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Case Series

Fundectomy with Greater Curvature Plication; New Modification for Patients with Morbid Obesity

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ABSTRACT

Background: Obesity is a global epidemic. Laparoscopic greater curvature plication [LGCP] is a restrictive surgical procedure described for the first time on 1981 by Wilkinson. Fundectomy is a selective resection of the acid-producing segment of the stomach, with removal of peptide hormone-producing cells [the oxyntic mucosa] as a consequence of the fundectomy.

Aim of the work: Our aim is to assess the feasibility and advantages of the novel modification for morbidly obese patients which include fundectomy with greater curvature plication.

Patients and Methods: Ten patients were included in this study, which carried out at Al-Azhar University Hospital [New Damietta].

Results: Body mass index [BMI] ranged from 30 to 48 kg/m² [the mean was 38.8 kg/m²]. Operative time ranged from 60 to 120 minutes [Mean time: 93.5 minutes]. The mean hospital stay time was 1.35 days. The mean estimated weight loss percentage [EWL%] was 29.1% at three months, 44.6% at six months, 60.4% at one year, and 72.4% at two years. EWL% was less than 50% for one patient which needs reoperation with Laparoscopic Sleeve Gastrectomy. Two patients [20%] developed heartburn due to gastroesophageal reflux disease [GERD]. Nine patients [90%] presented nausea, and vomiting was present in four patients [40%].

Conclusion: Fundectomy and Greater curvature plication is a feasible, safe, effective as a bariatric operation with avoidance of complications of other bariatric operations. As a new modification for bariatric surgery, this operation needs more investigations and longer periods for follow up.

Keywords: Ghrelin Hormone; Greater Curvature Plication; Laparoscopic Sleeve Gastrectomy; Bariatric Surgery; Fundectomy.

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* Main subject and any subcategories have been classified according to the research topic.

INTRODUCTION

Obesity is defined as a worldwide epidemic. In 2008, the World Health Organization [WHO] estimated that, clinical obesity affects more than 500 million adults around the world [BMI > 30 kg/m²] [1].

Obese subjects at high risk of many obesity-related complications [e.g., diabetes mellitus, hypertension, dyslipidemia, coronary heart disease, specific cancers, and gastroesophageal reflux disease [GERD]] [2].

In all WHO regions, females are more candidate to be obesity than males. The incidence of obesity and/or overweight generally increases with the country's income levels. The frequency of obesity in the middle- and high-income states is more than twice than in low-income states [3].

A worldwide survey published on 2015 revealed that 468,609 bariatric surgical modalities were completed on 2013 all over the world. 95.7% of these surgeries were laparoscopically performed. The commonest accomplished bariatric surgery was Roux-en-Y gastric bypass [RYGB, 45%], then the sleeve gastrectomy [SG, 37%]; and adjustable gastric banding [10%]. Most momentous was the rise of SG from 0 to 37% of whole procedures from 2003 to 2013, with a drop of AGB from 68% to 10% in 2008 to 2013 [4]. Besides, RYGB reduced from 52% to 32% from 2008 to 2014 [5].

The gastric fundus had a crucial role on the secretion of the ghrelin hormone and its metabolism. Physiologically, ghrelin significantly increased during fasting and a rapid fall after meals. In obese subjects, fasting ghrelin is increased, but dynamics are altered with absent fall after meals [6].

In laparoscopic sleeve gastrectomy [LSG], there is a change in gastrointestinal hormones, these alterations are demonstrated by a reduction in endogenous ghrelin production due to fundectomy [7].

Laparoscopic greater curvature plication [LGCP] is a restrictive bariatric approach that was described in 1981 for the first time by Wilkinson. It successfully diminishes the gastric volume by greater curvature

plication and a reversible restrictive intervention with absent use of synthetic materials [8].

In spite of a lower rate of complications, LGCP has been existed routinely performed as an inpatient process with a length of hospital stay duration between one to two days [9].

THE AIM OF THE WORK

Our aim was to appraise the feasibility and advantages of the novel modification for morbidly obese patients which include fundectomy with greater curvature plication.

PATIENTS AND METHODS

Ten patients were included in this study, which carried at Al-Azhar University Hospital [New Damietta], after approval of the study protocol by the institutional Ethical and Research Board [Faculty of Medicine, Al-Azhar University, Damietta]. Besides, an informed, written consent was signed by all patients after explanation of the procedure details and expected complications.

The inclusion criteria were patient age between 18 and 50 years, no past history of open upper abdominal operations, failed previous weight loss attempts, BMI > 35 or BMI > 30 with comorbidities, and willingness to make lifestyle change and commit to long-term follow-up. On the opposite side, exclusion criteria were super obesity, previous bariatric surgery, cardiopulmonary disorders that contraindicate general anesthesia, and not manageable psychological disorders.

Preoperative assessment was done with complete blood count, laboratory liver function tests, renal function tests, blood glucose level, serum cortisol, thyroid function tests. Echocardiography, respiratory function tests, abdominopelvic ultrasonography and upper gastrointestinal endoscope were done. Subcutaneous low molecular weight heparin was given at the night of operation. Third generation cephalosporin injected with induction of anesthesia.

Patients were positioned in Trendelenburg position, visual port 10mm was inserted at the midline above the umbilicus, exploration of the abdominal viscera was done, two acting ports; one 12 mm at the left midclavicular line and 5 mm in the right midclavicular

line. Liver retractor was inserted through 5mm subxiphoid port. 5mm port for assistant inserted in the left hypochondrium. Devascularization of the greater curvature of the stomach was done using a vessel sealing device, about 5cm from the pyloric ring up to angle of His. After calibration with 32-French bougie, determination of the fundus which will be removed [Figure 1], then using linear stapler loaded with blue cartilage, fundectomy carried out [Figure 2].

Greater curvature plication was done in two layers, first interrupted and continuous second layer. Plication started with inversion of stapler line, continue to the remaining part of greater curvature using Talebpour technique with interrupted four bites of non-absorbable suture [Figure 3] [10], down to 5cm from the pyloric ring [Figure 4-5]. Second layer of continuous non-absorbable sutures was done for strengthening of the first layer [Figure 6].

Extraction of gastric fundus, then good hemostasis was done followed with closure of the port sites with sutures.

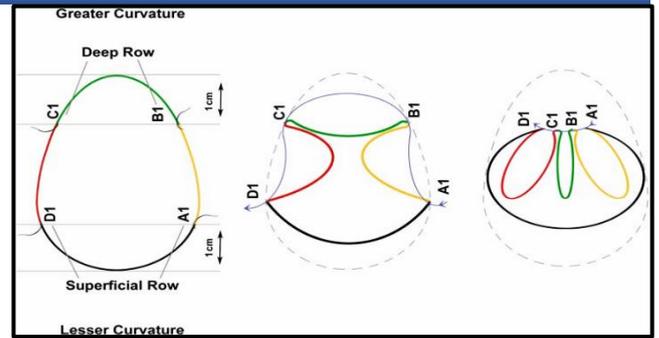


Figure [3]: Transverse section of plicated stomach [10].

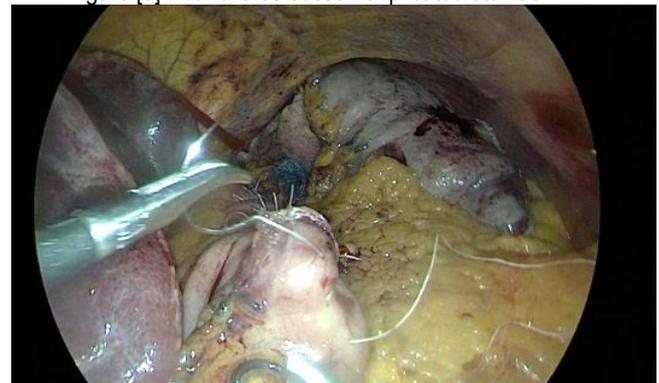


Figure [4]: First layer of interrupted non-absorbable sutures. Two bites posterior to the greater curvature

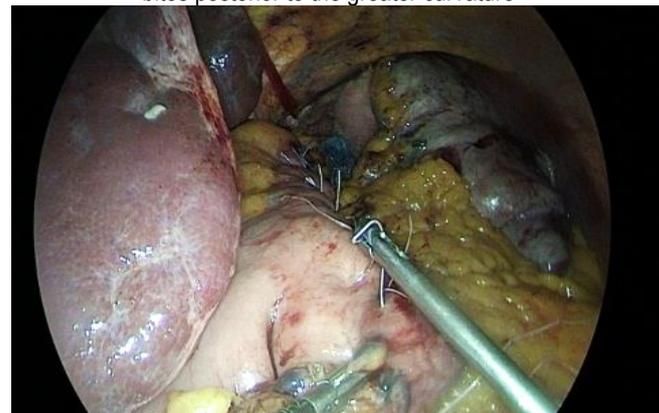


Figure [5]: First layer of interrupted non-absorbable sutures. Two bites anterior to the greater curvature

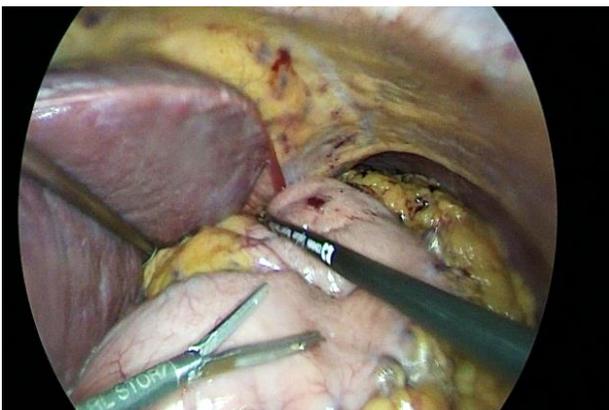


Figure [1]: Determination of fundus which will be removed.

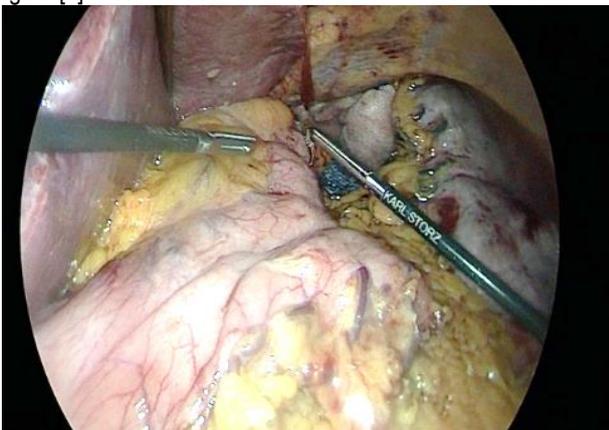


Figure [2]: After fundectomy

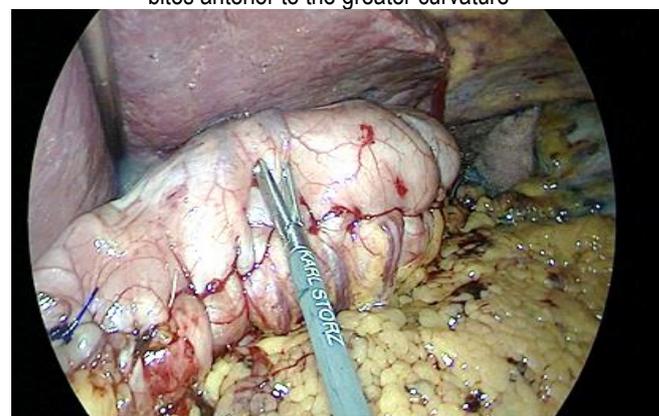


Figure [6]: Final appearance after the second continuous non-absorbable sutures

RESULTS

Our study includes ten patients and carried out from January 2018 to May 2020. There were 6 female patients [60%], 4 male patients [40%], the mean age was 41.3 years, BMI ranged from 30 kg/m² to 48 kg/m² [the mean was 38.8 kg/m²]. Operative time ranged from 60 minutes to 120 minutes [mean time: 93.5 minutes]. The mean hospital stay time was 1.35 days. The follow up period was two years for all patients, and conducted two weeks, three months, six months, one year, and two years postoperative. Conversion, bleeding, and leak did not occur in any patients. The mean EWL% was 29.1% at three months, 44.6% at six months, 60.4% at one year, and 72.4% at two years. EWL% was less than 50% for one patient which needs reoperation with Laparoscopic Sleeve Gastrectomy. We found that, weight reduction was better for subjects with lower initial BMI.

Two patients [20%] developed heartburn due to GERD [Figure7], which improved with conservative measures. Nine patients [90%] presented nausea which persisted for a few days, gradually subsided. Vomiting was present in four patients [40%], three patients got better after two weeks, but persisted for three months for one patient, medical management was proton pump inhibitor and prokinetic drugs. Edema and hyperemia of gastric mucosa [Figure8] can explain nausea and vomiting, which subside with time. Our results presented in table [1].



Figure [7]: Postoperative GERD grade A.



Figure [8]: Postoperative Upper Gastrointestinal Endoscopy revealed hyperemic plicated gastric mucosa

Table [1]: Demographic data with postoperative follow up results.

Variable	Result
Mean age [years]	41.3
Gender Female	6 [60%]
Male	4 [40%]
Mean BMI [30Kg/m ² - 48 Kg/m ²]	38.8 Kg/m ²
Operative time [60-120minutes]	93.5 minutes
Mean hospital stay duration [1-2 days]	1.35 days
Follow up	2 years
Mean postoperative EWL%	3 months [29.1%]
	6 months [44.6%]
	1 year [60.4%]
	2 years [72.4%]
Heartburn	2 [20%]
Nausea	9 [90%]
Vomiting	4 [40%]
Failure	1 [10%]

DISCUSSION

LGCP is remarkably similar to a LSG in the creation of a gastric tube by elimination of the greater curvature, but LGCP creates this tube without gastric resection. LGCP significantly decreases the potential for gastric leaks. Talebpour and Amoli [9] presented one case with a gastric leak after an aggressive form of LGCP. The authors explained the development of this leak by excessive vomiting, early after surgery.

In two distinct articles, Fusco *et al.* [11, 12] showed the efficacy of gastric plication interventions, as determined by weight changes overtime in an animal study. In one article, Fusco *et al.* showed an augmented effect from GCP than plication of the anterior gastric surface. These results agree with a clinical report of Brethauer *et al.* [13] who demonstrated better weight loss in LGCP than the anterior surface plication.

The stomach physiological functions are diverse, and are lost after gastrectomy. Gastrectomy followed by alteration in food transit time, change in nutrition intake, anomalous digestion and absorption, and micronutrients deficiency. The whole systemic function is adversely affected after gastrectomy [14].

Gastric surgery is a clinically appropriate intervention in humans. Indications include gastric tumors, advanced peptic ulcers, surgical management of morbid obesity, and bleeding gastric varices [15, 16].

The surgical removal of the different gastric parts be associated with frequent issues regarding patient's quality of life and postoperative comorbidities [14].

Total gastrectomy causes osteopenia. In animal models, total gastrectomy stimulates the striking effects in many skeletal parts, including the trabecular and cortical bones [17].

Fundectomy through selective resection of the acid-producing cells could be achieved by the removal of oxyntic mucosal parts, rich in peptide hormone-producing cells [18].

Some authors reported that excision of the fundus in pigs stimulates momentous reduction of the gain in body weight, which is comparable to the loss of the

body weight perceived after gastrectomy in human subjects [19].

LSG is chiefly a restrictive bariatric surgery for weight reduction. The peri- and post-operative mortality are 0.29% and 0.34%, respectively, with 13% complication rate [20, 21].

Rare complications were reported after LSC early after surgery; however, dangerous comorbidities [e.g., difficult-to-remedy proximal leaks [4.9%] and long staple line bleeding [2.4%]] were reported [22, 23]. The majority of comorbidities after LSG reported in the late postoperative time [e.g., GERD [23%], vomiting [18%], gastric stricture [2.3%], stenosis [2.4%], leak [2.4%], incisional hernia [2.4%], fistula, and weight regain [24].

LGCP has attained admiration between surgeons and their patients due to different causes. Neither foreign body [FB] implant [i.e., gastric banding] nor intestinal bypass nor gastric resection is required. Thus, the risk of leak is dramatically decreased, and has a high reversibility degree. Also, LGCP looks like and yields a gastric restriction similar to that obtained after LSG without the use of a staple or presence of a staple line [25]. Ghada [26] documented that, the EWL% at 3 months was $40 \pm 5.4\%$ and $58.2 \pm 3.2\%$ at 6 months.

Talebpour and Amoli [9], Ramos, *et al.* [27], and Brethauer, *et al.* [28] reported that LGCP lead to real loss of weight at 12 months postoperative, which was greater than 50% EWL. Kourkoulos *et al.* documented that, EWL% after 12 postoperative months was 23.3% for the AP and 53.4% in LGCP group. The authors reported gastric obstruction in one patient, who needed reoperation [29]. In our study, the mean EWL% was 29.1% at three months, 44.6% at six months, 60.4% at one year, and 72.4% at two years. EWL% was less than 50% for one patient which needs reoperation with Laparoscopic Sleeve Gastrectomy. We found that, the results of weight reduction were better for patients with lower initial BMI.

Vomiting is the commonest complaint in the early postoperative period after LAGBP, but commonly alleviated within 48 postoperative hours [30].

Kourkoulos *et al.* [29] documented that, reoperation rate was 3.0% after LGCP. There was only one

conversion [0.2%] due to an injury of mesenteric structures from a faulty trocar, an infrequent but dangerous complication of laparoscopic intervention, and no mortality was reported. Minor comorbidities rate was 10.7%, and the most common complications were nausea, vomiting, and sialorrhea. Intraoperative bleeding reported in 1.7% and was managed without the need for conversion or transfusions. Finally, no worsening of GERD symptoms or development of new GERD was reported.

Nine patients [90%] presented in our study with nausea which persisted for a few days, gradually subsided. Vomiting was present in four patients [40%], two patients got better after two weeks, but persisted for three months for one patient, medical management was proton pump inhibitor and prokinetic drugs. Edema and hyperemia of gastric mucosa can explain nausea and vomiting, which subside with time.

We found that, two patients [20%] developed heartburn due to GERD, which improved with conservative measures. Conversion, postoperative bleeding, and leak did not occur in any patients.

The drawbacks of gastric bypass surgery include incidence of leakage, delay with consequent poor prognosis of gastric cancer if occurred, and physiological disturbance. In LSG, there is incidence of leak with hormonal disturbance due to excision of normal tissue, so we need to preserve normal anatomy and physiology of the human body as the future may carry more not known drawbacks. Also, the financial cost of bariatric surgery is of major concern particularly in developing countries and LGP could resolve this problem.

A major advantage of fundectomy is to remove the part of stomach which secret Ghrelin hormone which is responsible for satiety. Greater curvature plication produces restriction of stomach similar to Sleeve gastrectomy without resection of normal parts of stomach which secret important hormones for human body.

In our modification, we got benefits of fundectomy which secret Ghrelin hormone and plication of the remaining part of greater curvature of stomach, so incidence of leakage decreased also normal tissues of

stomach preserved, with comparable weight loss like other bariatric operations.

Conclusion: Fundectomy and Greater curvature plication is a feasible, safe, effective as a bariatric operation with avoidance of complications of other bariatric operations. As a new modification for bariatric surgery, this operation needs more investigations and longer periods for follow up.

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