectomy syndrome [35], and is uncommon after MGB. It is usually easily managed by an “anti-dumping diet”, to help slow gastric emptying into the small intestine (Table 1). There had been no intractable hypoglycemia.

1.4.7. Weak and dizzy, fainting

The MGB results in steatorrhea, mild diuresis and loss of body water [2]. This is advantageous, often resulting in resolution of hypertension, pulmonary edema and peripheral edema. Uncommonly, the diuresis is powerful; in such cases, careful attention to fluid intake can avoid dehydration.

1.4.8. Vitamin and mineral deficiencies

Supplemental vitamin D, iron, B-vitamins, calcium (as dairy), as well as yoghurt are prescribed after the MGB. As after the RYGB, vitamin and mineral deficiencies can occur. Proper dietary habit and blood-work to detect deficiencies are indicated [7].

Rapid weight loss can lead to temporary hair loss, resolution of gout preceded by a gouty flare-up, and cholelithiasis. Hair loss will stop after several months. Cholelithiasis can usually be prevented post-operatively by prescribing Actigall® (ursodeoxycholic acid) orally. MGB should be avoided in patients with hepatic insufficiency or cirrhosis and portal hypertension.

Table 1
Anti-Dumping diet.

Small, frequent meals
Eat small bites slowly and chew well
Eat protein: lean poultry, meat, fish, eggs, tofu, nuts, yogurt, some cheeses, and limited amounts of peanut butter
Avoid sweets and sugary foods, eg. candies, cookies, soda, juice and syrup
Eat whole grain high-fiber foods, apples, oats, beets, carrots, spinach and beans
Avoid high fat servings
Avoid liquids with meals – instead drink before or after meals

1.4.9. Calcium oxalate renal stones

Because of a degree of steatorrhea, dietary calcium (instead of normally becoming bound to fatty acids), is free to bind to dietary oxalate and be absorbed, rarely forming renal stones (0.1%). This can be avoided by reducing animal protein (such as meat, eggs, and fish), getting enough calcium from food or taking calcium supplements with food, and avoiding foods high in oxalate (such as spinach, rhubarb, nuts, and wheat bran).

1.4.10. Gout

Markedly obese patients have an increased rate of uric acid production. Gout often resolves following MGB. However, in the *early* postoperative period, there is the effect from crushing of stomach and extensive catabolism, leading to a transient rise in circulating nucleic acids and thus uric acid dihydrate crystals [36].

1.4.11. Fear of carcinoma unfounded

After the old Mason horizontal loop gastric bypass for obesity [37], bile reflux adjacent to the esophagus had the potential to cause esophagitis. Following the Billroth II gastrectomy performed for the past 100 years for peptic ulcer and gastric, studies for the development of carcinoma found a *decreased* incidence [38–41], even though *H. pylori* was not known or treated then.

There was also a lack of understanding of the development of neoplasia in studies of bile in the rat stomach. With bile-insertion studies in the rat stomach, Frantz and others [42,43] found that hyperplasia and neoplasia occurred in the *proximal* two-thirds of the unique rat's stomach (which is *squamous-cell*), but did *not* occur in the distal glandular third (which corresponds to the human stomach).

After the other bariatric operations, 44 cases of cancer have been reported [44–46]. However, after the MGB (which has a *long* lesser curvature gastric pouch), almost no cases of carcinoma have been reported [47]. One case of GE adenocarcinoma, found at 18 months after MGB in a 54-year-old Indian male smoker with heavy alcohol intake, has been reported; he had not had pre-operative gastroscopy [48]. However, after the thousands of vagotomy and pyloroplasty operations of the 1960–70s for duodenal ulcer (which permitted bile in the distal stomach), gastric cancer did not develop. Fear of gastric cancer after MGB appears to be unfounded [47].

2. Conclusion

The MGB is a fairly rapid, technically simple, low-risk operation, with only rare leaks, a single non-obstructing antecolic GJ constructed in easy view, the bypass length modifiable with the degree of BMI, durable weight loss, easily revisable by moving the anastomosis, and if ever necessary, reversible. However, the surgeon must be aware of strategies to prevent and treat the uncommon complications.

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Guarantor

Drs. Deitel and Rutledge accept accept full responsibility for the work and contents of this paper.

Declaration of competing interest

We have no conflicts of interest.

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