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Original Research Article

Laparoscopic gastric plication: towards standardization

Ahmed Abdel Monem Ibrahim[1]*, Ahmed Elgeidie[2], Nabil Gadelhak[2]

[1]Department of Surgery, Mansoura University, Mansoura, Egypt
[2]Gastrointestinal Surgery Center, Mansoura University, Mansoura, Egypt

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***Correspondence:**
Dr. Ahmed Abdel Monem Ibrahim,
E-mail: ahmedmonem69@yahoo.com

ABSTRACT

Background: Laparoscopic gastric plication (LGP) is a restrictive bariatric procedure which was found to be safe, effective and economic as well. However, it hasn't a good reputation among some bariatric surgeons due to some reasons; the most important of them is lack of standardization. Objective of the present stud was to study propose a standardized technique for LGP aiming at a better outcome. Setting. Settings: University-affiliated hospital.
Methods: This is a retrospective analysis of patients who underwent LGP by the proposed technique., using seromuscular bites with non-absorbable thread, adoption of the four-bite technique, and calibration using bougie.
Results: Eighty-eight consecutive morbidly obese patients had been operated by the proposed standardized technique of LGP between March 2010 and September 2014. There were 19 men and 69 women, with a mean age of 30.3 years and a mean BMI of 36.7kg/m^2 (range 32-51kg/m^2). The most frequently reported complication was prolonged early postoperative nausea/vomiting occurred in 5 of 88 (5.7%) patients. Weight regain was reported in one patient who was treated with conversion of LGP to laparoscopic mini-gastric bypass. Hospital stay was prolonged for a mean of 6.0 (3 -10 days). Postoperative follow-up period ranged from 2 to 38 months with a mean of 15 months. Percentage of excess weight loss was 38.2%, 52.0%, and 63.1% at 3, 6, and 12 months, respectively.
Conclusions: The proposed technique of LGP would help in standardization of the procedure in order to improve the outcome; however, the clinical application of this proposed standardized technique should be tested by future studies.

Keywords: Bariatric surgery, Calibration, Gastric plication, Laparoscopic, Suturing

INTRODUCTION

Laparoscopic gastric plication (LGP) is a fairly new restrictive weight loss surgery that seems attractive to many surgeons and many morbidly obese patients who do not want to use traditional methods and like to preserve their stomach without changing their body physiology. Being a conservative surgery, LGP has many advantages. It requires no gastric resection nor gastrointestinal anastomosis and no use of staplers thus greatly avoiding staple line-related complications particularly leakage and bleeding. Unlike laparoscopic adjustable gastric banding, there is no foreign body placement or need for adjustment. It is potentially reversible and allows replication or revision to other forms of bariatric surgery. Moreover, it is not associated with major nutritional deficiencies. The financial burden of bariatric surgery is of major concern particularly in developing countries and LGP could be offered to such patients.

Despite all these benefits of LGP, the American society of metabolic and bariatric surgery (ASMBS) issued a policy statement about LGP containing the following recommendations, gastric plication should be considered *"investigational"*, reporting of short- and long-term safety and efficacy outcomes in the medical literature is strongly encouraged, and any marketing or advertisement for this procedure should include a statement to the effect that this is an investigational procedure.[1-3,9] Some authors

see that LGP may have no future in management of morbid obesity.[10] Another prospective non-randomized study concluded that LGP is inferior to LSG as a restrictive procedure for weight loss, despite its significantly smaller cost at short term.[11]

This lack of enthusiasm in LGP could be due to three main reasons which are:

- Lack of long term outcome and concerns of weight regain,
- Difficult management of failed plication
- Lack of standardization of the technique.

The aim of this study is to propose a standardized technique of LGP in an effort to obtain the best weight loss outcome and to reduce the complications at the same time.

METHODS

The position of the patient on the operating table is standard in all cases, in an anti-Trendelenburg position at 30-degree French position (operator between legs) and two assistants on each side of the patient.

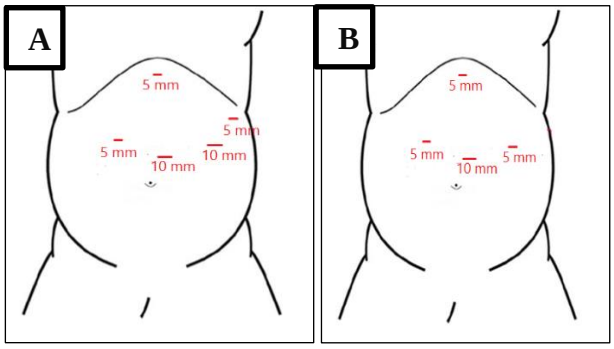

Figure 1: (A) Traditional port design at LGP; (B) Proposed port design.

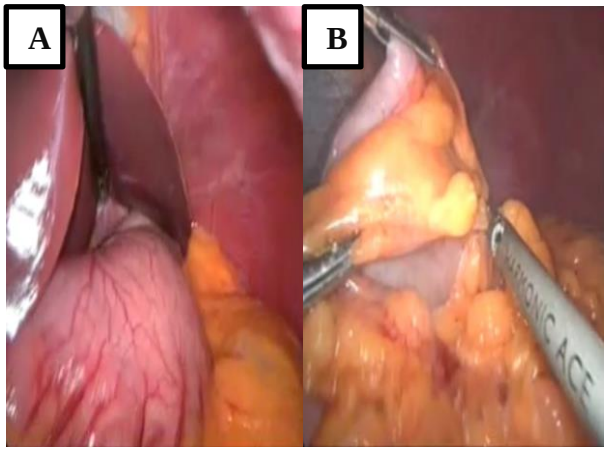

Figure 2: (A) Assistant grasper used for left liver lobe retraction; (B) Assisting grasper used for aiding upper short gastric vessels division.

Most of bariatric surgeons use five ports for LGP, in this proposed technique.

Figure 3: Needle introduction through the camera port after camera withdrawal.

Devascularization of the greater curvature can be done using harmonic scalpel, vessel ligation system, or even ligature.

Also thermal injury can avoided by stay away from gastric wall from 1 to 2cm.

Also stop dissection before the angle of hiss 2cm to prevent reflux is an important point.

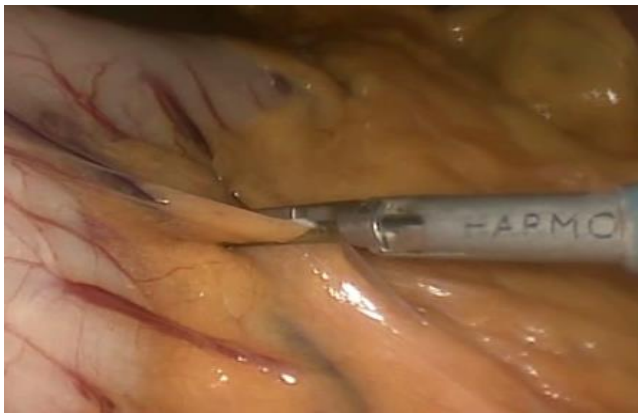

Figure 4: Starting devascularization of the greater gastric curvature at the midportion of the stomach 2cm away from gastric wall and outside the vascular arcade.

Calibration

Calipration of the plicated stomach can managed by different sizes calibration tubes ranging from 36-Fr to 48 Fr nasogastric tube.

Stomach is measured transversely at the level of 6cm below gastroesophageal junction (x-cm) and plication formula is applied to determine the amount of plication

(y=(x+1)/2). Stomach is marked from lesser curvature side y cm away then start to plicate greater curvature two layers at this point [Anterior marking (y) and Posterior marking (End of Lesser curvature vessels)] (Figure 8).

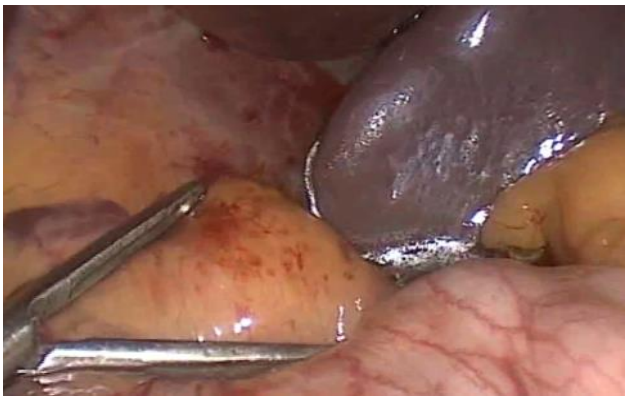

Figure 5: Leaving the angle of His intact and measuring two cm from cardio-esophageal angle as a starting proximal point of plication.

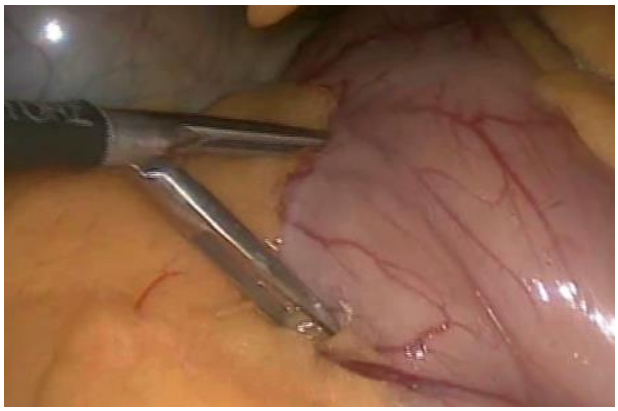

Figure 6: Measuring the distal limit of plication.

Figure 7: Division of retro-gastric adhesion for proper gastric wall invagination.

Suturing

In the past anterior wall plication was done without devascularization of greater curvature with poor results.

The inner layer of sutures should begin 2 cm below the cardioesophgeal junction (Figure 10). This important step helps to avoid obstruction of the cardia by the invaginated intraluminal gastric septum and subsequently reducing the incidence of early postoperative nausea/vomiting.

The risk of minor perforations become more higher if the non absorbable sutures taken full layer.

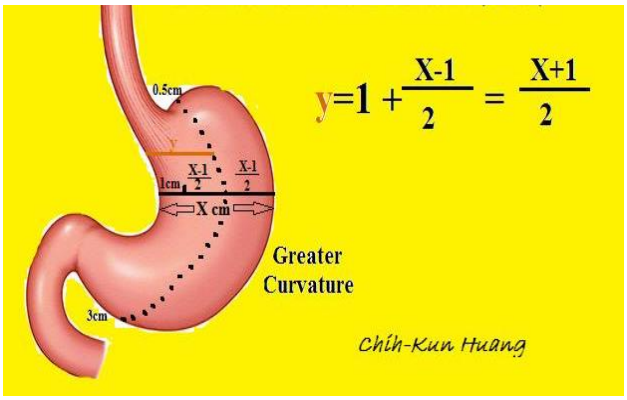

Figure 8: Huang's Gastric plication formula.

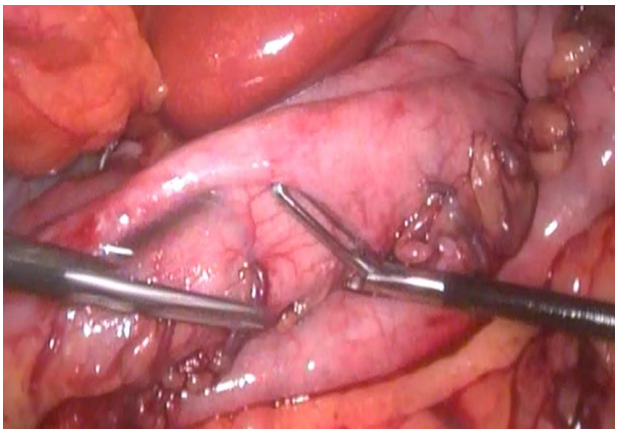

Figure 9: Bougie in place for calibration of plication.

Figure 10: Proximal point of plication beginning 2cm below the angle of His.

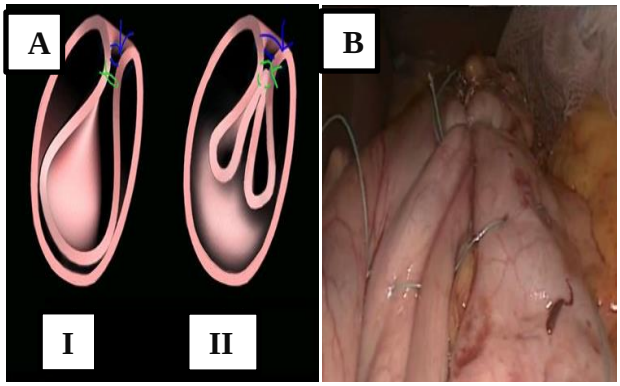

Figure 11: (A) Schematic presentation of two-bite technique (I) and four-bite technique (II) of LGP. (Quoted from ref 3), (B) Operative view of the four-bite technique.

The four bite technique which invaginates the greater curvature into small intraluminal gastric folds will decrease postoperative hospital stay and prevent seroma collection.

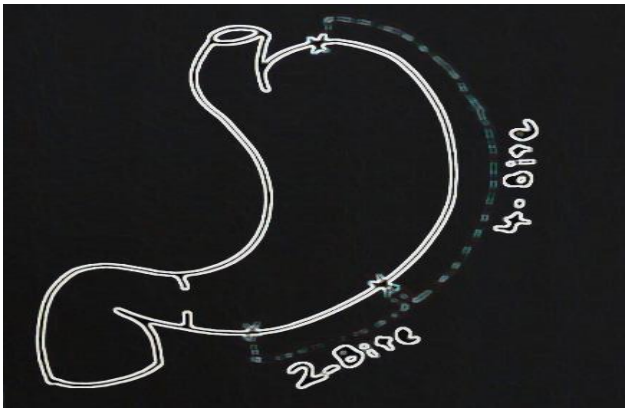

Figure 12: Four-bite technique for the proximal gastric portion and two-bite technique for the distal one.

Continues non absorbable sutures with proline 210 help is more safe to prevent leakage.

RESULTS

The data of morbidly obese patients who were underwent LGP by our standardized technique were analysed. We previously published our results on 63 morbidly obese patients.[22] Herein, we update our results on 88 consecutive patients between March 2010 and September 2014. There were 19 men and 69 women, with a mean age of 30.3 years (range 19-52 years) and a mean body mass index (BMI) of 36.7kg/m^2 (range 32-51kg/m^2). An informed consent was obtained from all patients, and our local ethical committee approved the study.

There were no deaths, no conversion to laparotomy, and no readmissions. The most frequently reported complication was prolonged early postoperative nausea and vomiting and occurred in 5 of 88 (5.7%) patients. Those patients had been successfully treated with intravenous fluids, parenteral proton pump inhibitors and antiemetics during their hospital admission, and they were discharged once they tolerated oral drinks. One major complication was reported. This patient had an early leak from the site of upper stitch, and the leak was detected in the first postoperative night and managed by conversion to laparoscopic sleeve gastrectomy. Weight regain was reported in one patient who was treated with conversion of LGP to laparoscopic mini-gastric bypass. Hospital stay was prolonged for a mean of 6.0 (3-10 days). Postoperative follow-up was possible in all patients either via outpatient clinic visits or phone call contact. The follow up period ranged from 2 to 38 months with a mean of 15 months. Percentage of excess weight loss was 38.2%, 52.0%, and 63.1% at 3, 6, and 12 months, respectively. Table 1 shows resolution/ improvement of comorbidities after LGP.

Table 1: Resolution of comorbidities after 12 months in the two groups.

	Outcome at 6 months	Outcome at 12 months
Δ Hypertension, n	3/14 (21.4%)	3/13 (23.1%)
Δ Type 2 diabetes, n	3/5 (60%)	3/5 (60%)
Δ Dyslipidemia, n	2/17 (11.7%)	5/17 (29.4%)
Δ OSAS, n	5/7 (71.4%)	4/5 (80%)
Δ Back/joint pain, n	3/10 (30%)	7/10 (70%)

*Δ denotes remission/improvement of patients with the diagnosis of comorbidity in relation to the baseline prevalence.

DISCUSSION

Patient positioning on the operating table is standard in all cases, in an anti-Trendelenburg position at 30-degree French position (operator between legs) and two assistants on each side of the patient.

Most bariatric surgeons use five ports for LGP one 10mm port for the camera which is placed about 20cm from xiphisternum slightly to the left of the midline to avoid the bulky falciform ligament, one 10mm port for the surgeon's right hand and for introduction of the needle, one 5mm port at the right midclavicular line and at (or slightly above) the level of the umbilicus for the surgeon's left hand, one 5mm port at the left anterior axillary line for the assistant, and 5mm port for liver retractor (Figure 1A). In our proposed technique, the number of ports could be reduced to 4 instead of 5 (Figure 1B). The surgeon can dispense the assisting port (at the left anterior axillary line) since the assistant grasper is introduced instead of liver retractor via the port placed immediately below the xiphisternum. This assisting grasper could aid in different jobs during LSG. It helps in liver retraction, in devascularization of the greater gastric curvature, and in holding the gastric

fundus up during division of the upper short gastric vessels and dissection of the fundus (Figure 2).

At the same time, the surgeon's right-hand port could be 5 mm instead of 10/12mm. 5mm port is enough for introducing the energy source used for dissection/devascularization and at the same time does not require closure at the end of the procedure. The needle, and even sponge, could be introduced through the 10mm port of the camera upon camera withdrawal (Figure 3).

For division of gastrocolic and gastrospleric omenta and liberation of the gastric greater curvature, different energy sources were used by LGP surgeons including Harmonic scalpel (Ethicon Endo-Surgery, Cincinnati, Ohio), Ligasure™ Vessel Ligation System (Covidien), or even diathermy. However, there is an agreement among most surgeons to start devascularization at the midportion of the stomach due to few adhesions thus facilitating greater sac opening.[12]

It is crucial during this step to stay 1-2cm away from the gastric wall. This is important to avoid thermal injury of the gastric wall with the subsequent risk of leakage, and to keep remnant of the omentum that could be used as a useful landmark for proper gastric walls suturing and invagination (Figure 4).[3,13,14] Some authors claim that preserving the gastroepiploic arcade with its lymphatics reduces edema of placated gastric walls and thus greatly minimizing postoperative nausea/vomiting.[14] The caudal point of devascularization is almost fixed and it is about 3-4cm proximal to the pylorus. However, there is no agreement about the cephalid limit. Talebpour and Amoli stopped 2cm below the angle of his.[14] In addition, Ramos et al removed the esophageal pad of fat, while Skrekas and Antiochos preserved the pad.[3,14,15]

It would be more appropriate not to expose the left crus of the diaphragm and to stop dissection 2 cm below the cardioesophageal junction preserving the angle of His (Figure 5) which has a definitive role in the anti-reflux mechanism aiming to lower the risk of postoperative gastroesophageal reflux. In the proposed standardized technique dissection is better stopped 2 cm from the pylorus rather than 4-6cm (Figure 6), aiming at more weight loss.

After freeing of the whole gastric greater curvature, all adhesions between the posterior gastric wall and the anterior surface of the pancreas should be cut for better invagination of gastric walls (Figure 7).[3,16,17]

There are various methods for calibration of placated stomach. Talepbour did not use any calibrating device but he took the sutures 2 cm from the lesser curvature.[14] Huang utilized what he called 'gastric plication formula' for calibration (Figure 8).[18] Other authors described the use of intraoperative endoscopy not only as a calibration device but also for visualizing the imbrications intraluminal and for testing the integrity of plication at the end of the procedure.[19]

The last method for LGP calibration is the use of bougie (Figure 9). For the standardized technique, the use of bougie (32-38 Fr) seems more superior for many reasons. It is a simple convenient tool for plication that is readily available. At the start of the procedure it helps in aspirating gastric contents. Its use is beneficial not only for controlling the remaining gastric volume but also for protecting against suturing the lesser curvature. The size of the calibrating bougie varies among surgeons where Skrekas et al used a 36-Fr bougie while Andraos et al and Ramos et al used a 32- Fr. Pujol Gebelli used 36 and 48-F orogastric tube.[3,4,16,17] Since the difference in bougie diameter is few millimetres we prefer the use of 38-Fr bougie for calibration. This size seems appropriate at it is neither too small to cause gastric obstruction nor too big to leave a large gastric tube.

Suturing of the gastric walls is the integral part of LGP. In the beginning of LGP plication was done by suturing the anterior gastric wall only without devascularization of the greater curvature. Studies reported a poor weight loss outcome.[7] Thus anterior gastric wall plication was obsolete in flavor of greater curvature gastric plication so that the term LGP now means laparoscopic gastric greater curvature plication.

Also in the first years of plication, Talepbour, who is considered the father of modern LGP, performed the procedure using only one row of non-absorbable suture.[14] Later on he and colleagues published a study concluding that two row plications is more effective and more durable than one row plication.[7] Fried et al found that there were no differences between single-row plications and two-row plications in terms of weight loss and complication rates.[5] It is recommended that the plication is better to be done in at least two rows. Two-row plication is not only more effective and durable but also helps to make a better plication with uniform tension and to avoid the herniation of gastric wall between stitches.

The inner layer of sutures should begin 2cm below the cardioesophgeal junction (Figure 10). This important step helps to avoid obstruction of the cardia by the invaginated intraluminal gastric septum and subsequently reducing the incidence of early postoperative nausea/vomiting.

There is a conflicting report regarding the type of stitch whether interrupted or running. Some authors prefer 2 rows of running sutures, some used 2 rows of interrupted sutures and others recommend a combination of running and interrupted sutures.[3,7,8,10,11,16,17,20,21] Inner layer sutures are better to be taken in an interrupted manner to adjust the plication and to avoid suture breaking of continuous layer leading to failure. The outer layer should be running stitch to avoid herniation in between. Full thickness bites increase the risk of minor perforation

and make sutures exposed to intraluminal acid, therefore it preferable to be extra mucosal bites. Sutures should be non-absorbable and better to be braided for easy handling and knotting. The distance between the sutures must be not more than 2cm to reduce the risk of stomach herniation between stitches.

The four-bite technique is an important technical contribution of LGP that was proposed by Skerekas and Antiochos (Figure 11).[3] In the four-bite technique the greater curvature of the stomach is invaginated by taking two bites at the posterior and two bites at the another gastric wall resulting in a W-shaped intraluminal septum. Multiple small intraluminal gastric folds created with the four-bite technique result in decreasing the pockets created in-between the gastric folds that might collect seroma and lead to gastric obstruction. After adopting this technique, Skerakas and Antiochos reported less incidence of postoperative nausea/vomiting and subsequently less hospital stay. This technique of suturing should be the preferred method for inner layer suturing. A word of caution should be mentioned. Four-bite technique is possible in the proximal saccular portion of the stomach where there is an ample space. At the distal tubular portion, the gastric antral region would be much narrowed with this type of bites. So, four-bite technique is advisable in the proximal two thirds while in the distal third it is better to take ordinary two bites for inner layer sutures (Figure 12).

The outer plication layer should be taken in a continuous manner using non-absorbable monofilament suture such as Proline 2/0. Monofilament sutures are easy to use for continuous suturing. It is preferable to begin superiorly till the middle of the greater curvature then to go inferior with another non-absorbable suture and tie the two threads at the middle of the greater curve. This adds strength to the outer layer of plication. At the end of the procedure, a useful step is to inject of saline/methylene blue via the bougie to detect leak and to ensure the whole greater curve of stomach was totally invaginated with no herniation between sutures. The use of drain along suture line is optional.

CONCLUSION

The proposed technique of LGP would help in standardization of the procedure in order to improve the outcome; however, the clinical application of this proposed standardized technique should be tested by future studies. As in any surgical procedures, the most important two factors for a successful outcome is proper selection of patients and proper technique. The bad reputation of LGP among some surgeons is due to lack of considering these two factors. If you do not like plication you can do the method that is routine in your hand but if you want to do plication, please do it in a correct way.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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