Laparoscopic One Anastomosis Gastric Bypass/Mini Gastric Bypass: MGB Technique

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Contents

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Abstract

The mini-gastric bypass (MGB) consists of a long, narrow lesser curvature gastric pouch beginning below the crow's foot, extending lateral to the esophagogastric (EG) junction, with a wide anastomosis to an antecolic jejunal loop at a point about 150–200 cm distal to Treitz' ligament, providing malabsorption. The operation is brief, simple, and safe, has provided reliable weight loss, and is now being increasingly performed. If needed, the biliopancreatic limb length can be easily adjusted for body mass index (BMI). The technique, complications, tips for performing a safe operation, and results are reported.

Keywords

Mini-gastric bypass · One-anastomosis gastric bypass · Omega-loop gastric bypass

Introduction

Since the first mini-gastric bypass (MGB) in 1997, the operation is becoming more and more popular due to increasing reports supporting the operation as a short, straightforward procedure with low complication rates and good outcomes [1–19]. This chapter includes a brief review of the physiology of the MGB [also called the One-Anastomosis Gastric Bypass (OAGB) and the omega loop gastric bypass]. The information presented is formed by the combined experience of Rutledge and Kular with over 10,000 MGBs [1, 3, 17]. In India, Kular and Manchanda [17] started MGB and documented that the MGB can be performed in a consecutive series of more than 1000 patients with extremely low risk and good outcomes in a community hospital. The emerging international reports of success with MGB, including controlled randomized trials by Lee et al., have added to the current interest [5, 12]. With the widespread use of the gastric band, the sleeve gastrectomy (SG), and the Roux-en-Y gastric bypass (RYGB), the question of "Why consider MGB?" arises. MGB overcomes some limitations of the other operations and offers many features of an ideal bariatric operation [1]. MGB is a short, simple, and low-risk operation. It has now been shown in short- and long-term studies that MGB results in significant weight loss, good resolution of comorbidities, and high levels of patient satisfaction [14–19]. In addition to the above advantages, it also offers the benefit of the ease of revision or reversal of MGB [10, 11, 20, 21]. The power of MGB comes from the fact that it has restrictive and malabsorptive components; additionally, it produces hormonal changes and also lowers the patient's bile acid pool. Studies show that a bariatric operation that includes a gastric and intestinal component outperforms purely gastric restrictive procedures like the band and sleeve gastrectomy [12, 14, 15, 18, 22, 23].

History of Mini-Gastric Bypass

Historically, the horizontal "Mason loop" bypass for morbid obesity was a modification of the high subtotal gastrectomy with Billroth II reconstruction but being anastomosed high near the EG junction, it had the potential for dreadful postoperative leaks due to tension on the high gastrojejunostomy (GJ) and the possibility of bile reflux. Thus, the RYGB was introduced by Griffin to overcome these concerns [24, 25]. RYGB is not an ideal procedure because of issues such as technical demand, internal hernia, gastrojejunal stricture, late weight regain, chronic abdominal pain, and difficulty reversing and revising [26–28]. These factors led to the development of the gastric band and sleeve gastrectomy. MGB was designed to overcome the limitations of RYGB and improve its outcomes [12, 29]. The goal was to create a powerful operation that was simple with minimal complications, a short learning curve, a high degree of efficacy, and also one that was easily reversed or revised [28, 29]. The Billroth II with antrectomy has been performed continuously since the late 1800sas a standard general surgery operation for peptic ulcer or antral carcinoma. Unlike the Mason loop, MGB constructs a lesser curvature gastric conduit to or below the crow's foot. An erroneous objection to MGB has been the potential development of gastroesophageal cancer from bile reflux. Data show that Billroth II gastrectomy is not associated with increased cancer rates [30–33]. Likewise, significant number of vagotomy and pyloroplasties (V & P) were performed in the 1960s/1970s, where bile moved proximal to the pylorus, but gastric cancer did not develop after V & P. Furthermore, experiments with bile applied to a rodent's unique stomach found that proliferative lesions develop in the proximal two-thirds which is squamous cell but not in the distal one-third which is glandular and corresponds to the human stomach [34, 35]. Out of a total of 64 reported cases of gastrointestinal carcinomas after bariatric surgery till date, there are two reports after MGB [36–40]. One case had carcinoma in the residual stomach, and the second one had it in the lower esophagus in the second year after MGB [41]. It is important to mention that no preoperative endoscopy was done in the latter case of a male who was a smoker [41]. A recent report of carcinoma of gastric cardia after MGB has been published [42]. The malignancy was detected 2 years after surgery. His preoperative endoscopy showed grade C esophagitis, but no biopsies were taken.

Technical Details in Performing Mini-Gastric Bypass

This chapter describes the original operative technique of MGB (Fig. 1). A short video of the original MGB technique by the authors is also attached in this chapter. There exist various variations to the operation which are good, in particular, the so-called OAGB with an anti-reflux afferent limb described by Drs. Garcia-Caballero and Carbajo of Spain [2, 4, 13]. This chapter specifically focuses on the widely adopted technique of MGB. There is a separate chapter for technical details of OAGB operation in this book.

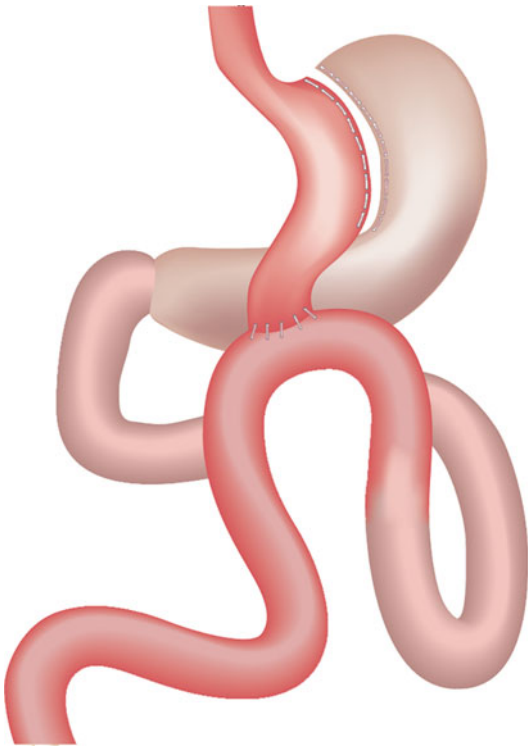

Fig. 1 Diagram of the mini-gastric bypass (one-anastomosis gastric bypass)

Patient Positioning

The patient is placed on the operating table, which is inclined to maximum reverse Trendelenburg and maximum left side up. This requires secure patient immobilization. The team should slowly test this position prior to draping the patient to confirm the security of the positioning and the stability of the vital signs.

Ports

Five ports are placed in a "diamond-shaped" pattern in the upper abdomen:

- 12-mm camera port in the midline approximately two handbreadths below the xyphi-sternum (ignoring the location of the umbilicus).
- 12-mm port in between the right midclavicular and anterior axillary line, 2–3 fingerbreadths below the right costal margin.
- 12-mm midline port (the surgeon's left hand working port), 2–3 fingerbreadths below the xyphi-sternum.

- 12-mm port in the left midclavicular line two to three fingerbreadths below the patient's left costal margin is the surgeon's right hand working port.
- 5-mm assistant port in the left anterior axillary line, 2–3 fingerbreadths below the left costal margin.

Constructing the Gastric Tube

The goal of this step is to eliminate the reservoir function of the stomach and to convert it into a nonobstructive extension of the esophagus. The mesentery at the crow's foot (the junction between the antrum and the body) on the lesser curvature is dissected for 2–3 cm, making a window into the lesser sac, cleaning the stomach to the gastric serosa in preparation for the later gastrojejunostomy. The first staple firing is critical in the creation of the gastric pouch. From the epigastric port angling down and toward the left lower quadrant, a 45-mm stapler is fired perpendicular to the lesser curvature.

It is common for new MGB surgeons to perform this step incorrectly as they often come from a RYGB background. The pouch in the RYGB is designed to be small and "tight" which is an underlying mechanism of action of the RYGB. However, the gastric tube of the MGB is not designed to be "obstructive"; although it does have a restrictive effect on intake, it is explicitly designed to allow the patient to eat comfortably. MGB needs to have a very long gastric pouch that is nonobstructive. To re-emphasize, the first stapler firing is critical; it needs to be perpendicular to the lesser curvature and far down on the lesser curvature to create a long pouch, keeping the daily stream of bile well away from the esophagus. Many surgeons even go further distal to the crow's feet for their first staple to create a long gastric pouch. There should be around 2 cm distance between the end of the first staple line and the greater curvature for free flow of gastric juice. Using the left-hand working port or the patient's right-side port, a second stapler is fired. Where the first stapler was fired from superior to inferior, perpendicular to the lesser curvature of the stomach, this next firing begins to turn the staple-line to now run parallel (not perpendicular) to the lesser curvature in the proximal antrum. A bougie (36–40F) is advanced under direct vision. The surgeon maintains attention on the left upper quadrant to report to the anesthesiologist if he/she can see any problems. Similarly, the anesthesiologist will continually describe the distance that the bougie has advanced as he proceeds. Then, through the patient's left subcostal (surgeon's right-hand working) port and parallel to the lesser curvature, the 60-mm stapler is repeatedly applied well lateral to the EG junction to reach the top of the stomach.

To restate, this technique is opposite to that of SG, where surgeons advocate a medial dissection into the area of the cardia, esophagus, and crura. While dissection of the EG junction may be necessary in SG to remove medial fundus, reported leak rates for SG procedure indicate that 3.5 out of every 100 primary cases may face the devastating and deadly complication of a high periesophageal leak [23, 43]. In MGB, the EG junction is explicitly avoided and not dissected. As to the use of the bougie in MGB, beware of an attempt to get greater weight loss by the error of

tightly applying the stapler to the bougie. Tension next to the bougie as it closes can lead to an insecure staple-line along the tube and the feared complication of a leak. Thus, with attention to meticulous handling of the tissue, try to make a relatively narrow pouch but never a tight pouch. The goal of the gastric pouch in MGB is to remove the reservoir function of the stomach and convert it to a purely transport tube, that is, to convert the stomach into a non-obstructed extension of the esophagus, where food does not stay in a reservoir but is dumped into the lumen of the jejunum.

Running the Bowel and Construction of the Gastrojejunostomy

Attention is now turned to the left abdominal gutter and the infra-colic compartment. The omentum is retracted medially, and the ligament of Treitz is identified. The omentum is not routinely divided. It can be divided in patients who are super-obese and the omentum is heavy. The bowel is run to a distance of approximately 150–200 cm distal to the ligament of Treitz. The length of the bypass is related to the amount of weight loss. A new MGB surgeon may be tempted to offer longer bypasses; however, experience has shown that as the length of the bypassed jejunum increases, the risk of excess weight loss and malnutrition increases [44]. A harmonic scalpel is used to create a gastrotomy and jejunotomy. A linear 45-mm blue stapler is used to create the gastrojejunostomy anastomosis (GJA), and the stapler defect is closed using either hand-sewn (absorbable sutures) or stapled techniques. A methylene blue leak test is advised for newer surgeons. As surgeon experience increases, the test becomes superfluous as the leaks are now not found during surgery. No nasogastric tube or abdominal drains are used (Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12).

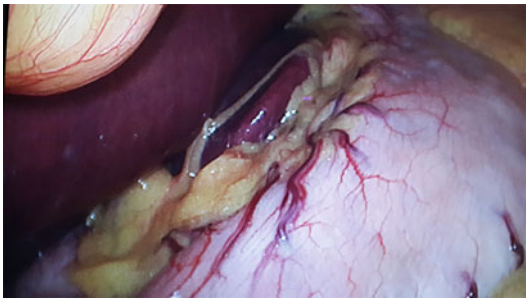

Fig. 2 Expected view of the abdomen using the ports described for mini-gastric bypass (MGB). On the left, is the blue retractor on the liver. On the right is the spleen. On the lower left is the omentum; on the lower right is the body of the stomach; and in the upper mid-portion of the picture is the inferior surface of the patient's left hemidiaphragm. The instrument on the left is passed via the midepigastric port using the left hand

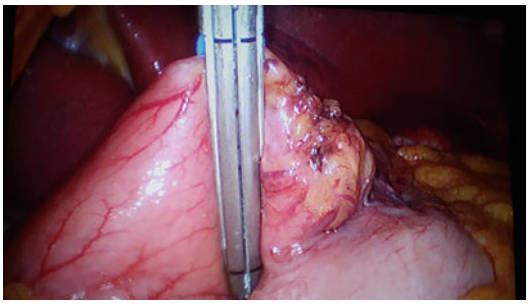

Fig. 3 The lesser curvature of the stomach has been skeletonized at the junction of the body and the antrum of the stomach and the first stapler is in place. Important: Note the angle of the stapler as it enters from the left upper corner of the screen and passes diagonally toward the right lower portion of the screen perpendicular to the lesser curvature

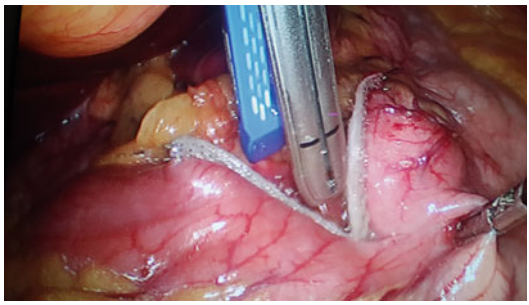

Fig. 4 The first stapler has been fired. This creates the new base of the gastric pouch and will be the location of the gastrojejunostomy. The stapler is passed via the midepigastric port using the left hand for this one and only staple firing

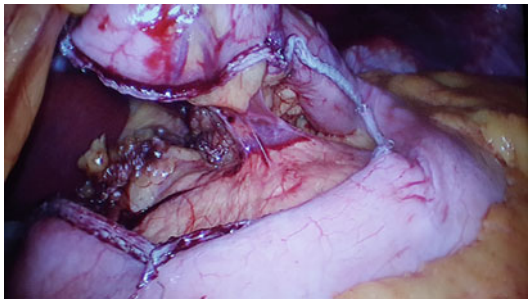

Fig. 5 The stapler is moved to the patient's left midclavicular line port and fired repeatedly parallel to the lesser curvature up towards the esophagogastric junction

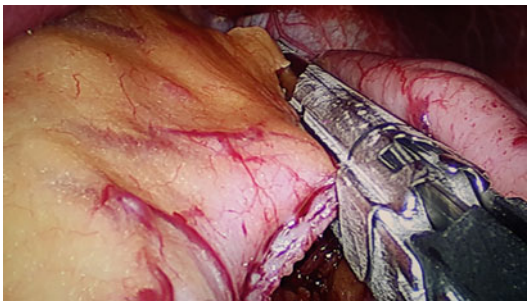

Fig. 6 Extreme care is taken to avoid the junction and stay well away from this dangerous area as the stomach is divided completely

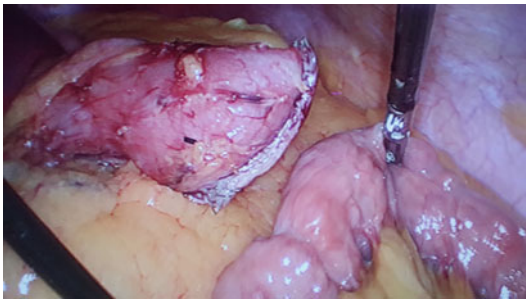

Fig. 7 The bowel is run to a distance of 2 m distal to the ligament of Treitz and the loop brought up along the left gutter to the tip of the gastric pouch. It is never necessary to divide the omentum

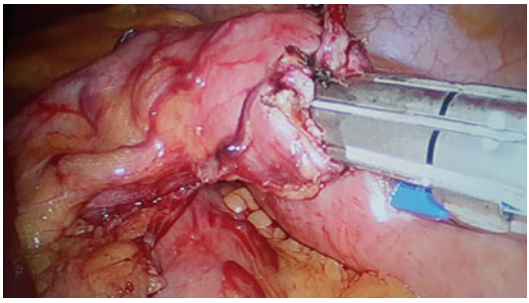

Fig. 8 A gastrotomy and enterotomy are created and a gastrojejunostomy is created. Care is taken to avoid a "twist" of the bowel loop

Critical Factors in Use of the Staple-Gun in Mini-Gastric Bypass

How to Prevent Staple-Line Bleeds

To prevent bleeding and obtain the ideal form of the staple "B" formation, "go slow to go fast."

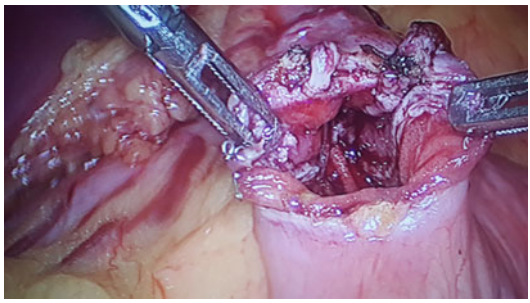

Fig. 9 The interior and exterior of the gastrojejunostomy is inspected for bleeding and security of the anastomosis. The bougie is very slowly and gently passed across the anastomosis into the efferent limb in preparation for closure of the defect

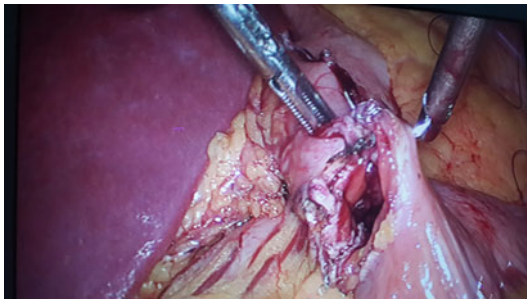

Fig. 10 The gastrojejunostomy is closed with staples or hand sewn

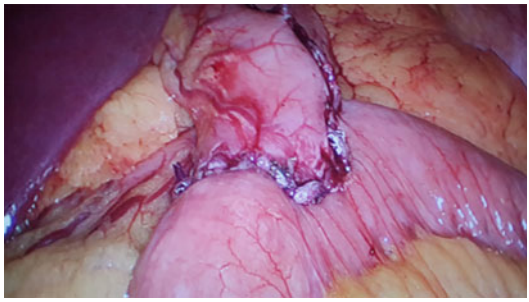

Fig. 11 The completed mini-gastric bypass

Direct pressure is the easiest way to control the bleeding to begin with. Selection of a stapler with the appropriate staple size for the tissue thickness can help prevent the problem with staple line bleeding.

Overly thick or thin tissue may result in unacceptable staple formation. Do not attempt to remove the shipping safety wedge until the stapler is loaded into the instrument. Do not squeeze the handle while pulling back the black retraction knobs. Do not attempt to override the safety interlock – doing so will render the stapler non-operational. Failure to completely fire the stapler will result in an incomplete cut and incomplete staple formation and may result in poor hemostasis. By slow

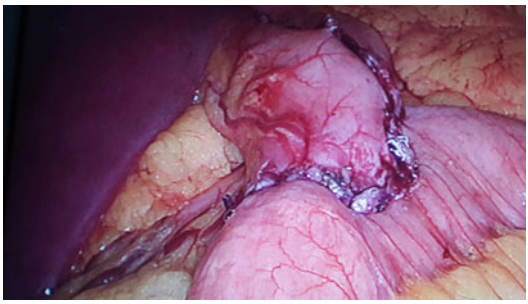

Fig. 12 Another view of the completed mini-gastric bypass (MGB) with the loop inflated. Note that routinely, MGB table does not include clips or clip applier; no suction is used and no irrigation is on the OR table for this case. In more recent cases, no sutures are used

meticulous application of the staple-gun, the procedure is actually performed in a more rapid manner, and the staple-line is secure and less likely to leak. This "slower" technique saves the time that could be required to deal with a bleeding staple-line.

Avoiding a Twist in the Pouch

Be careful not to cause a twist during the creation of the gastric pouch. As the surgeon advances the staple-line, there is a tendency to pull on the anterior wall of the gastric pouch, and the staple-line can rotate posteriorly, creating a spiral toward the back wall of the stomach and around toward the lesser curvature. This can cause obstructive symptoms, reflux, and failure of the operation, especially if not carefully managed at the time of the gastrojejunostomy.

Postoperative Period and Follow-Up

Oral clear liquids are started in a few hours when the patient is awake. Patients are ambulated within 1–2 hours of the operation and are usually discharged in 1–2 days. The first postoperative follow-up is done on the seventh or eighth day. The next follow-up visits are at 1, 3, and 6 months, and then yearly. Patient information on the length of stay, late complications (more than 30 days), resolution of the comorbidities, weight regain, and revision is recorded [45]. Patients' blood work in the form of hemoglobin (Hb), glycosylated Hb, blood sugar, renal function tests, liver function tests, lipid profile, and serum calcium, iron, vitamin D3, and vitamin B12 can be performed on follow-up visits and recorded. Multivitamin, iron, and calcium supplements are routinely prescribed to all postoperative patients. Follow-up upper GI endoscopy is done in symptomatic patients only.

Complications and Management

Immediate Postoperative Complications

MGB has shown low complication rates compared to the other operations [5, 14, 17]. Early intra- and postoperative bariatric surgery complications can occur and would require standard management as with bariatric or general surgical procedures.

Leak

Early leak, diagnosed in the first 48 hours, often can be closed with a suture repair. Late leak, diagnosed after 48 hours, is a dangerous situation and here, simple repair is not recommended but instead dividing the gastrojejunostomy and performing a gastro-gastrostomy recreating the preoperative anatomy is advisable [17].

Management of Late Complications

Late complications can occur in the form of some deficiency. A commonly seen deficiency, as in other forms of bariatric surgery, is that of vitamin B12, mostly seen in pure vegetarians. These patients can be treated with sublingual or injectable vitamin B12. Iron deficiency can be commonly seen in young menstruating females. This can be treated with iron supplements, oral iron porphyrin, or iron infusions [46].

Marginal Ulcer

The incidence of marginal ulcers is 1–6% which is similar to RYGB [3, 5, 17, 26, 27, 47]. These ulcers are acid-peptic in origin which are routinely managed by stopping smoking, removing ulcerogenic medications such as NSAIDs, steroids, and others, and prescribing proton pump inhibitors, H2 blockers, and probiotics. Regarding the fear of bile reflux, no anti-bile therapy is prescribed. Kular and Manchanda [17] reported a very low incidence of ulcers in the state of Punjab, probably owing to the fresh vegetarian diet and a minimal incidence of smoking. In the case of an intractable marginal ulcer or a perforation in smokers who refuse to quit, the operation can easily be reversed or converted to RYGB [29, 44].

Malnutrition: Hypoproteinemia

MGB is a powerful form of weight loss surgery. This impact on the patient's nutrition is good in those who are massively obese but can be too powerful in others, as shown by Robert M et al. in their YOMEGA trial [48]. In such cases, the decreased intake of calories and nutrients can lead to excess weight loss or nutritional deficiencies. Routine follow-up is necessary for the patient's lifetime, and in the event of excess weight loss or a specific deficiency, treatment such as extra supplements may be instituted. However, in some cases (0.5–1% in Dr. Rutledge's

series), significant specific or nonspecific excess weight loss and deficiencies have been treated by reversal of the MGB [17, 29, 44]. Fortunately, it is a very simple procedure involving a division of the gastrojejunostomy and then forming gastro-gastrostomy (gastric pouch to the existing gastric remnant), which usually is a very easy and simple procedure requiring less than 45–60 min in the operating-room. This is one of the real advantages of MGB: it has an "Exit Strategy."

Internal Hernia

Internal hernia has been widely recognized in RYGB patients, and all surgeons are alert to this complication [25]. A few reports of internal hernia after OAGB have been published recently [49–52]. As per the Consensus Conference Statement on One-Anastomosis/Mini-Gastric Bypass (OAGB/MGB), it was agreed that the routine closure of Peterson's space is unnecessary in MGB/OAGB [53]. Nevertheless, the patient and surgeon should be warned to look for the signs and symptoms that might indicate bowel obstruction [17].

Dumping Syndrome

Dumping syndrome can happen to anyone after a rapid and high volume of high osmolar food bolus or a large and rapid intake of sugars. Due to gastrojejunostomy in MGB, the patient is likely to be much more sensitive to rapid and large intakes of sugary foods or to boluses of food delivered to the small bowel. In general, these patients find sweets and liquid calories very hard to handle. Therefore, patients who undergo MGB find it difficult to handle sodas, ice cream, and candy except when they take those slowly and in small volumes. High volume fatty foods are also very poorly tolerated and often lead to bloating, diarrhea, and steatorrhea. Thus, MGB induces the patient to eat a very healthy diet that mimics, in most ways, the ideal Mediterranean diet. Patients who undergo MGB report increased intakes of yogurt, fresh fruits, and vegetables and a marked decrease in fatty foods, soda, and processed meats. The symptoms of dumping syndrome following MGB can usually be controlled with simple dietary modifications and rarely requires surgical intervention [54].

Diarrhea

In all MGB cases, the reported frequency of bowel movements increases from preoperative levels. In Dr. Rutledge's series, the number of preoperative bowel movements increased from a mean 0.5 per day to around two per day postoperatively, with a marked variation depending upon the dietary fat content [1, 3]. Significant diarrhea was seen in 4–5% of cases. This is often related to lactose intolerance in patients who do not recognize the issue and take in high dairy volumes. This can be managed by decreasing or stopping intake of dairy products, choosing fermented dairy such as yogurt, choosing low lactose dairy, and/or giving lactase enzyme orally. The surgeon should rule out that excessive long biliopancreatic limb (BPL) is not the contributing factor [55].

Steatorrhea and Flatulence

MGB interferes with fat absorption to a significant degree [17]. If a diet rich in fatty food is consumed, patients often have steatorrhea as a direct evidence of the decreased absorption of fat after MGB. This is simply managed by decreasing the fat content in the diet and by increasing the fiber content.

Bile Reflux

About 1–2% of patients complain of bilious vomiting once in 2 or 3 months [1, 3, 17]. The underlying cause of bile reflux in MGB can be an ulcer or an abnormal short-length gastric pouch. The most important intervention in these patients is the addition of probiotic foods such as yogurt and avoidance of high fat or high-volume meals. Often bile reflux indicates the presence of a marginal ulcer of acid-peptic origin. In such cases, as described above, the routine treatment is similar to that of any acid-peptic ulcer. In refractory cases (occurring in less than 1%) that do not respond to medical management, a side-to-side Braun jejuno-jejunostomy can be performed at least 60–80 cm distal to the GJA using a white cartridge. In severe cases, a conversion to RYGB is performed [55]. It is technically easy to perform. The afferent limb (BPL) can be divided with a stapler near the GJA and a jejuno-jejunostomy can be performed at least 70–80 cm distal to the GJA [53, 55].

Cholelithiasis

As is seen with all forms of weight loss surgery, the incidence of cholelithiasis can be anywhere from 4% to 10%. Ursodeoxycholic acid can be routinely used to prevent cholelithiasis for the first 6 months.

Weight Regain in Mini-Gastric Bypass

No bariatric procedure is perfect as people may have different eating behaviors and genetic make-up. MGB has the ability to be tailored easily. The length of the bypass can be adjusted easily in case the dietary modifications do not help [20, 29]. The gastric pouch is divided just above the GJA, and a new GJA is performed at the desired length of the BPL. Utmost care is taken that the gastric pouch length is not compromised and it is not shortened during this conversion.

Reported Results of Mini-Gastric Bypass

Weight Loss

The mean excess weight loss (EWL) at 6, 12, 24, and 60 months was 60.68%, 72.56%, 78.2%, and 76.6%, respectively, with this operation [55]. In the study by Kular's group [17], the average EWL at 2 years was 91%. Weight loss was well maintained over 5 years, with less than 5% of patients regaining more than 10 kg. A mean EWL of 85% was maintained over 6 years of follow-up [17]. Noun et al. [10] reported a mean EWL of 69.9% at 1 year, which persisted at 5 years (68.6%). Lee

et al. [5] reported 72.9% EWL. Carbajo et al. [4] reported a mean EWL of 75% at 1 year and greater than 80% at 18 months. Piazza et al. [11] reported a percentage excess weight loss (%EWL) of 65% at 1 year and 80% at 2 years. A recent systematic review by Parmar et al. [56] showed that MGB is a safe and effective option for the management of patients with BMI >50 kg/m^2 with the tailoring of the BPL. The mean %EWL in this group of patients at 12 and 18–24 months was 67.7% and 71.6%, respectively.

There is now literature available to show the role of MGB as a revisional procedure after failure of other primary bariatric procedures such as, gastric bands and sleeve gastrectomy [57]. A systematic review showed that the median BPL length in these revisional cases was 200 cm, and it was safe and effective with acceptable weight loss results and complications [56]. The mean %EWL at 1 year and 2 years was 65.2% and 68.5%, respectively, after revisional surgery [57].

Comorbidity Resolution

Many studies have shown resolution of several comorbidities after MGB. Of these, most commonly resolved comorbidities include type 2 diabetes mellitus (T2DM), sleep disorders, hypertension, and dyslipidemia [3, 10, 11, 17]. Other comorbidities that have been shown to be resolved after MGB include shortness of breath [3, 17], gastroesophageal reflux [3], and urinary incontinence [3, 10, 17]. In addition, several studies have also shown the advantages of MGB over other procedures like SG and RYGB, with regard to higher T2DM remission, mean decrease in HbA1c, and additional weight loss [14, 15, 19, 48]. Lee [12, 54] reported a higher resolution of T2DM with MGB than RYGB, and there was also a higher post-op rise of GLP-1. Interestingly, Garcia-Caballero and coworkers [13] performing One-Anastomosis Gastric Bypass in diabetics with BMI 24–29 kg/m^2 found resolution of T2DM in 77%, as well as a significant decrease in hypertension and hyperlipidemia. Parmar C et al. [58] in their systematic review showed that there was satisfactory evidence to consider MGB-OAGB as a safe and effective metabolic procedure for diabetic patients with a BMI of <35 kg/m^2.

Conclusion

There are many satisfactory choices for operations for morbid obesity. There are growing numbers of MGB advocates [59]. MGB has been shown to be a very safe and effective operation with durable weight loss and high levels of patient satisfaction. It is simple to reverse or revise and has a short learning curve for new surgeons who wish to adopt this operation. Although simple and straightforward, there are tricks and traps in the performance of MGB.

Key Learning Points

- MGB is a simple, rapid, and quite safe bariatric operation. It works mainly by causing malabsorption.
- It consists of a long conduit from below the crow's foot extending up to the left of the angle of His (the cardia is not dissected). An antecolic loop of jejunum 150–200 cm distal to Treitz' ligament is anastomosed antecolic. Bile reflux is generally not a problem, and fear of cancer is unwarranted.
- Excess weight loss is durable at about 80%, but the anastomosis can be constructed more distally for patients with super-obesity, and the anastomosis can later be moved if required in rare cases.
- Type 2 diabetes resolves in 90%, and resolution of other comorbidities has also been found to be higher than with other bariatric operations.
- MGB was first performed by Robert Rutledge in 1997 but has now become mainstream due to increasing number of published series showing its advantages over other bariatric operations.

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