Understanding the Technique of MGB: Clearing the Confusion

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2.1 Introduction

Since the first Mini-Gastric Bypass (MGB) was performed by Dr. Robert Rutledge in 1997, the MGB has had a long and circuitous route from conception to widespread adoption. Much of the 20-year gestation of the MGB was related to misunderstanding and confusion of some basics of general surgery, their application and the specific technique of the MGB. There is now recognition of the MGB as a good and maybe the best form of bariatric surgery [1–3]. The aim of this chapter is to provide the correct surgical technique of the MGB (Fig. 2.1), to seek the best results and avoid short- and long-term complications.

2.2 What a Bariatric Surgeon Should Not Forget

The gastric pouch of the MGB is analogous to the Collis gastroplasty and the bypass is equivalent to an antrectomy and Billroth II. In contrast to the anatomy and physiology of the Lap-band, sleeve gastrectomy (SG), Roux-en-Y gastric bypass (RYGB), the "banded" RYGB, the "banded" SG and various sleeve plus distal bypass operations such as the single-anastomosis-duodeno-ileal bypass, the gastric pouch of the

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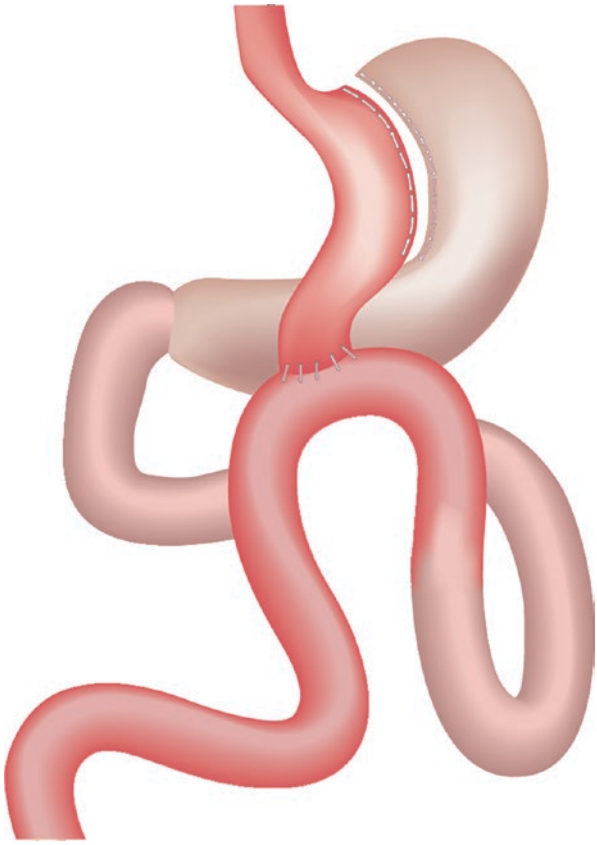

Fig. 2.1 MGB created by horizontal division distal to crow's foot and then vertical division upwards to the left of the angle of His. A wide antecolic gastro-jejunostomy is performed commonly 180–200 cm distal to Treitz' ligament

MGB is intentionally designed to be a "non-obstructive" conduit for food (like the esophagus) from its upper inlet to its outlet. Adding a moderate bypass to the MGB gastric pouch induces rapid gastric emptying into the mid-jejunum. This anatomy then produces an exaggerated post-gastrectomy syndrome physiology that makes sweets and liquid calories induce discomfort and any more than small amounts of fatty foods similarly relatively intolerable [4]. This effectively leads to an aversion to high calorie, high fat, "junk" foods, and encourages a six small meal diet of low sugar and low fat dietary choices that is equivalent to the standard general surgery "post-gastrectomy syndrome diet" and in many ways mimics the Mediterranean diet.

In this chapter, we will discuss the creation of the gastric pouch, the bilio-pancreatic limb and the end-to-side gastro-jejunostomy (GJ). The old Mason loop gastric bypass included a gastric pouch and loop-type GJ, but is not an MGB. Critics of the MGB often do not understand some of the basic components of the anatomy and physiology of the MGB, which are critical to differentiating the MGB from the old Mason loop horizontal gastric bypass [5].

To perform a safe and successful MGB, surgeons need to differentiate between the placement of a GJ within a few centimeters of the esophagogastric (EG) junction,

as opposed to antrectomy and Billroth II type reconstruction, in which the GJ is placed in the antrum. As can be seen in the MGB done by surgeons knowledgeable in the MGB technique, the completed GJ should lie distant from the left upper quadrant and usually at the level of transverse colon, far distal to the EG junction.

Unfortunately, surgeons and surgeons' websites incorrectly claim that they are performing the MGB, but the diagrams, or postoperative endoscopy/radiological studies demonstrate a short gastric pouch. The low-pressure pouch designed for the MGB, must be created 1–2 cm distal to the crow's foot, to protect the esophagus from GE reflux. When the GJ is performed between the long gastric pouch and jejunum, the MGB has been shown to be a very effective and safe operation. If the small bowel with bile is placed adjacent to the EG junction, bile may reflux into esophagus, leading to serious "bile reflux esophagitis".

The work of Theodor Billroth 100 years ago ushered in gastric resectional therapy, first for cancer and later for peptic ulcer disease. In 1993, Goh reported that laparoscopic Billroth II gastrectomy offers a minimally invasive option that is remarkably less traumatic for gastric ulcer and cancer [6]. General surgeons know that following a total or high subtotal gastrectomy, a Billroth II should not be performed, because of possibility of bile reflux esophagitis, and a Roux reconstruction is used instead.

2.3 Critical Factors in Creation of the MGB Gastric Pouch

The creation of the gastric pouch in MGB is different in its goals and performance than the proximal gastric pouch created in the Lap-band, SG and RYGB, which are restrictive AND "obstructive." After "obstructive" restrictive procedures, patients are forced to have "pathologic eating." Usual bulky healthy foods such as broccoli, sandwiches and apples are problematic, and ice cream, Coca-Cola, candy and other soft calories are easily consumed, leading to pathologic eating and later to weight regain. The MGB pouch and physiology are different, restrictive but NOT obstructive. In the MGB, the bougie size between 28 and 36 Fr is not critically important. Focusing on bougie size is often a hold over from the use of bougie in the SG. The MGB does restrict the intake of food but not via a stricture type obstruction and must not create a stricture/obstruction.

The MGB pouch is designed for relatively rapid non-obstructive transport of food from the esophagus into small intestine. Food passes rapidly into the small bowel. This results in the well-known general surgical post-gastrectomy syndrome and is managed by the patient's following a post-gastrectomy syndrome diet, which intentionally avoids sweets and liquid/soft calories; after MGB, fresh healthy foods are often well-tolerated, whereas sweets, greasy, heavy and so-called junk foods are poorly tolerated. The pouch diameter is equal to the diameter of the esophagus. The pouch length, GJ and Loop Billroth II are designed to recapitulate the surgical analogue of antrectomy and Billroth II.

In a survey of >3000 of our MGB patients, the postoperative meals were approximately 25% of what they ate pre-operatively—significant restriction, without

obstruction. The decrease is largely due to the "large" non-obstructive gastric pouch, the non-obstructive GJ leading to rapid gastric emptying, and the widely and well understood post-gastrectomy syndrome. After MGB, the patient is inhibited from eating sweets, high fat or high volume foods, and instead is induced into eating a "post-gastrectomy syndrome" type diet—high in relatively normal healthy food, such as an apple, sandwich or broccoli for example, which are often problematic for the Band/SG/RYGB patient.

The gastric pouch should lie such that the medial aspect (the mesentery of the lesser curvature) points directly the usual position of the ports to the patient's right and the neo-greater curvature (staple-line) points directly to the patient's left, with anterior and posterior walls of the pouch being equal.

It is important to avoid bleeding, which may occur if the staple-gun is applied rapidly. Rather, compression by the stapler is the primary component for the control of bleeding. The rapid firing of the stapler may lead to a need to control bleeding by cautery, clips and suture which may waste time and sometimes can compromise the staple-line.

A critical point in the performance of the MGB is management of the EG junction. SG surgeons have extensively focused on the need for extensive dissection of the EG junction. Numerous studies show that more than 90% of SG leaks occur at the EG junction [7]). SG leak at the EG junction is often a devastating complication. In the performance of the MGB, experience has shown that the EG junction should be avoided. The MGB technique explicitly avoids the EG junction, as there is no advantage to dissecting it and, as the SG experience shows, there is a great danger in this dissection. For the same reason, the final staple-line division of the stomach in the MGB is intentionally placed lateral to the EG junction (Figs. 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, and 2.10). Always perform the proximal division in the MGB lateral to the EG junction. Leaving a small amount of fundus behind is always acceptable (Fig. 2.11).

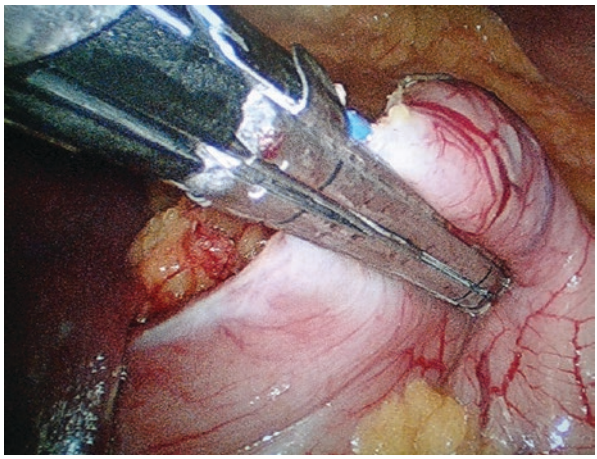

Fig. 2.2 The first fire, 45 mm blue, through the epigastric port

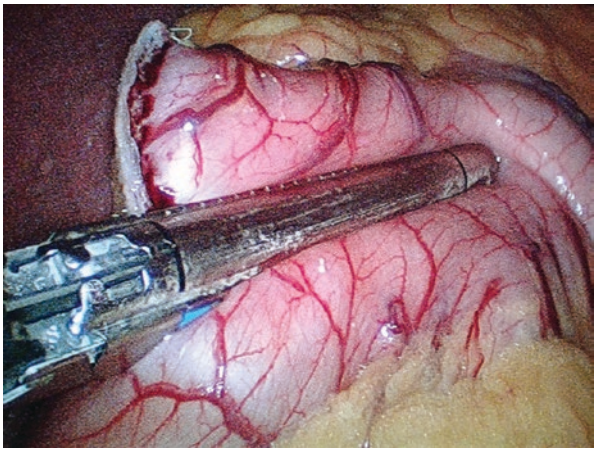

Fig. 2.3 Second fire from right subcostal port, parallel to the lesser curvature

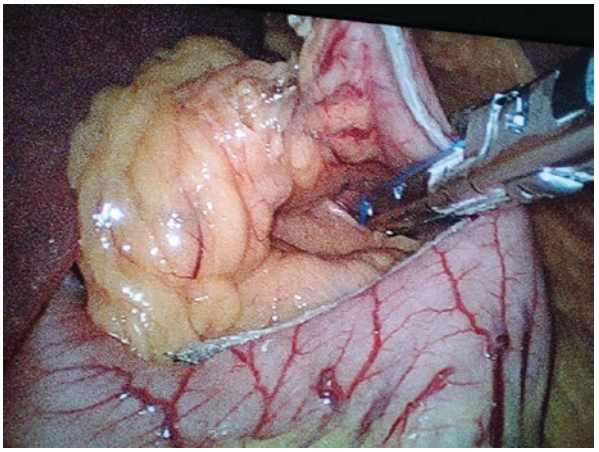

Fig. 2.4 Third fire from the left subcostal port, vertically upwards, along the lesser curvature

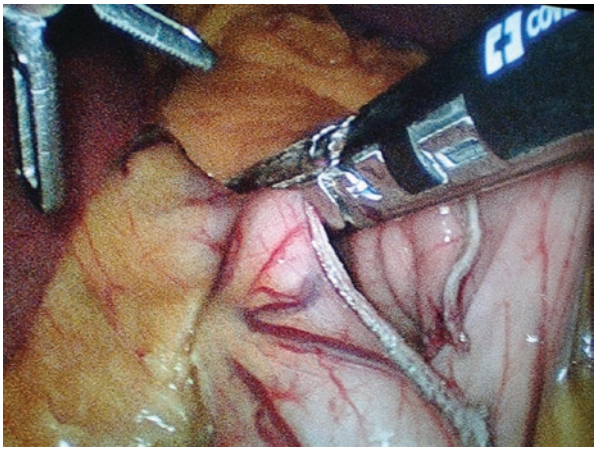

Fig. 2.5 Making the tube along the lesser curvature loose over the bougie

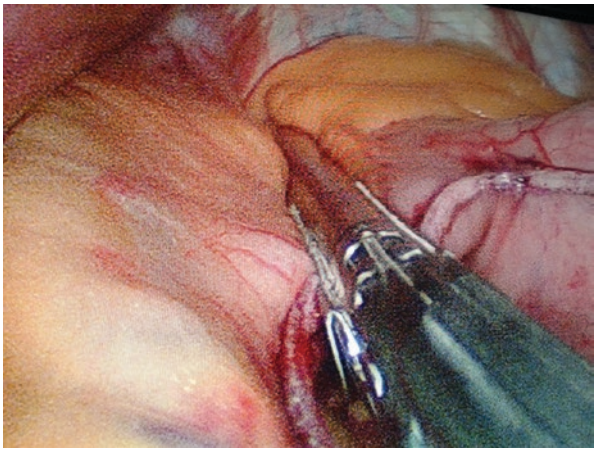

Fig. 2.6 Last fire on the gastric tube

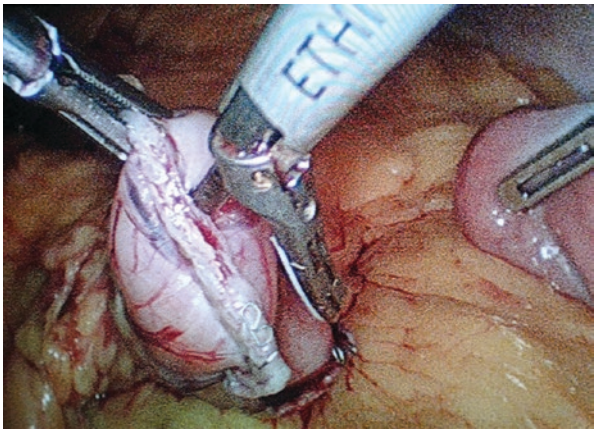

Fig. 2.7 Anterior gastrotomy at the tip of the gastric tube

Fig. 2.8 Antimesenteric jejunotomy, keeping the harmonic, the jejunum and the assistant's instrument in one line

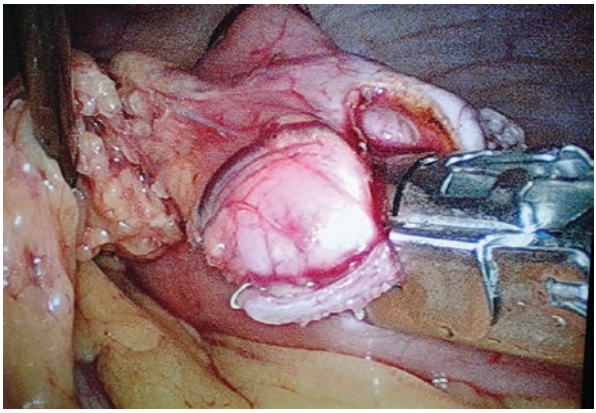

Fig. 2.9 Gastro-jejunostomy with 45 mm blue through the umbilical port, cutting the first staple in the middle

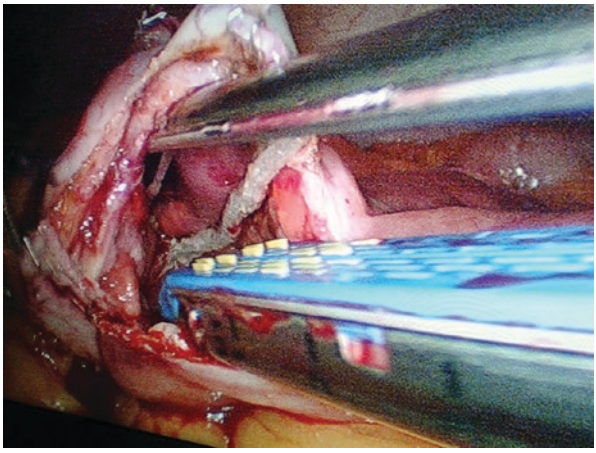

Fig. 2.10 Checking the anastomotic hemostasis

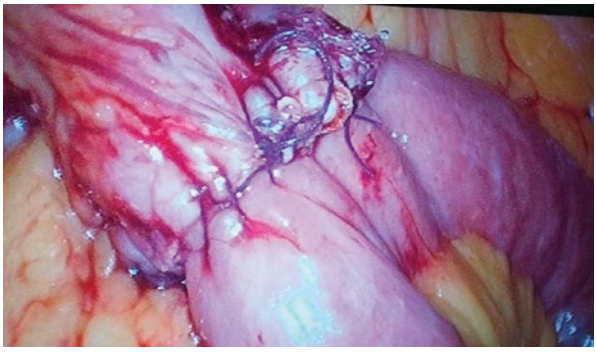

Fig. 2.11 Final gastro-jejunostomy view

2.4 Port Placement

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

(Fig. 2.12). Location of the ports is as follows: 12-mm camera port in the midline, 2 handbreadths below the xiphisternum; 12-mm retractor port in the right midclavicular line, 2–3 fingerbreadths below the costal margin; 12-mm midline working port, 2–3 fingerbreadths below the xiphisternum; 12-mm left working port, 2–3 fingerbreadths below the left costal margin in the midclavicular line; and 5-mm assistant port in the left anterior axillary line, 2 fingerbreadths below the costal margin.

2.5 Management of Hiatal Hernia

In patients with or without gastro-esophageal reflux disease (GERD) and a hiatal hernia (HH), the MGB technique explicitly avoids dissection of the EG junction, i.e., the MGB does *not* dissect the hiatus nor repair the crura. For a variety of reasons, including the fact that the MGB creates a low-pressure tube, the MGB leads to resolution of GERD to >85% [8]. Our experience of >6000 patients demonstrates that repair of a HH rarely needs secondary treatment. However, in the case of a massive HH, the stomach is reduced as a usual step of creating the gastric pouch and the patient is referred for further evaluation in 12 months.

The success rate of MGB in treating GERD is higher or equal to the success rate of Nissen or other forms of HH repair, without the attendant risks and complications of dissection of the EG junction proven by the experience with sleeve gastrectomy. In the uncommon event that repair of an HH remains necessary, this should be done 12–18 months later when the patient is healthier and thinner. In the author's experience, follow-up CT Scan and endoscopy have led to further intervention in only two cases with the placement of mesh in an uncontaminated field.

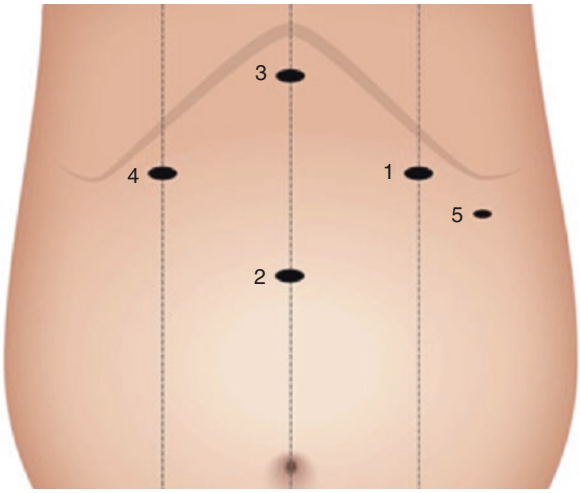

Fig. 2.12 Usual location of ports for the MGB

2.6 The Biliopancreatic Limb

The performance of the MGB should never require division of the omentum. Division increases reactive scar tissue and increases the risk of internal hernia and bowel obstruction. Leave the omentum alone; simply retract it medially. Run the small bowel hand-over-hand in the left mid-abdomen with atraumatic bowel clamps. With this technique also important visceral fat mass can be handled easily. Gentleness in handling the tissue is critical to avoid damage to the small bowel.

It should be recalled that the small intestinal length changes due to food, cold, pain and other forms of both parasympathetic and sympathetic tone. The bowel length varies moment to moment so that "perfect" bowel length is impossible to determine at operation. It is more important to be sure of having at least 2–3 m of small bowel distal to the GJ to avoid malnutrition. The MGB is unique in allowing the surgeons in consultation with the patient and referring physician to select either a conservative approach for biliopancreatic (BP) limb length or in selected cases the BP limb length may be tailored to meet the needs and desires of the patient, family and their physician. In certain circumstance where the patient has justification for a more aggressive approach, e.g., super-obesity or severe or progressive disease, the MGB allows the patient, family and surgeon to discuss a more aggressive approach on an individual basis, i.e., a longer bypass.

For example, 150 cm is relatively conservative with a predicted outcome of excess weight loss needing revision of 1/1000 cases. Whereas a longer bypass of 200 cm obtains 80–85% excess weight loss, it increases the risk of excessive loss to as much as 1% of cases, including malnutrition and vitamin deficiency. Either approach has merit, depending upon the needs and wants of the patient as well as the preference of the surgeon. Factors such as the patient's dietary choices (vegetarian), knowledge, follow-up capability, the surgeon's experience and outcomes with the MGB, as well as family and the societal issues all may be taken into account.

2.7 Measuring the Bowel Length

It needs to be understood that any attempt to measure bowel length is necessarily imperfect. Measuring the length of grasper tip (usually between 1.5 and 3 cm) and run the bowel length approximately 60 steps which translates to 3 cm (1.2 in.) at each grasp. Creating a biliopancreatic limb of ~180 cm is a reasonable choice, depending on the patient. Situations that may determine the choice of limb-length include overall illness of the patient, diabetes, older age, heart disease, a vegetarian diet, and problematic follow-up.

After identifying the site of the proposed GJ and the length of the BP limb and prior to proceeding, confirm that at least 2–3 m of small bowel is present distal to the GJ. Specifically, it is *not* necessary to run the entire small bowel.

2.8 Creation of the Gastro-Jejunostomy

The gastro-jejunostomy of the MGB is a critical part of the procedure, and it is not similar to the GJ created in the RYGB. GJ could be considered one of the most important steps in the MGB. Most surgeons new to the MGB have little idea of the importance of the GJ in the procedure. The sometimes stated and sometimes implicit in the SG, the Band and the RYGB is the idea of a high-grade obstruction, a stricture as the tool, which blocks eating and is the critical factor in the success or failure of the operation. This is not the goal or the mechanism of action of the MGB. This misunderstanding is so widespread as to be critical, so that it be restated in this chapter on several occasions. To restate this issue again: the goal of the GJ in the MGB is a wide open and non-obstructive GJ that allows easy and rapid emptying of the gastric pouch, mimicking the rapid and non-obstructed passage of food through and out of the esophagus. This new gastric pouch with the large non-obstructed gastro-jejunostomy then contributes to the mechanism of action of the MGB. The GJ is integral in the induction of the post-gastrectomy syndrome which acts to modify: (1) the types of foods that can be eaten, (2) the amounts of foods that can be eaten, and (3) the timing of when foods can be eaten. To reach these goals and avoid the failed obstructive restriction that occurs in the SG, the Band and the RYGB, the GJ must be formed correctly.

The technique of the GJ in the MGB follows the basics of usual general surgical principles that are often violated by other bariatric surgeons in other forms of bariatric surgery. The specific technique is described as follows:

After identifying the site on the bowel for the GJ, gently grasp the bowel loop to be anastomosed and move it to the left upper quadrant, making sure not to twist the afferent and efferent limbs of the bowel. The grasper holding the bowel is carefully given to the assistant to hold the loop in place in the left upper quadrant. Now attention is turned to the gastric pouch.

Carefully expose the tip of the gastric pouch. Evaluate the pouch and make certain it is not twisted.

The Gastrotomy: The initial gastrotomy is made immediately anterior to the lateral gastric pouch staple-line. It should be placed lateral to the medial aspect of the pouch (the lesser curvature of the stomach, the mesenteric border) and medial to the lateral border of the pouch, i.e., the *neo-greater curvature* of the pouch, the lateral pouch staple-line. The gastrotomy should be carefully sized equal to the diameter of the stapler anvil and no bigger.

The Jejunotomy: A jejunotomy is made on the anti-mesenteric border about 180 cm (150–200 cm) distal to Treitz' ligament. The biliopancreatic limb length depends on the choice as described above. The goal is to make the jejunostomy equal to and no larger than the staple cartridge itself. First dilate the jejunotomy with the anvil of the 60-mm cartridge. Remove the anvil, and place the staple cartridge in the bowel. Thread the edge of bowel all the way up to the cartridge junction with the anvil.

Now stop. The surgery is almost over, but we recommend at this point that you take your time. Critical factors in performing the gastro-jejunostomy include careful and meticulous positioning of: (1) the staple cartridge, (2) the gastric pouch, and (3)

the bowel which must be exactly aligned for a successful surgery. Proceeding slowly and carefully at this point will result in a good outcome. Ignoring these points means failure and post-operative problems for the patient. Take care here.

Once again, to emphasize the several important points: the gastric pouch and the bowel edges must meet exactly at the junction of the cartridge and the anvil of the staple-gun.

Warning: Inspect the stomach and bowel before proceeding and confirm the alignment of the gastro-jejunostomy. There should be no twist or "kink" in either the bowel or the gastric pouch.

The ideal MGB GJ has certain characteristics. Think again of the geometry of the GJ of the MGB. The gastric tube is defined as a tubular structure with an anterior and posterior surface; the medial border is defined as the lesser curvature, mesenteric border of the stomach, and the lateral aspect defined as the neo-greater curvature is the staple-line. These two borders should, in a "good" or ideal MGB, lead to an equal anterior and posterior surface. In an untwisted ideal MGB gastric pouch, the GJ anastomosis should be placed on the posterior wall exactly half way between the medial and lateral borders of the gastric pouch.

Distal Tip of the Gastric Pouch: Another critical and often misunderstood aspect of the MGB is the importance of the shape of the distal tip of the gastric pouch. The diameter of most staple-guns used in laparoscopic bariatric surgery is 12 mm. Thus, the minimum of 1.2 cm of the posterior wall of the gastric pouch of the MGB will be directly impinged upon by the staple-line and the staples and the damage of the staples crushing and coapting the two layers of tissue from the bowel and the stomach. On the medial aspect, the distance from the lesser curvature of the pouch to the staple-line of the GJ is not a concern, because the area is very well vascularized. However, remember that the lateral GJ staple-line creates an "ischemic zone" between the neo-greater curvature of the pouch and the lateral staple-line of the GJ. The area of concern is more and more at risk as the tip of the gastric pouch is narrowed. The potential for perfusion of this "at risk area" is increased as the size of the tip of the pouch increases. All this is simply to say "Make a large diameter tip to the distal end of the MGB gastric pouch," which is not similar to the teachings of the SG and the RYGB procedures.

In summary: when creating the gastric pouch for the MGB, it is important to avoid a "Bird's Beak" deformity with a narrowed distal tip of the pouch. In the ideal MGB pouch, the distal tip of the pouch should be larger than the body of the pouch, allowing for a wide "cobra head" effect of the distal tip to provide a wide perfusion field for the lateral aspect of the distal gastric portion of the GJ.

2.9 Proper Positioning of the GJ Stapler: Beware the Lateral Gastric Pouch Staple-Line

When applying the GJ staple-line, it is important to recall the power as well as the problems of the stapled GJ. In particular, it is important to realize that the security of the GJ staple-line is compromised if the GJ staple-line crosses the lateral staple-line

of the gastric pouch. To remind the surgeon, a staple-line may cross another staple-line at a perpendicular angle, but it may not be secure if it runs across the staple-line for a longer distance. The staple cartridge and anvil should not run longitudinally along the gastric pouch staple-line. Keep the gastric pouch staple-line out of the jaws of the stapler and more than a centimeter from the GJ anastomosis staple-line. There should be visible space on the posterior gastric wall between the lateral gastric staple-line and the staple cartridge and anvil (to avoid an ischemic island).

All the while remember to avoid tension or sudden motions that would tear the fragile small intestine, while creating the anastomosis.

2.10 Further GJ Points

Be careful to keep the gastric mesentery out of the GJ staple-line. Before firing, carefully and slowly evaluate the gastric pouch, the bowel and the staple-gun. Do not proceed until each element is perfectly placed. The authors have seen that in many cases new MGB surgeons struggle in this area, because of poor port placement and experience, and poor assistance. This step is one that needs preparation and attention, and the surgeon needs to be well prepared for this step along with his or her team ahead of time.

Be careful to assess the surgeon and assistant's arm and hand placement. Use appropriate arm and hand placement, so that this step is done smoothly. Dr. Rutledge moves the camera port to allow this to help with this step. Again, do not proceed until each port is perfectly placed. Now carefully and slowly close the stapler, and fire the stapler very slowly to use maximum compression to avoid bleeding.

"Slowly" is the watchword, e.g., 30 s of compression before firing. The staple-line MUST NOT BLEED.

The staple-line should not bleed post-operatively, because blood in this area leads to nausea and vomiting, and the enclosed space can result in rupture of the GJ or severe discomfort, with blood clot in vomit.

The stapled GJ is then completed, and the stapler removed.

Now the GJ should lie perfectly with the sweep of the bowel from the patient's left to right, with the GJ located approximately at the level of greater curvature of the stomach and the transverse colon.

If it is not perfect, consider dividing the GJ and performing another accurate and precise GJ. Do not leave it as "Good enough." If necessary, divide the GJ, advance 10–15 cm distal to the failed anastomosis and revise the anastomosis. Do not leave an imperfect GJ. This is one of the most critical steps of the operation.

2.11 GJ Closure

The final step is closure of the GJ. Here again, we see frequent violations of basic well-researched general surgery tenets by new MGB surgeons who are led into errors by either fear of leaks or residual application of the ideas behind the SG, the band, and the RYGB. Recall that the diameter of the GJ in the MGB should be large.

A few comments: Either a stapled or hand-sewn closure of the GJ is acceptable. A closure in one or two layers is acceptable, but NEVER MORE. Usually one layer is best when one layer is done well, as it avoids narrowing the GJ outlet.

Remember the basics of general surgery: the anastomosis heals with diffusion of oxygen in blood cells in the spaces between the sutures. This means that there must be 1–3 mm between sutures, and the sutures should not strangulate the tissue. Simple, but we have routinely seen these basics violated by new MGB surgeons.

2.12 Leak Testing

For the first 150 cases, we recommend leak testing of the anastomosis with air and/or methylene blue for demonstration of technical errors. After the first 150 cases, if the surgeon still finds leaks with air or methylene blue, he/she should consider retraining for laparoscopic surgery with another more experienced surgeon.

The critical factor is that a leak should be recognized early and managed easily, if the surgeon takes the appropriate interventions.

2.13 Discussion

MGB has been described as a "simple" straightforward technique; however, in the hands of physicians and surgeons with an incomplete knowledge of the underlying anatomy and physiology, the operation can lead to serious complications. Most importantly, the GJ must not be placed high on the stomach near the esophagus, so that bile GE reflux will not occur. A long gastric pouch will minimize this complication. Patient and family education, strict daily supplements, and follow-up surveillance are mandatory to prevent severe hypoalbuminemia, especially in vegetarians, and anemia, especially in menstruating women. Limb lengths, prevention of GE reflux, diet and nutrition, and related essentials are covered in this book by the experts.

Conclusions

The MGB has been misunderstood for almost 20 years, primarily by American surgeons, who failed to differentiate the old Mason loop gastric bypass which violated basic general surgical principles, from the MGB. The MGB is nothing more than a close analog to the widely used and well researched antrectomy and Billroth II operation that was and is a foundational procedure in GI surgery for more than 100 years. Whereas the old Mason loop placed the Billroth II loop high on the stomach adjacent to the EG junction, the MGB places the Billroth II loop distal to the EG junction at the level of the antrum. New surgeons are still today making this same mistake and calling that procedure an MGB. The MGB mechanism of action is different from the obstructive restriction that is the foundation of the SG, the Band, the VBG and the RYGB. Instead the MGB models itself on the well known post-gastrectomy syndrome that leads to restriction of so-called junk foods like sweets, liquid calories, fatty and greasy foods, while

encouraging a diet of healthy foods in 6 small feedings. This leads to anatomic differences in the MGB from older operations (SG, Band, RYGB) that new MGB surgeons need to understand to avoid resultant failure of the MGB. The MGB, when well and completely understood and only when well understood, is a short simple and very powerful operation, which has added advantages of the ability to tailor the operation to the desires and opinions of the surgeon and the patient and family. It is also easily reversible and revisable. For all of these reasons, we urge surgeons to spend the time to understand the details of this very powerful operation for the treatment of obesity and metabolic diseases.

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