Effect of gastrojejunal anastomosis diameter in laparoscopic one-anastomosis gastric bypass for the treatment of morbid obesity and related disorders: a comparative study

Hatem ElGohary[a], Noha Boshnak[b], Eslam Alabassy[c], Mohammed Gamal Abdulrahman[d]

Departments of [a]Laparoscopic GIT and Bariatric Surgery, [d]General Surgery, Helwan University, Helwan, Departments of [b]Clinical Pathology, [c]General Surgery, Ain Shams University, Cairo, Egypt

Correspondence to Mohammed Gamal Abdulrahman, Lecturer of General Surgery, Helwan University, Egypt; Department of General Surgery, Helwan University, Helwan, Zipcode 11722, Egypt
e-mail: drgemi1981@gmail.com

Received: 15 March 2021
Accepted: 24 April 2021
Published: xx Month 2021

The Egyptian Journal of Surgery 2021, 40:1056–1064

Background
One-anastomosis gastric bypass (OAGB) is a safe and effective bariatric procedure that employs a long gastric pouch with antecolic loop gastrojejunal (GJ) anastomosis. The optimum anastomosis diameter is still unclear, as there are many differences in the literature.
Aim
This study aims to evaluate the short-term effect of different GJ anastomosis diameters in patients offered laparoscopic OAGB regarding weight loss, bile reflux, and nutritional and metabolic effect.
Patients and methods
A total of 59 patients were included in this study, and they were divided into two groups: group A included patients with GJ anastomosis made by a 45-mm stapler reload, and group B included patients with GJ anastomosis made by 20 mm of the stapler reload.
Results
There was no statistically significant difference between groups regarding postoperative mean BMI at 3, 6, 9 months, and 1 year; excess weight loss (EWL%); remission of comorbidities; and bile reflux ($P>0.05$). Hypoalbuminemia was significantly more evident in group B at 3, 9 months, and 1 year, with P values of less than 0.001, 0.035, and 0.031, respectively. Moreover, group B patients had more iron-deficiency anemia, which was statistically significant at 3, 6, and 9 months ($P<0.05$), whereas there was no significant difference at 1 year ($P=0.128$).
Conclusion
OAGB is an effective bariatric procedure, but the use of a 45-mm stapler reload for GJ anastomosis may be associated with less nutritional deficiencies than using 20 mm of the reload. Further studies are needed on a larger number of patients with long-term follow-up.

Keywords:
mini-gastric bypass, one-anastomosis gastric bypass, bariatric surgery, laparoscopy

Egyptian J Surgery 40:1056–1064

1110-1121

Introduction

Obesity is a major health problem, and its incidence is rising. Bariatric surgery is still the main line of treatment with sustained weight loss and improved metabolic profile [1].

The two most commonly performed bariatric procedures are laparoscopic sleeve gastrectomy and laparoscopic Roux-en-Y gastric bypass (LRYGB) with low incidence of complications [2–4].

A more recent procedure introduced to the bariatric surgery field is one-anastomosis gastric bypass (OAGB). It is a safe and effective bariatric procedure that employs a long gastric pouch with an antecolic loop gastrojejunal (GJ) anastomosis. A study of Rutledge and additional reports has demonstrated excellent outcomes in patients offered OAGB [5–8].

However, there is a lot of debate about this procedure, mainly concerning the possible long-term carcinogenic effects of bile reflux in the gastric pouch [9].

It is not to be confused with its earlier version, the Mason loop gastric bypass, which was stopped mainly because of complications related to symptomatic biliary esophagitis. These complications have been reported after OAGB as well [10], but the longer, lesser curvature gastric pouch is believed to decrease reflux compared with the Mason loop gastric bypass [11–13].

In addition to the long lesser curve pouch, there is another important issue when performing this procedure which is the GJ anastomosis, as Rutledge and Walsh [14] described a wide GJ anastomosis diameter in their series.

In 2002, a modification was originated in Spain by Carbajo *et al.* [15], which included a latero-lateral narrower GJ anastomosis about 2.5 cm with final fixation of the jejunal loop apex to the bypassed stomach to avoid bile reflux.

In a study done by Deitel [16], which included 139 surgeons from 31 different countries who performed more than 100 cases of OAGB, the diameter of GJ anastomosis was variable. Among mini-gastric bypass surgeons, 18% performed 6-cm anastomosis, 4–5 cm for 47%, and 3–4 cm for 35%. However, the OAGB surgeons preferred a GJ anastomosis diameter of 2.5–3 cm, and their results showed no statistically significant difference between mini-gastric bypass and OAGB regarding excess weight loss (EWL%) [16].

The optimum GJ diameter in laparoscopic OAGB is still unclear, as there are many differences in the literature. Rutledge did not mention the accurate GJ anastomosis diameter in his first 1274 series [5]. On the contrary, Carbajo *et al.* [17] described 2–2.5-cm GJ diameter in their technique done for 1200 patients, whereas other studies recommended anastomosis diameter of 4.5 cm [18].

The purpose of this study was to evaluate the short-term effect of different GJ anastomosis diameters in patients offered laparoscopic OAGB regarding weight loss, bile reflux, and nutritional and metabolic effect.

Patients and methods

This is a prospective comparative study done between April 2018 and July 2019 in Helwan University hospitals, and all the procedures were done by the same surgeons in bariatric surgery unit. Ethical committee approval and written consent from all patients were obtained.

Our study included 59 patients with morbid obesity who underwent laparoscopic OAGB, and they were eligible for this procedure if their BMI was more than or equal to 40 or more than or equal to 35 kg/m^2 and had one or more comorbidities.

Patients were divided into two groups, and their allocation to each group was done randomly by closed envelop technique.

Group A included patients with GJ anastomosis performed by a 45-mm stapler reload and group B included patients with GJ anastomosis performed by 20 mm of the stapler reload.

All patients were subjected to preoperative full history taking, thorough clinical examination including BMI calculation, full laboratory blood tests (complete blood picture, liver function, kidney function, random blood sugar, glycated hemoglobin, thyroid profile, and coagulation profile), pelvi-abdominal ultrasonography, chest radiograph, pulmonary function tests, and ECG.

If any patient was discovered to have any laboratory abnormality or deficiency, the surgery was postponed until correction.

Echocardiography was done to patients older than 50 years or having history of cardiac disease.

If gallstones were detected by preoperative abdominal ultrasound, cholecystectomy was performed concomitantly during the procedure regardless if it was symptomatic or not.

Preoperative esophago-gastro-duodenoscopy (EGD) was done for patients with gastro-esophageal reflux symptoms, and if gastro-esophageal reflux disease +/– hiatus hernia was found, the patient was excluded from the study and was planned for LRYGB.

Surgical technique

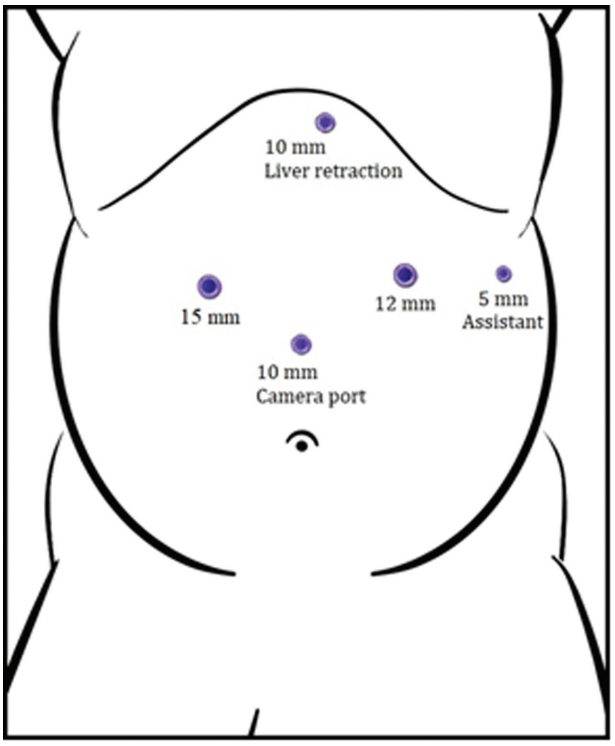
All the surgeons followed the same technique for the procedure, which was as follows.

The procedure was done under general anesthesia, and patients were placed in supine position with the surgeon standing between the legs, camera operator to the right of the patient, and the assistant on the left side. Five trocars were used (Fig. 1), and pneumoperitoneum was routinely done from the midline trocar (Visiport) and then all trocars were introduced under vision using 30° camera lens.

The procedure was started by creating the long lesser curvature pouch by dissecting the lesser omentum off the stomach wall at the level below crow's foot downward to create a window for the transversely fired first stapler reload which was 45 mm using Endo GIA stapler (Covidien/Medtronic).

The rest of the pouch is created by using 60 mm reloads using calibration tube size 36 F.

Figure 1



Ports' sites in MGB-OAGB.

After creation of a gastric pouch, we started to locate ligament of Treitz for measurement of the bypassed jejunal loop, which was approximately fixed to 200 cm, and all surgeons measured the bowel length by using a constant 10-cm benchmark on the shaft of the laparoscopic instrument. Then, anastomosis with the gastric pouch was done in anticolic and retrogastric manner.

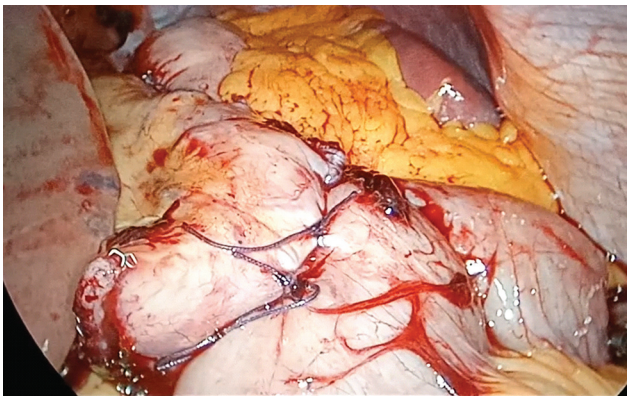
In group A, a 45-mm stapler reload was used for the GJ anastomosis, whereas in group B, the GJ anastomosis was made through the adjustment of stapling to 20 mm. This was followed by two layers suturing of the gastrotomy and enterotomy as the first layer was continuous taking the full thickness, and the second layer was interrupted (three to four stitches) taking only the serosal layer to avoid narrowing of the anastomosis in addition to anchoring anti-reflux stitch 2 cm above the anastomosis (Fig. 2).

The final step of the procedure was methylene blue leakage test and a tube drain was routinely inserted intra-abdominally from the left subcostal port and positioned just below the GJ anastomosis.

Postoperative management

All patients were instructed for early mobilization and to start clear oral fluids from the second postoperative day. Patients received low-molecular-weight heparin (Clexane 0.4 mg) daily for 2 weeks as a prophylactic against thrombosis, 1-g third-generation cephalosporin (Ceftriaxone) once daily for 3 days, and proton pump inhibitors (Controloc 40 mg twice daily) and the later was continued to 3 months.

Figure 2



The final appearance of MGB/OAGB.

Patients were discharged on the second postoperative day unless if there were any complications, and the drain was left for observation of any leakage or bleeding and was removed on the fifth postoperative day in the first outpatient clinic visit. All patients received multivitamin supplements, and calcium and protein powder were started from the second week and continued for life.

All patients were instructed to return to the emergency department if they had any of the following symptoms: sudden unusual abdominal pain, tachycardia, or fever.

Follow-up

Through a multidisciplinary team, the surgeon and the clinical nutritionist assessed each follow-up visit and the first follow-up visit was on the fifth day of the discharge and then once weekly until the end of the first month. Then, patients were advised to follow-up in the outpatient clinic once per month for 1 year and the least accepted follow-up was 1 year. Patients were examined clinically during their visit with measurement of weight, and they were asked about any systemic or gastrointestinal tract complaints.

Bile reflux was suspected by the presence of symptoms of frequent heartburn, nausea, epigastric pain, and/or greenish yellow vomiting. Then, it was confirmed by EGD (presence of large amount of bile in the gastric pouch +/− gastritis, mucosal breaks or GJ anastomotic ulcer).

Follow-up laboratory tests (complete blood picture, serum ferritin, iron, transferrin and total iron-binding capacity, albumin, serum calcium, and vitamin D and vitamin B12 levels) were done every 3 months in the same laboratory, and any deficiencies were corrected as needed.

Fasting blood glucose and glycosylated hemoglobin were added to the follow-up laboratory tests in patients with type 2 diabetes mellitus (T2DM) to detect remission. T2DM remission was considered by fasting blood glucose less than 126 mg/dl and glycosylated hemoglobin less than 6.5% without hypoglycemic medications. Moreover, iron-deficiency anemia was diagnosed by low hemoglobin levels (<12 in females and <13 in males), serum iron less than 10 mmol/l, total iron-binding capacity more than 95 mmol/l, MCV less than 80 fl, MCH less than 27 pg, and with total saturation of less than 20%.

Statistical analysis

Data were analyzed using the statistical program SPSS, version 26.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were expressed as mean±SD, and qualitative variables were expressed using absolute and relative frequencies. χ^2 test was used to study the association between qualitative variables, and also Fisher exact test was used instead when 2 or more cells have expected count less than 5. Student *t* test or Mann–Whitney test was used to study the differences between means for two groups, depending on the application conditions, and analysis of variance or Kruskal–Wallis, for more than two groups. Statistical significance was set at *P* value less than 0.05.

Sample size calculation was done using G*Power software, version 3.1.2 for MS Windows, Franz Faul, Kiel University, Germany. The sample size calculation was based on assuming that there is a large effect size (Cohen's *d*) of 0.8 between the two groups regarding the mean EWL% after 1 year. Accordingly, we calculated that the minimum sample size was 24 patients in each group to be able to reject the null hypothesis with 80% power at α=0.05 level.

Results

A total of 59 patients were initially included in the study with four (6%) patients lost to follow-up and were excluded, so 55 patients were available for analysis. There was no statistically significant difference in demographic data and preoperative BMI between both groups (P>0.05). Moreover, there was no statistically significant difference between both groups regarding history of cholecystectomy, and there were two (5.1%) patients in group A who underwent concomitant cholecystectomy during OAGB (P>0.05) (Table 1).

Table 2 shows no significant difference regarding postoperative mean BMI at 3, 6, 9 months, and 1 year and EWL% (P>0.005).

Regarding postoperative complications, there were no reported cases of postoperative bleeding, leakage, stricture, or mortality during our study. Symptomatic bile reflux was 12.9 and 16.7% in group A and group B, respectively, and marginal ulcer occurred in one (3.2%) case in group A (P>0.05) (Table 3).

None of the patients in both groups had deficiencies at baseline and postoperative follow-up laboratory results showed that group B patients experienced more from iron-deficiency anemia, which was statistically significant at 3, 6, and 9 months (P<0.05), whereas

Table 1 Demographic data, comorbidities, and surgical history

	Group A (*N*=31) [*n* (%)]	Group B (*N*=24) [*n* (%)]	*P* value
Sex			0.415**
Males	5 (16.1)	6 (25)	
Females	26 (83.9)	18 (75)	
Age			0.841*
Mean±SD	39.09±10.96	39.67±9.62	
Range	22–58	23–55	
BMI	45.88±6.26	49.54±9.56	0.093*
Comorbidities			
T2DM	10 (32.3)	10 (41.7)	0.472**
Hypertension	11 (35.5)	10 (41.7)	0.640**
History of cholecystectomy	1 (3.2)	4 (16.7)	0.156***
Concomitant cholecystectomy	1 (3.2)	0	1.000*

T2DM, type 2 diabetes mellitus. *Student *t* test. **χ^2 test. ***Fisher exact test, *P* value less than 0.05 is significant.

Table 2 Postoperative BMI, excess weight loss percentage, and remission of comorbidities

	Group A (*N*=31)	Group B (*N*=24)	*P* value
BMI after 3 months			
Mean±SD	39.06±5.90	41.67±8.40	0.182*
Range	27.5–54	30–58	
BMI after 6 months			
Mean±SD	35.28±5.20	35.68±6.87	0.808*
Range	24–48	27–49	
BMI after 9 months			
Mean±SD	32.87±4.91	32.75±5.63	0.933*
Range	23–46	24–43	
BMI after 1 year			
Mean±SD	29.68±4.83	30.42±5.49	0.601*
Range	22–42	22–42	
EWL%			
Mean±SD	76.45±17.46	80.83±14.16	0.321*
Comorbidities remission at 1 year [*n* (%)]			
T2DM	7 (70)	10 (100)	0.211**
HTN	7 (63.6)	10 (100)	0.090**

EWL, excess weight loss; HTN, hypertension; T2DM, type 2 diabetes mellitus. *Student *t* test. **Fisher exact test, *P* value less than 0.05 is significant.

Table 3 Postoperative complications

	Group A (*N*=31) [*n* (%)]	Group B (*N*=24) [*n* (%)]	*P* value
Bleeding	0	0	
Leakage	0	0	
Bile reflux	4 (12.9)	4 (16.7)	0.718**
GJ anastomotic ulcer	1 (3.2)	0	1.000**

GJ, gastrojejunal. **Fisher exact test, *P* value less than 0.05 is significant.

there was no significant difference at 1 year (P=0.128). Moreover, hypoalbuminemia was significantly more evident in group B, with P values of less than 0.001, 0.035, and 0.031 at 3, 9 months, and 1 year, respectively.

Vitamin D deficiency was also more evident in group B at 6 and 9 months, with P values of 0.010 and 0.005, respectively, and there was no statistical significance at 3 months and 1 year (P>0.05). Finally, there was no significant difference between both groups regarding vitamin B12 deficiency and hypocalcemia through the study period (P>0.05) (Table 4).

Discussion

OAGB is now gaining more popularity worldwide, as in 2015, it became the third most common performed bariatric procedure [19]. From the data available in the literature on more than 7000 patients who underwent OAGB, Lee and Lin [20] and Victorzon [21] concluded that it is a simple and safe procedure when it was compared with LRYGB. It showed efficient resolution of comorbidities, better long-term weight loss, and lower revision rate than LRYGB [22].

In developing countries and in our institution, we offer OAGB mainly for patients who are morbidly obese, super obese, having comorbidities (T2DM and/or hypertension), and also who can afford lifelong intake of multivitamins with long-term laboratory follow-up as this may add financial burden to these patients and their families, and this may explain the limited sample size in our study.

OAGB is now recognized by IFSO as a well-established effective bariatric procedure despite that there are concerns regarding postoperative short-term bile reflux and the possible long-term carcinogenic effect [20].

There are some technical differences among bariatric surgeons all over the world when performing OAGB. Other than performing long lesser curve gastric pouch to avoid bile reflux, there is another variable component, which is the GJ anastomosis diameter and the length of the bypassed intestinal segment.

In this study, we included 55 patients who underwent OAGB with a standard long lesser curve pouch below the level of crow's foot, and fixed intestinal bypass length of 200 cm from ligament of Treitz, and we used two different lengths of stapler reload for GJ anastomosis in group A and group B.

Despite that the fixed bypassed intestinal length of 200 cm, as mentioned by Rutledge, is still the most frequently used, there are significant variations in the bypassed intestinal lengths done by different surgeons [23].

Measuring the total bowl length for tailored OAGB is advised by many surgeons as patients may vary in their intestinal length, and this may affect the outcome of postoperative weight loss and their nutritional status, but it may be associated with longer operative time and additional risk of serosal injuries to small intestine. Moreover, some surgeons advise adjusting the bypassed intestinal length according to preoperative BMI, ranging from 180 to 250 cm.

Regarding weight loss, our study showed that both groups had successful weight and BMI loss (EWL >50%) during the study period. Moreover, there was

Table 4 Postoperative laboratory results

	Group A (*N*=31) [*n* (%)]	Group B (*N*=24) [*n* (%)]	*P* value
Iron-deficiency anemia (<12 in females and <13 in males)			
3 months	3 (9.7)	18 (75)	<0.001*
6 months	3 (9.7)	10 (41.7)	0.006*
9 months	1 (3.2)	6 (25)	0.035**
1 year	3 (9.7)	6 (25)	0.128*
Hypoalbuminemia (<3.5 mg/dl)			
3 months	0	8 (33.3)	<0.001**
6 months	0	0	
9 months	1 (3.2)	6 (25)	0.035**
1 year	0	4 (16.7)	0.031**
Hypocalcemia (<8.6 mg/dl)			
3 months	1 (3.2)	0	1.000**
6 months	1 (3.2)	0	1.000**
9 months	0	0	
1 year	1 (3.2)	0	1.000**
Vitamin D deficiency (<30 ng/ml)			
3 months	5 (16.1)	0	0.061**
6 months	2 (6.5)	8 (33.3)	0.010*
9 months	0	6 (25)	0.005**
1 year	2 (6.5)	4 (16.7)	0.387**
Vitamin B12 deficiency (<187 pg/ml)			
3 months	0	0	
6 months	1 (3.2)	0	1.000**
9 months	0	0	
1 year	1 (2.6)	0	1.000**

*χ^2 test. **Fisher exact test, *P* value less than 0.05 is significant.

no statistical difference in EWL% at 1 year, being 76.45 and 80.83% in group A and group B, respectively (P=0.321).

A study by Elgeidie *et al.* [24] on 209 patients found better EWL% and TWL% in patients with stoma size of 30 mm rather than 45 mm at 6-month follow-up, but at 1- and 2-year follow-up, the difference between both groups disappeared.

Moreover, group B patients in this study had better resolution of comorbidities, with 100% remission of both T2DM and hypertension at 1 year, when compared with group A, with 70 and 63.6% for T2DM and hypertension, respectively, but this result was found to be statistically insignificant (P>0.05).

The total incidence of bile reflux during our study was 14.5%, and there was no statistical significance between group A and group B, with incidences of 12.9 and 16.7%, respectively (P=0.718). However, our detection for bile reflux was limited only to symptomatic patients as we did not perform EGD as a routine postoperative investigation for all patients.

A study done by Saarinen *et al.* [25] concluded that the presence of bile in gastric pouch is common as they used bile reflux scintigraphy in addition to EGD to confirm the presence of bile reflux, and they reported that 31.6% of patients had a positive findings, 28.9% had bile only in the gastric pouch, and 2.6% showed activity also in the esophagus at the end of the scan.

Another debate regarding the long-term effect of OAGB is malnutrition, hepatic failure, and excessive weight loss, with reported incidence of postoperative protein deficiency of 1.3–4.7% [26].

During our study, there was a higher incidence of hypoalbuminemia in group B at 3, 9 months, and 1 year (P<0.05), but serum albumin levels did not fall below 3 g/dl, and unfortunately, accurate data of patient's compliance for daily protein and vitamins supplementation were not evaluated.

Chen *et al.* [27] reported protein deficiency after gastric bypass surgeries, with an incidence of 2.8 and 1.8% in OAGB and LRYGB, respectively, and they also found that these patients were likely to be male with higher initial BMI than other patients.

Another common presentations of malnutrition after gastric bypass surgery is anemia, which is related to iron and/or vitamin B12 deficiency secondary to

malabsorption [28]. In a study done by Rutledge and Walsh [14] on 2410 patients, they reported iron-deficiency anemia in 5% and excessive weight loss in 1.1% who required revisional surgery.

We found that there was a significant increase in the incidence of iron-deficiency anemia and vitamin D deficiency in group B at 3, 6, and 9 months ($P<0.05$), but at 1 year, it turned insignificant, and this may be explained by the correction of deficiencies during follow-up visits, in addition that most of our patients tolerated eating different types of food at 1 year better than in the first month postoperatively ($P>0.05$).

In our study, we reported one case of marginal ulcer in group A, which was managed conservatively, and we did not report any cases of excessive weight loss or severe malnutrition requiring revision during 1-year follow-up.

A study by Khalaj *et al.* [29] reported 3.7% incidence of readmission owing to severe malnutrition, and these patients required revisional surgery after failure of supportive measures.

The main limitations in our study were the small sample size of patients who underwent OAGB, short-term postoperative follow-up, and inaccurate data of patient's compliance to vitamin and protein intake. These factors do not permit a thorough evaluation of the long-term risk-effectivity ratio and inferences on the late outcomes of this procedure. Nonetheless, as the main objective of this study was to evaluate the short-term effect of using two different anastomosis diameters during OAGB, further research and long-term follow-up are needed to provide more evidence regarding its long-term outcomes.

Conclusion

OAGB is a safe and effective bariatric procedure whether GJ anastomosis was made using a 45-mm stapler or 20 mm of the reload. However, using a 45-mm stapler reload may be associated with less nutritional deficiencies than 20 mm with insignificant difference for the occurrence of bile reflux. Further studies are needed on a larger number of patients with long-term follow-up.

Acknowledgements

The authors acknowledge all the working members and nurse staff in General Surgery Department and Endoscopy Unit in Helwan University Hospital.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Magouliotis D, Tasiopoulou V, Sioka E, Chatedaki C, Zacharoulis D. Impact of bariatric surgery on metabolic and gut microbiota profile: a systematic review and meta-analysis. Obes Surg 2017; 27:1345–1357.

2 Angrisani L, Santonicola A, Iovino P, Formisano G, Buchwald H, Scopinaro N. Bariatric surgery worldwide 2013. Obes Surg 2015; 25:1822–1832.

3 Stroh C, Weiner R, Horbach T, Ludwig K, Dressler M, Lippert H. New data on quality assurance in bariatric surgery in Germany. Zentralbl Chir 2013; 138:180–188.

4 Gagner M, Deitel M, Erickson A, Crosby R. Survey on laparoscopic sleeve gastrectomy (LSG) at the Fourth International Consensus Summit on Sleeve Gastrectomy. Obes Surg 2013; 23:2013–2017.

5 Rutledge R. The mini-gastric bypass: experience with the first 1,274 cases. Obes Surg 2001; 11:276–280.

6 Mahawar KK, Jennings N, Brown J, *et al.* 'Mini' gastric bypass: systematic review of a controversial procedure. Obes Surg 2013; 23:1890–1898.

7 Wang W, Wei P, Lee Y, Huang M, Chiu C, Lee W. Short-term results of laparoscopic mini-gastric bypass. Obes Surg 2005; 15:648–654.

8 Noun R, Zeidan S. Laparoscopic mini-gastric bypass: an effective option for the treatment of morbid obesity. J Chir (Paris) 2007; 144:301–304.

9 Johnson W, Fernanadez A, Farrell T, Macdonald K, Grant J, McMahon R. Surgical revision of loop ('mini') gastric bypass procedure: multicenter review of complications and conversions to Roux-en-Y gastric bypass. Surg Obes Relat Dis 2007; 3:37–41.

10 Noun R, Skaff J, Riachi E, Daher R, Antoun N, Nasr N. One thousand consecutive mini-gastric bypass: short- and long-term outcome. Obes Surg 2012; 22:697–703.

11 Kular KS, Manchanda N, Rutledge R. A 6-year experience with 1,054 mini-gastric bypasses-first study from Indian subcontinent. Obes Surg 2014; 24:1430–1435.

12 Musella M, Susa A, Greco F, De Luca M, Manno E, Di Stefano C, Milone M. The laparoscopic mini-gastric bypass: the Italian experience: outcomes from 974 consecutive cases in a multicenter review. Surg Endosc 2014; 28:156–163.

13 Mahawar KK, Carr WR, Balupuri S, Small P. Controversy surrounding 'mini' gastric bypass. Obes Surg 2014; 24:324–333.

14 Rutledge R, Walsh TR. Continued excellent results with the mini-gastric bypass: six-year study in 2,410 patients. Obes Surg 2005; 15:1304–1308.

15 Carbajo M, García-Caballero M, Toledano M, Osorio D, Lanza C, Carmona J. One-anastomosis gastric bypass by laparoscopy: results of the first 209 patients. Obes Surg 2005; 15:398–404.

16 Deitel M. Consensus survey on mini-gastric bypass and one-anastomosis gastric bypass. Ann Bariatrics Metab Surg 2018; 1:10.

17 Carbajo M, Luque-de-León E, Jiménez J, Ortiz-de-Solórzano J, Miranda M, Castro-Alija M. Laparoscopic one-anastomosis gastric bypass: technique, results, and long-term follow-up in 1200 patients. Obes Surg 2017; 27:1153–1167.

18 Solouki A, Kermansaravi M, Davarpanah Jazi AH, Kabir A. One-anastomosis gastric bypass as an alternative procedure of choice in morbidly obese patients. J Res Med Sci 2018; 23:84.

19 Deitel M. Letter to the editor: bariatric surgery worldwide 2013 reveals a rise in mini gastric bypass. Obes Surg 2015; 25:2165.

20 Lee W-J., Lin Y-H. Single-anastomosis gastric bypass (SAGB): appraisal of clinical evidence. Obes Surg 2014; 10:1749–1756.

21 Victorzon M. Single-anastomosis gastric bypass: better, faster, and safer? Scand J Surg 2015; 104:48–53.

22 Musella M, Susa A, Manno E, *et al.* Complications following the mini/one anastomosis gastric bypass (MGB/OAGB): a multi-institutional survey on 2678 patients with a mid-term (5 years) follow-up. Obes Surg 2017; 27:2956–2967.

23 Mahawar KK, Kular KS, Parmar C, *et al.* Perioperative practices concerning one anastomosis (mini) gastric bypass: a survey of 210 surgeons. Obes Surg 2018; 28:204–211.

24 Elgeidie A, Abdelgawad M, El Sorogy M, *et al.* The effect of stoma size on the mid-term weight loss outcome of one anastomosis gastric bypass (OAGB): a single-blinded prospective randomized trial. Surg Endosc 2021; 35:1691–1695.

25 Saarinen T, Pietiläinen KH, Loimaala A, *et al.* Bile reflux is a common finding in the gastric pouch after one anastomosis gastric bypass. Obes Surg 2020; 30:875–881.

26 Skroubis G, Sakellaropoulos G, Pouggouras K, *et al.* Comparison of nutritional deficiencies after Roux-en-Y gastric bypass and after biliopancreatic diversion with Roux-en-Y gastric bypass. Obes Surg 2002; 12:551–558.

27 Chen J, Shen C, Lee W, Tsai P, Lee Y. Protein deficiency after gastric bypass: the role of common limb length in revision surgery. Surg Obes Relat Dis 2019; 15:441–446.

28 Steenackers N, Gesquiere I, Matthys C. The relevance of dietary protein after bariatric surgery: what do we know? Curr Opin Clin Nutr Metab Care 2018; 21:58–63.

29 Khalaj A, Kalantar Motamedi MA, Mousapour P, Valizadeh M, Barzin M. Protein-calorie malnutrition requiring revisional surgery after one-anastomosis-mini-gastric bypass (OAGB-MGB): case series from the Tehran obesity treatment study (TOTS). Obes Surg 2019; 29:1714–1720.