



Laparoscopic Gastric Plication: Appropriate Option in Times of Crisis?

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Authors' contributions

This work was carried out in collaboration between all authors. Author ARH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MFS and OS managed data analyses and reviewed the discussion. Author MFS searched the literature and the managed the presentation of data. All authors read and approved the final manuscript.

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ABSTRACT

Objective: The aim of this study is to investigate the practice of laparoscopic gastric plication (LGP) in Syria with particular emphasis on efficacy and complications, and to explore the concept of bariatric surgery in times of crisis with its related issues and concerns.

Materials and Methods: A prospective cohort study included all patients who underwent LGP between February 2011 and September 2014. The main outcome was the percentage of excess weight loss (%EWL). Secondary outcomes included operative time, hospital stay, postoperative complications, and improvement of related comorbidities.

Results: Of the 129 patients who underwent LGP in the study period, 96 patients were included in the final analysis. The mean body mass index was 39.5 kg/m² (32–49 kg/m²). No cases of conversion to laparotomy, leak, intraabdominal infection, or mortality were seen. Vomiting was the most common postoperative complaint, which was encountered in 91.6% of patients. Two patients required operation reversal because of protracted vomiting. Mean %EWL was 60%, 65%, 70%, 67%, 66% and 65% at 6, 12, 18, 24, 30 and 36 months respectively. Obesity-related comorbidities were present in 33 patients (34.4%), and they showed considerable improvement or complete

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resolution in 57-100% of cases. Weight regain was seen in 7 patients (7.3%) after 36 months, three of whom (3.1%) requested reoperation.

Conclusions: LGP is a feasible and safe operation for the treatment of morbid obesity, and it is comparable to other restrictive bariatric operations with fewer rates of serious complications. It is an appropriate technique in times of crisis due to low cost and ease of follow-up.

Keywords: Morbid obesity; bariatric surgery; laparoscopic gastric plication; greater curvature plication.

1. INTRODUCTION

Laparoscopic gastric plication (LGP), also known as vertical gastric plication or greater curvature plication, is one of the most controversial topics in bariatric surgery. In spite of its approval and popularity in developing countries, LGP is still considered an operation under investigation in many parts of the world [1]. Many studies proved the efficacy of this technique in reducing weight and improving comorbidities in the obese patients, as well as the relative safety in comparison with other restrictive techniques [2,3].

Despite good results in most studies, some series reported high rates of reoperation because of complications or weight regain, which raised many questions about the real feasibility of the technique [4]. Laparoscopic sleeve gastrectomy (LSG) is deemed a better restrictive alternative than LGP [5,6], although it can be very costly in developed countries or in times of crisis. In addition, it is not known whether bariatric surgery in general and LGP specifically is an appropriate therapeutic option in times of war or crisis. Barriers may include the operative decision, the high costs, the significant deficiencies in healthcare system, and the inability to follow the patients in the long term.

In this study we investigate the practice of LGP in Syria with particular emphasis on results and complications. We also explore the concept of bariatric surgery in times of crisis with the related issues and concerns. Then we present a discussion about some important lessons learnt from this study.

2. MATERIALS AND METHODS

This study is a prospective cohort study that included initially 129 successive patients. The patients underwent LGP in a single center between 1/2/2011 and 30/9/2014. All patients had morbid obesity with a BMI of less than 50 kg/m², and all had failed conservative methods of

weight reduction. All patients gave an informed consent for participation in the study.

Preoperative tests included routine blood tests, thyroid function tests, endocrinology or cardiology consultation (as needed), and upper endoscopy (for patients with epigastric complaints). Patients who complain of severe gastroesophageal reflux disease or active peptic ulcer disease were excluded.

All operations were performed under general anesthesia. The French position with 30° reverse Trendelenburg was used. Patients were given one dose of prophylactic antibiotics half an hour before skin incision. Closed pneumoperitoneum with 12-15 mmHg was achieved using Veress needle through the position of the first trocar. The five trocars were positioned as illustrated in Fig. 1: (1) 10-mm camera trocar 20 cm from the xiphoid towards the umbilicus, (2) 10-mm surgeon's right hand trocar at the left hypochondrium, (3) 5-mm assistant's trocar at the left hypochondrium on the anterior axillary line, (4) 5-mm surgeon's left hand trocar at the right hypochondrium on the midclavicular line, and (5) 5-mm liver retractor's trocar at the hypogastrium (in cases of hepatomegaly or technical difficulty).

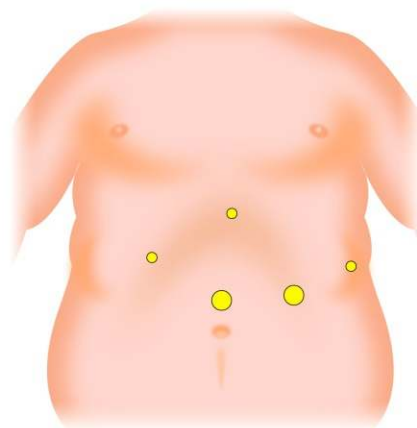


Fig. 1. Trocar placement for laparoscopic gastric plication

Using the harmonic ACE (Ethicon Endo-Surgery Inc., Cincinnati, Ohio, USA), the omentum was dissected away from the greater curvature of the stomach, starting 4-5 cm to the left of the pylorus up to 2 cm below the angle of His. We believe that it is very important to stay 1-2 cm away from the wall of the stomach in order to avoid thermal injury and the subsequent risk of leak. A 36-French bogie was then inserted transorally. Under guidance, the stomach was plicated using the two-row plication technique as illustrated in Fig. 2. The greater curvature of the stomach was invaginated inwards by taking two rows of sero-muscular running sutures using a nonabsorbable Prolene 2/0 suture. The gastric tube was removed under vision at the end of the operation. We did not use a nasogastric tube or a drain postoperatively, and we did not administer low molecular weight heparins (LMWHs) before surgery, but sequential compression device was used in all patients intraoperatively.

received a daily dose of LMWHs for one week after surgery. Anti-emetics and analgesics were administered as needed. Follow-up visits were scheduled at the first, third, and sixth month postoperatively, and subsequently every six months.

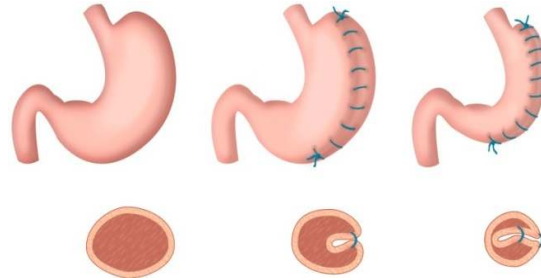


Fig. 2. The two-row plication technique, which was used for laparoscopic gastric plication in this series

All patients were discharged once they were able to tolerate a liquid diet. Diet progressed from clear fluids during the first week, to high protein liquid diet for the second week, then soft diet for the third week. Regular diet was gradually introduced thereafter. Proton pump inhibitors were administered for 2 months, while patients

Fig. 3 shows the flow diagram of the study group. Two patients were excluded from the analysis due to early surgical revision, and 31 patients were excluded because of drop-out from the first postoperative weight assessment at 6 months. The final analysis included 96 patients, who were followed for up to 36 months.

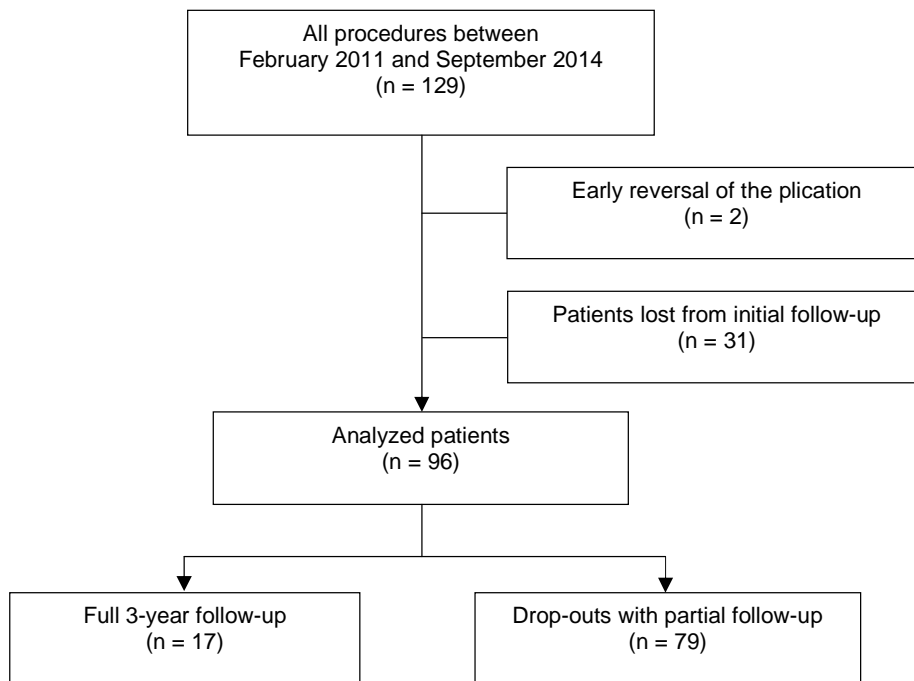


Fig. 3. Flow diagram of the study group

3. RESULTS

The analysis included 96 patients: 82 females (85.4%) and 14 males (14.6%). The mean age was 29.7 years (18-65 years). The mean BMI of the patients was 39.5 kg/m² (32-49 kg/m²). All patients with BMI less than 35 kg/m² had obesity-related comorbidities.

3.1 Postoperative Results

All operations were completed laparoscopically with no conversions. The mean operative time was 75 minutes (50-155 minutes) and the mean duration of hospital stay was 31 hours (1-4 days). We encountered intraoperative hemorrhage in two cases (from short gastric vessels and minor liver injury, respectively). Both were properly controlled, and neither required intra- or postoperative blood transfusion. The mean time for returning to routine daily activity was 6 days (4-21 days).

Table 1 shows the major complications in the study group. No wound infections, gastrointestinal leaks, or intra-abdominal infections were seen. Vomiting was the most common postoperative complaint, and it was classified into slight, severe, and protracted according to the required treatment. It resulted in acute renal failure in one case because of dehydration and delayed patient presentation. Two additional patients complained of protracted vomiting with unresponsiveness to treatment. Upper GI series confirmed the absence of obstruction, but both patients required reversal of the operation (undoing of the plication). These two patients were excluded from the final analysis (1.6% of the original 129 patients). The three patients who suffered from pneumonia and pulmonary embolism were treated successfully and discharged with no further complications.

3.2 Long-term Results

We present our follow-up results in Table 2 and Fig. 4. The data show an initial increase in %EWL during the first 18 months after surgery. Afterwards, a slow decline ensued over the next 18 months. The average excess weight loss in the 17 patients who could be followed for three years was 65%.

Weight regain occurred in 7 patients: in 3 of the patients who were followed for 12 months, then in 3 additional patients after 24 months, and in one patient after 36 months. Rates of weight regain were thus 3.1%, 6.2%, and 7.3% after 12, 24, and 36 months, respectively. Three patients requested reoperation (3.1%) due to weight regain (one patient) or failure to lose weight (two patients). All of them underwent laparoscopic reversal of the plication with sleeve gastrectomy.

Obesity-related comorbidities were present in 33 patients (34.4%), and most patients showed considerable improvement or complete resolution after 18 months of follow-up. The results are summarized in Table 3. Nine patients in the study group had type 2 diabetes mellitus (T2DM), and the disease resolved completely with treatment cessation in 7 of them. The majority of patients reported resolution of skeletal pain in the knee and the back.

4. DISCUSSION

We found that LGP is an effective and safe bariatric operation for reducing weight and improving obesity-related comorbidities in the long term, even in times of crisis. Patients achieved an excess weight loss of 65% over a follow-up period of three years. Comorbidities showed improvement in more than 50% of cases. The rate of serious complications was very low, and we did not encounter any case of leak, intraabdominal infection, or mortality.

Table 1. Major complaints and complications in the study group

Complications	Patients	N (%)	Management
Vomiting			
all cases	88	(91.6%)	
slight	77	(80.2%)	Outpatient management with antiemetics
severe	6	(6.2%)	Intravenous therapy in the outpatient setting
protracted	5	(5.2%)	Readmission
Reflux symptoms	25	(26.0%)	High-dose PPIs
Pneumonia	2	(2.1%)	Antibiotic therapy
Pulmonary embolism	1	(1.0%)	Readmission, ICU management
Acute renal failure	1	(1.0%)	Readmission, fluid management

ICU = intensive care unit, PPIs = proton pump inhibitors

Table 2. Mean percentage of excess weight loss (%EWL) at successive follow-up periods with the number of drop-outs

Follow-up point	Number of drop-outs	Number of followed patients	Mean% EWL*
6 months	-	96	60%
12 months	17	79	65%
18 months	35	61	70%
24 months	49	47	67%
30 months	65	31	66%
36 months	79	17	65%

* %EWL was calculated at each time-point only for patients who completed the follow-up at this specific point

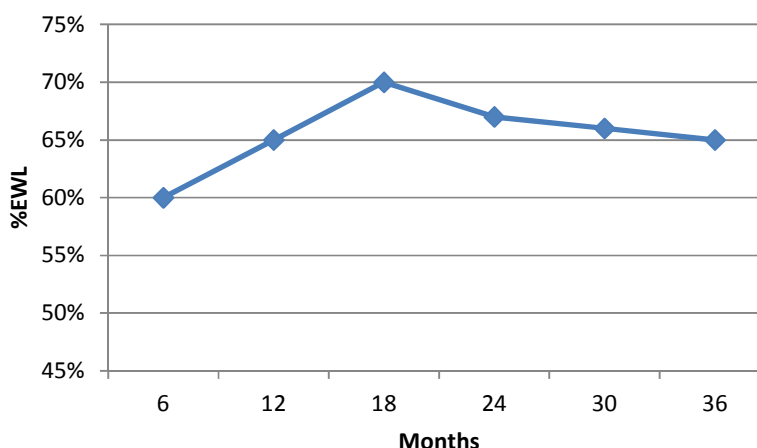


Fig. 4. Percentage of excess weight loss (%EWL) in the study group

Table 3. Remission of comorbidities in the study group after 6 and 18 months

Comorbidity	Patients	N (%)	Remission N (% of involved patients)	
			After 6 months	After 18 months
Diabetes mellitus type 2	9	(9.4%)	6 (66.7%)	7 (77.8%)
Arterial hypertension	5	(5.2%)	2 (40.0%)	3 (60.0%)
Dyslipidemia	7	(7.3%)	3 (42.9%)	4 (57.1%)
Back/knee pain	29	(30.2%)	19 (65.6%)	22 (75.9%)
Obstructive sleep apnea	1	(1.0%)	1 (100.0%)	1 (100.0%)

Gastric plication was originally proposed by Wilkinson and Peloso, who operated on 100 patients between 1976 and 1981 [7]. The laparoscopic version of this technique was revived by Talebpour in the last decade, and was investigated by various surgeons in many countries. The results of LGP are so far very encouraging. In all series, excess weight loss exceeded 50% by the end of the first year after surgery [3,8], and reached 66-68% after 2-4 years [9-11]. The rates were comparable in our analysis: %EWL was 70% in 18 months and declined to 65% in 3 years. The largest study on LGP included 800 patients with BMI up to 59 kg/m². The mean excess weight loss was 55% after 5 years of follow-up [9]. Even better results could be achieved through postoperative meetings coupled with behavioral therapy. In one

series, the authors reported an %EWL of 74.4% after 24 months, and six patients were able to lose more than 84% of their excess weight [12].

Follow-up in the long term showed also good results. In the study with the longest follow-up period of 12 years, only 31% of patients reported weight regain [9]. The rate of reoperation after LGP varies widely in the literature. Zerrweck et al. reported a high failure rate, with the need of conversion to sleeve gastrectomy or gastric bypass in 30% of patients, either because of severe symptoms or unsatisfactory weight loss [13]. Even higher rates were reported in other studies, with conversion in up to 53.6% of cases [4]. In our series, only 3.1% of the patients were re-operated because of weight regain. This may be attributed to the low rate of follow-up among

our patients (only 17.7% of our analyzed patients could be followed for 3 years), but also to the reluctance of some patients to undergo a bariatric operation once again after a suboptimal experience.

LGP has shown excellent results concerning remission of comorbidities. In one of the largest series with a follow-up for 2 years, resolution of T2DM was seen in 70% and 95% of cases after 6 and 12 months, respectively [9]. In another study, which involved 60 patients with T2DM, remission of the chronic disease was achieved in 92% of patients after a follow-up period of one year, with ameliorated blood glucose control in the rest of the study group [14]. In our analysis, resolution of T2DM was seen in 7 of 9 patients (77.8%). In another study, bioimpedance analysis was used to determine the change in body composition after LGP. The authors found that 83% of the total weight loss was due to reduction in fat mass rather than fat-free mass, which "shifts body composition toward normal" [15].

The single published study about LGP in adolescents showed just as good results as by adults. Authors reported an %EWL of 68.2% in 12 adolescents after two years, with an improvement of all medical comorbidities after surgery [16]. LSG in adolescents has not been compared with other bariatric techniques in a two-arm study so far [17].

LGP can be considered a safe operation. No mortality was reported in the literature, and the rate of serious complications varied between 0% and 15.4% [1,2]. We believe that the rate of complications and side effects can be lowered with increased experience in this operation. As an example, the leak rate could be decreased from 5% to 1% or less after accumulating the required experience [18,19]. Most authors reported a leak or fistulization rate of 0-1% [5,9], and we did not encounter any case in our study.

Vomiting is a particular problem after LGP. It was reported in 20-80% of cases in the literature [5,9], and was particularly common in our series (91.6%). This problem was more frequent in LGP than in LSG (20% vs 5%, respectively) [5]. Vomiting may be a cause for surgical revision, as was seen in two cases in our study (1.6% of all operated patients). The rates of early reversal reached 9% in another study [8]. Gastric leak was also reported to occur after severe postoperative vomiting [20].

Other rare complications of the procedure were reported. Gastric contents may accumulate in the gastric fold, leading to the so-called gastric compartment syndrome [21]. This may lead to gastric wall edema or even complete gastric obstruction [22]. Other complications included fold ulceration, necrosis of the suture line, gastric stenosis, portomesentric thrombosis, subphrenic abscess, hepatic abscess, hepatitis, aspiration pneumonia, and hypocalcaemia [8,9,11,22-24].

Acute renal failure was a notable complication in our series, which was not reported previously. It was a result of dehydration induced by late protracted vomiting. The patient presented relatively late with acute tubular necrosis. Renal function improved over days with proper fluid management.

LSG is still considered a bariatric operation with potential serious complications, in particular gastric leak which occurs in average in 2.4% of cases [25-27]. Concerning adjustable gastric banding (AGB), complications were reported in up to 76% of patients after 3 years, and band migration and erosion occurred in 11% of patients. Such complications may necessitate a difficult reoperation in more than 25% of patients, and up to 33% of patients may require device removal within 9 years after the surgery [28-30].

Four studies compared LGP with LSG in two case-control arms. The number of included patients ranged from 58 to 140 in each study, and follow-up periods ranged from 6 to 18 months. All these studies showed a statistically-significant advantage of sleeve gastrectomy in weight reduction after one year of follow-up [5,6,24,31]. Excision of the gastric mucosa with removal of the source of ghrelin was suggested as a cause for better effects of sleeve gastrectomy [32]. In spite of these results, all these studies have a relatively short follow-up period, and no study has investigated whether this difference would remain in the long term. Consequently, we believe that no definite conclusions can be made based on these results alone.

Another study compared LSG with mini-gastric bypass surgery, which is still an investigational procedure. A total of 40 patients were compared and followed for one year. There were no statistically-different results between the two groups. Additionally, LGP was associated with lower risk of iron deficiency [33].

Our study has two main drawbacks. The study did not include a control arm for comparison with

other surgical techniques. This approach is warranted, as all other bariatric operations need the use of endoscopic staplers or implantable devices, which are too expensive to be affordable in times of crisis. On the other hand, only 17 out of 96 patients (17.8%) could be followed for three years, which is a low follow-up rate. The rapid and continuous change in demographics in these situations presents a real challenge in following the patients in the long term after such operations.

Although the literature already contains a good deal of research about AGB, we believe that this study has very important implications. First, people seek bariatric surgery even at times of continued war or crisis. This means that bariatric surgery is now regarded as an important 'remedy' to a real health problem even by people in developing countries. The number of patients seeking bariatric surgery in our center has not been decreasing during the crises. Although this aspect was not explored in our analysis, we think that undergoing such operations with the subsequent good medical and aesthetic results have a great impact on the affection, and could help the morbidly-obese patient by alleviating psychological consequences of living within a crisis. Consequently, we believe that bariatric surgery should not be delayed or excluded in times of crises.

Second, people are willing to undergo a laparoscopic restrictive operation as long as the surgery would not be too expensive. The public healthcare system in Syria enables people to undergo such operations free of charge. However, when staplers are to be used, patients must bear the costs, which make patients refuse the surgery. In comparison, the cost of gastric plication can be \$2000 less than gastric sleeve or banding [9]. This is actually the current situation in Syria, as the average cost of LGP equals \$500, which is completely covered by the healthcare system. On the other hand, the costs of LSG amount to \$2500, and the patient must pay the extra \$2000. This is actually too expensive in light of the current 10-fold inflation in Syria. The meta-analysis performed by Sánchez-Santos et al. has even demonstrated that bariatric operations can be cost-effective procedures in times of crisis, apparently because of improvement in general health state and quality of life after surgery [34].

Third, many patients are becoming more informed about bariatric surgery and its

complications. Many candidates in our series refused initially both LSG and AGB, not only because of the costs, but also because of foreign body implantation as well as the need for frequent postoperative adjustments with banding. Wharton et al. found that 69.5% of obese patients identified postoperative risks as barriers to surgery, mainly staple line leakage and reoperation [35]. When surgeons offer safer options such as LGP, this would alleviate patients' fears and encourage them to take the chance.

Fourth, gastric plication spares the patients all nutritional side effects of bypass surgery, and this can be particularly convenient in times of crisis. Even if they were available, nutritional supplements can be too expensive to be taken regularly. Many patients cannot afford high-protein dietary intake as well due to the poor economic state in these circumstances.

Fifth, the need for urgent interventions after occurrence of complications should always be considered. The unavailability of the full range of interventions in times of crisis would shift the preference towards feasible options, and LGP is a more convenient choice in these cases due to the low risk of leak or staple line bleeding compared to other procedures.

More research is still needed on this topic. A long-term comparative study with a large specimen size would be essential to determine the best restrictive operation concerning the rates of weight regain and the need for reoperation. Available data show suboptimal results of LSG in comparison with bypass operations in patients with super-obesity, but the efficacy of LGP in this group was not determined so far [36]. This operation seems also very attractive and safe in adolescents, and a future comparative trial in this particular group is awaited [17].

We believe that LGP has a steep learning curve, and this aspect should be objectively investigated and invested. Surgeons who have basic skills in laparoscopic surgery can learn and master the technique of this operation quickly. This should benefit a large spectrum of morbidly-obese patients in developing countries, where staplers are considered too expensive or simply not available. Workshops and education programs should target this group of surgeons in particular.

5. CONCLUSION

In conclusion, we believe that gastric plication is an effective and safe restrictive technique, which can be considered the bariatric operation of choice in developing countries and in times of crisis. Advantages of this operation include low cost, minimal complications, absence of nutritional derangements, potential reversibility, and avoidance of foreign body implantation. If a comparative study could prove results similar to other restrictive operations in the long term, gastric plication can become the standard operation for morbid obesity.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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