Laparoscopic sleeve gastrectomy versus laparoscopic single anastomosis gastric bypass: short-term outcome

Asem F. Moustafa[a], Moharam A. Mohammed[a], Ashraf A. Zeineldin[a], Ahmed A. Elgeiedie[b], Amr T. Hafez[c]

[a]Department of General Surgery, Faculty of Medicine, Menoufia University, [c]Department of General Surgery, Shebin EL-Kom Teaching Hospital, Menoufia, [b]Department of General Surgery, Faculty of Medicine, Mansoura University, Mansoura, Egypt

Correspondence to Amr T. Hafez, MSC, Shebin El-kom, Menoufia, 32511, Egypt.
Tel: +20 100 678 6363;
e-mail: dr_amr_tarek@yahoo.com

Received: 13 November 2020
Revised: 8 December 2020
Accepted: 6 December 2020
Published: 18 May 2021

The Egyptian Journal of Surgery 2021, 40:300–308

Objective
To compare laparoscopic sleeve gastrectomy (LSG) and laparoscopic single anastomosis gastric bypass (LSAGB) for morbidly obese patients. Both procedures were compared regarding % of excess weight loss (%EWL), resolution of comorbidities, hospital stay, morbidity, mortality, and bariatric analysis and reporting outcome system (BAROS) on short-term basis.

Background
Bariatric surgery has been proved to be a successful treatment option, leading to long-term weight loss with improvement of obesity-related comorbidities. The LSG is now one of the most popular bariatric procedures worldwide, whereas the LSAGB is now rising worldwide.

Patients and methods
This prospective study involved 40 patients blindly divided into two groups: 20 of them underwent LSG and 20 of them underwent LSAGB. Written informed consent was obtained from all patients for the procedures and possible complications and conversion. The study was approved by the local ethical committee. All the patients had a 1-year period of follow-up postoperatively and were evaluated for % EWL, resolution of comorbidities, hospital stay, morbidity, mortality, and BAROS.

Results
A total of 40 obese patients were blindly divided into two groups: LSG included 20 patients, comprising three males and 17 females, with mean BMI of 43.7 kg/m^2. Among them, four had type 2 diabetes mellitus (T2DM), three had hypertension (HTN), five had osteoarthritis, two had obstructive sleep apnea (OSA), five had dyslipidemia, and one had polycystic ovary. LSAGB group included 20 patients, comprising four males and 16 females, having a mean BMI of 45.1 kg/m^2. Of them, 25 had T2DM, four had HTN, three osteoarthritis, one OSA, eight dyslipidemia, and two polycystic ovary. The mean operative time was 66 min in LSG, whereas it was 72.6 min in LSAGB. The mean duration of hospital stay was 2.5 days in LSG, whereas it was 3.5 days in LSAGB. Mean %EWL was 33.4% at 1 month and 77.22% at 12 months in LSG and was 20.13% at 1 month and 80.4% at 12 months in LSAGB. Overall, two patients with T2DM had complete and two had partial resolution in LSG, whereas three patients with T2DM in LSAGB. Moreover, two patients had complete resolution regarding HTN in LSG and all of them in LSAGB. There was resolution of osteoarthritis, OSA, and polycystic ovary in all patients in both groups. Bleeding was seen in one case in LSG. Wound infection was recorded in one case in LSG and in two cases in LSAGB. Postoperative nausea and vomiting was seen in three cases in LSG and in one cases in LSAGB. Symptomatic cholelithiasis was seen in seven patients in LSG group, and two patients needed surgery, whereas in LSAGB, five patients had symptomatic cholelithiasis, and three patients needed surgery. A total of eight patients had dumping symptoms only in LSAGB. According to BAROS, it was revealed that in LSG, 12 of the patients evaluated the quality of life as 'excellent' and two as 'very good,' whereas in LSAGB, 14 of the patients evaluated the quality of life as 'excellent' and three as 'very good.'

Conclusion
LSG has proved to be a safe and effective bariatric surgery with a rate of success that is similar to the LSAGB. LSAGB appears to reduce obesity-related comorbidities with low complication rate. Both procedures offer a good quality of life according to BAROS.

Keywords:
bariatric surgery, bariatric analysis and reporting outcome system, single anastomosis gastric bypass, sleeve gastrectomy

Egyptian J Surgery 40:300–308

1110-1121

Introduction

Obesity is a panendemic health problem in both Western and Eastern countries [1].

Obesity prevalence is rapidly increasing worldwide. A number of serious comorbidities are associated with morbid obesity, including type 2 diabetes mellitus (T2DM), hypertension (HTN), osteoarthritis, obstructive sleep apnea (OSA), gastroesophageal reflux disease (GERD), and nonalcoholic fatty liver disease [2].

More than two-thirds of adults in the United States are overweight or obese, and more than one-third are obese, according to data from the National Health and Nutrition Examination Survey. The prevalence of obesity in the USA continues to be high, exceeding 30% in most sex and age groups [3].

In Egypt, the estimated prevalence of overweight increased from 4% in 1990 to 7% in 2011 and is expected to increase [4].

Morbidly obese individuals generally have a BMI of more than 40 kg/m^2. Super obesity is a term sometimes used to define individuals who have a body weight exceeding a BMI of 50 kg/m^2 or greater [5].

Bariatric surgery is the most effective treatment for morbid obesity, and the long-term results regarding weight loss and improvement of obesity-related comorbidities have been well established [6].

Primary operations for morbid obesity are restrictive, malabsorptive, or combined [7].

Laparoscopic sleeve gastrectomy (LSG) was originally conceived by Gagner's group after they reviewed their results with laparoscopic DS procedures [8].

All recently published papers found that LSG is a safe, effective, and easy weight-loss surgical procedure. However, most surgeons fear the risk of leakage, which is associated with high morbidity/mortality [9].

Laparoscopic single anastomosis gastric bypass (LSAGB) was introduced by Rutledge in 1997; this variant of gastric bypass has the advantages of using a tension-free gastrojejunal anastomosis [10].

Although it is proven to be safe and effective, it is still an investigational bariatric procedure, and this is mainly owing to related morbidities [11].

Preoperative weight loss causes reduction in operative time and blood loss owing to reduction of liver size [12].

Patients and methods

This is a comparative study carried out on 40 patients assigned for surgical treatment of morbid obesity at Menoufia University and Shebin El-Kom teaching hospitals between June 2017 and June 2020. Patients were randomized into two equal groups: group 1 included 20 patients who underwent LSG, and group 2 included 20 patients who underwent LSAGB.

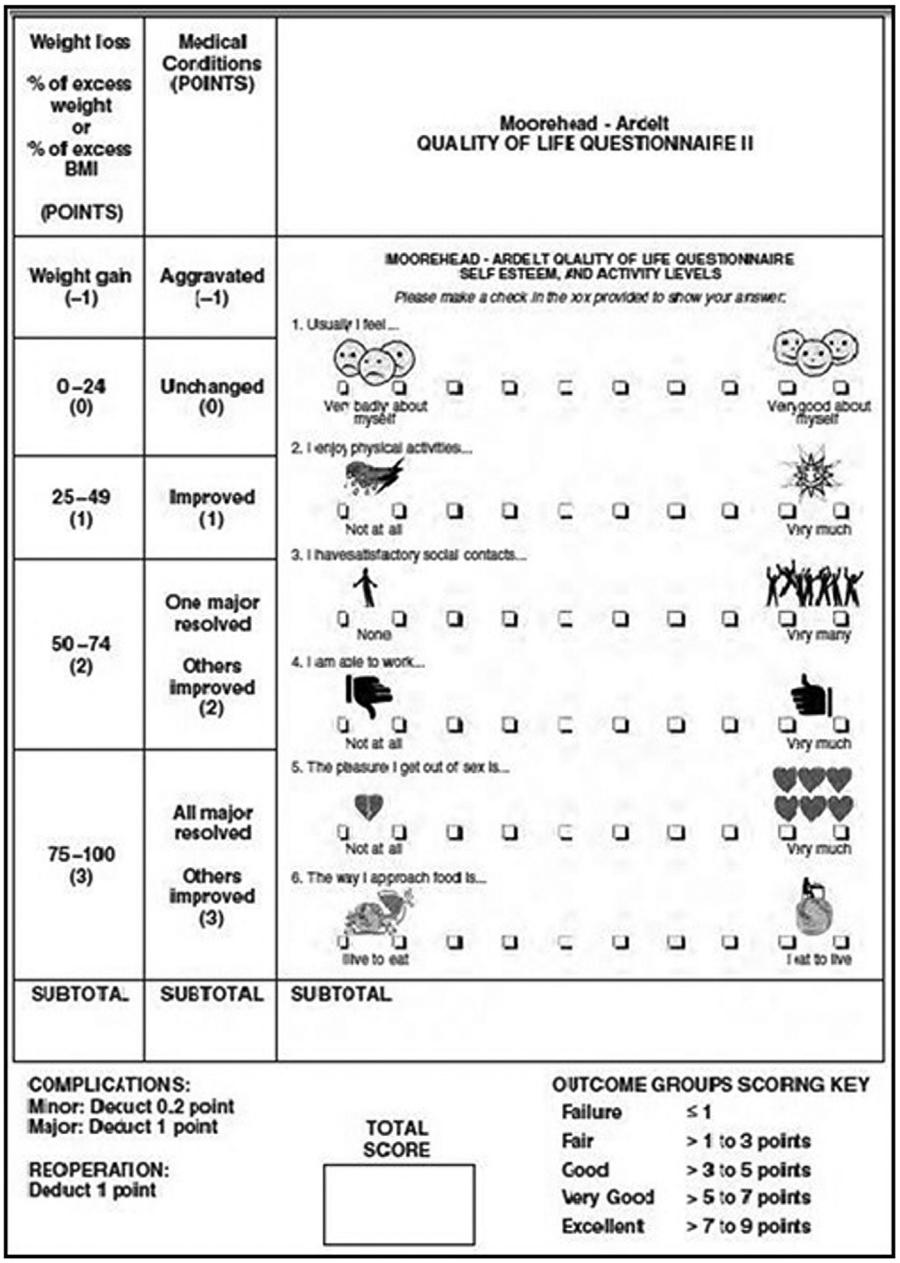
Written consent was obtained from all patients for the procedures and complications and conversion. The study was approved by the local ethical committee. Both groups had the same inclusion criteria: patients between 18 and 60 years with BMI more than or equal to 40 or BMI more than or equal to 35 with comorbidity and previous fully supervised but failed adequate diet and exercise program. Both groups had the same exclusion criteria: significant psychiatric disorders, active drug or alcohol abuse, active gastric ulcer disease, obesity owing to endocrinal cause, and patients unfit for surgery.

The outcomes of the study were % of excess weight loss (%EWL), the resolution of obesity-associated comorbidities, the overall morbidity and mortality of the surgery, total operative time and hospital stay length, and patient satisfaction and quality of life according to the bariatric analysis and reporting outcome system (BAROS) as outlined later. All patients had full clinical evaluation including the personal data and clinical examination. Preoperative evaluation of all the patients included upper gastrointestinal tract endoscopy, which was conducted to exclude severe esophagitis, large hiatus hernia, and active peptic ulcer; abdominal ultrasound for the patients for detection of gallstones; chest radiograph and respiratory function test (for patients with OSA or other respiratory problems); ECG and echocardiography; and routine laboratory investigation plus complete lipid profile, thyroid profile (fT3, fT4, TSH), serum cortisol level, and HbA1c for diabetic patients (Fig. 1).

Preoperative preparation

All patients were asked to follow a special preoperative diet (liver shrinkage diet) for 2 weeks, which includes a high-protein, low-carbohydrate, and no-fat diet. Smoking cessation was encouraged 4 weeks before surgery. Preoperative psychological assessment included personality examination as well as assessment of expectation/motivation, diet history, and lifestyle. A preanesthesia evaluation was done by an anesthesiologist day before surgery. Preoperative

Figure 1



The bariatric analysis and reporting outcome system (BAROS) [13].

antibiotics should be given before the surgical incision given by intravenous route. The use of ceftazidime 1 g was done. Prophylaxis of venous thromboembolism events is recommended for bariatric patients. Graduated compression stockings, early postoperative ambulation, and subcutaneous LMWH administration in dose of 40 mg/day after 12 h postoperatively and then once daily for 1 week were initiated.

Surgery

(1) Under general endotracheal anesthesia, under complete aseptic condition, the patients were positioned in 30° anti-Trendelenburg position with legs abducted (French position). Both legs were supported and secured with a belt and tape. The surgeon stands between both legs, whereas the first assistant, holding the camera, is on the left side of the surgeon. A second assistant is placed on the right side of the surgeon. Abdominal entry was established using closed method (Veress Needle). Pneumoperitoneum was created (15 mmHg). First, a mid-line supraumbilical incision (10 mm first port) 15 cm below xiphisternum was done. A 30° angled scope was introduced and the abdomen was inspected, then Epigastric port (10 mm) through which the liver retractor is introduced. Other two (12 mm) optical trocars (Excel)

Table 1 Demographic data of the study

Patients' demographics	LSG (*N*=20) [*n* (%)]	LSAGB (*N*=20) [*n* (%)]	Test of significance	*P*
Sex			χ^2=0.17	0.78
Male	3 (15)	4 (20)		
Female	17 (85)	16 (80)		
Age (years)			*t*=1.66	0.105
Minimum–maximum	21–49	20–47		
Mean±SD	30.3±3.6	28.1±4.6		
Preoperative BMI			*t*=1.6	0.117
Minimum–maximum	39.6–55.9	41.2–58.6		
Mean±SD	43.7±3.2	45.1±2.6		
Types of comorbidities			*Z* test	
Type 2 DM	4 (20)	5 (25)	–	1
Hypertension	3 (15)	4 (20)	–	1
Osteoarthritis	5 (25)	3 (15)	0.4	0.7
Obstructive sleep apnea	2 (10)	1 (5)	–	1
Dyslipidemia	5 (25)	8 (40)	0.68	0.5
Poly cystic ovary	1 (5)	2 (10)	–	1

LSAGB, laparoscopic single anastomosis gastric bypass; LSG, laparoscopic sleeve gastrectomy. *Z* test was used to compare two proportions in two groups. No statistical significance was found between both groups regarding patients' demographics (age, sex, initial BMI, and comorbidities).

included one in the left midclavicular line beneath the left rib arch and the other in the right midclavicular line beneath the right rib arch. Last, 5-mm port in the left anterior axillary line is used for the assistant.

(2) For LSG, mobilization of the gastric greater curve began 6 cm proximal to the pylorus, and continued to the angle of His with importance accorded to the total exposure of the left crus. Gastric resection was done using vertical 60 mm staple cartilages over a 36-Fr bougie, first one is green then gold, and finally at the fundus was blue Johnson and Johnson Staplers (Echelon Flex®, Ethicon Endo Surgery INC, J & J Medical SPA, Somerville, NJ, USA).

(3) For LMGB (laparoscopic mini-gastric bypass), the gastric tube was created from incisura angularis to the left crus using generally vertical 60-mm staple blue cartridges Johnson and Johnson Staplers (Echelon Flex) over a 36-Fr bougie 200 cm downstream the angle of Treitz. Gastrojejunostomy is performed side to side using 45-mm blue cartilage linear stapler and then the closure of the anastomotic opening was performed using vicryl 3/0 in two layer. For both procedures, absence of gastric leak was verified by introducing methylene blue through a bougie at the end of the operation.

Statistical analysis

All data were collected, tabulated, and statistically analyzed using SPSS 19.0 for Windows (SPSS Inc., Chicago, Illinois, USA) and MedCalc 13 for Windows (MedCalc Software BVBA, Ostend, Belgium).

Results

LSG) group included 20 obese patients aged from 21 to 49 years, with mean±SD age of 30.8±8.36 years. Of them, three (15%) were males and 17 (85%) were females. Mean±SD initial BMI was 47.85±5.83 kg/m^2. Concomitant comorbidities were four (20%) patients with T2DM, three (15%) HTN, five (25%) patients osteoarthritis, two (10%) OSA, two (10%) dyslipidemia, and one (5%) with polycystic ovary.

LSAGB group included 20 obese patients aged from 20 to 47 years, with mean±SD age of 30.8±7.3 years. Of them, five (25%) were males and 15 (75%) were females. The mean±SD initial BMI was 46.86 ±7.81 kg/m^2. Concomitant comorbidities were five (44%) patients with T2DM, four (32%) HTN, three (24%) patients osteoarthritis, one (16%) OSA, three (32%) dyslipidemia, and two (8%) with polycystic ovary (Table 1).

Mean operative time was 67 min in LSG, whereas it was 73 min in LSAGB. Mean beginning of oral intake was 1.23 days in SG, whereas it was 1.8 days in LSAGB. Mean duration of hospital stay was 2.27 days in LSG, whereas it was 3 days in LSAGB. Mean return to daily activities was 4.04 days in LSG, whereas it was 5.87 days in LSAGB. Mean return to work was 11.53 days in LSG, whereas it was 13.3 days in LSAGB. Mean duration of analgesia by paracetamol and opiates was 4.27 in LSG, whereas it was 5.67 days in LSAGB (Table 2).

Table 2 Operative time and postoperative recovery

Operative time and postoperative recovery (days)	LSG (*N*=20)	LSAGB (*N*=20)	*t*	*P*
Operative time (min)			1.58	0.12
Minimum–maximum	38.0–95.0	54.0–93.0		
Mean±SD	66.7±12.6	72.6±10.9		
Begin oral liquids (days)			0.63	0.53
Minimum–maximum	0.5–2.8	0.5–2.6		
Mean±SD	1.93±0.5	1.82±0.6		
Duration of analgesic (days)			1.89	0.07
Minimum–maximum	3–10	3–9		
Mean±SD	6.8±2.2	5.6±1.8		
Hospital stay (days)			4.12	>0.001*
Minimum–maximum	2–5	3–6		
Mean±SD	2.5±0.51	3.7±1.2		
Return to daily activities (days)			4.48	>0.001*
Minimum–maximum	4–12	5–10		
Mean±SD	4.3±1.2	6.9±2.3		
Return to work (days)			1.59	0.12
Minimum–maximum	10–18	12–20		
Mean±SD	11.6±2.5	13.4±4.4		

LSAGB, laparoscopic single anastomosis gastric bypass; LSG, laparoscopic sleeve gastrectomy. No statistical significance was found, except for hospital stay and return to daily activities, where LSG was superior to LSAGB ($P<0.001$). *P value less than 0.001: significant.

Table 3 Percent excess weight loss at 12 months of follow-up

Percent excess weight loss	LSG (*N*=20)	LSAGB *F*(*N*=20)	*t*	*P*
1 month			7	>0.001*
Minimum–maximum	24.1–45.7	13.2–29.4		
Mean±SD	33.4±6.3	20.9±4.9		
3 months			6.84	>0.001*
Minimum–maximum	35.1–68.3	25.3–49.5		
Mean±SD	55.05±8.08	38.9±6.8		
6 months			2.55	0.01*
Minimum–maximum	53–83.4	33.9–73.4		
Mean±SD	68.8±6.2	62.8±8.5		
12 months			2.1	0.04*
Minimum–maximum	67.7–88.9	46.5–88.2		
Mean±SD	77.2±3.6	80.4±5.8		

LSAGB, laparoscopic single anastomosis gastric bypass; LSG, laparoscopic sleeve gastrectomy. The mean percent excess weight loss was statistically significant in the first 6 months ($P<0.001$). LSG achieved more rapid weight loss than LSAGB. *P value less than 0.05: significant.

The mean %EWL was 32.05% at 1 month and 45.05% at 3 months in SG and was 22.13% at 1 month and 39.75% at 3 months in LSAGB. The mean %EWL was 67.6% at 6 months and 76.22% at 12 months in SG and 63.32% at 6 months and 80.31% at 12 months in LSAGB (Table 3).

Of the four patients with T2DM in LSG, complete remission was seen in two patients and two had partial resolution, and of five patients with T2DM in LSAGB, three showed complete remission and two partial resolution, with no statistical significance. Of six patients with HTN in LSG, complete remission was seen in four patients and partial resolution in two patients, and of five patients with HTN in LSAGB, four showed complete remission and one partial resolution, with no statistical significance. Of five patients with dyslipidemia in LSG, complete remission was seen in four patients and partial resolution in one patient, and of eight patients with dyslipidemia in LSAGB, seven showed complete remission and one partial resolution, with no statistical significance. Resolution of osteoarthritis, OSA, and polycystic ovary was seen in all affected patients in both groups, with no statistical significance (Table 4).

No mortality or visceral injury or anastomotic leak or venous thromboembolism was recorded in this study.

Regarding early complications, bleeding was seen in one case, which was managed conservatively in LSG,

Table 4 Postoperative resolution of comorbidities

Comorbidities	LSG (*N*=20) [*n* (%)]	LSAGB (*N*=20) [*n* (%)]	FE	*P*
Type 2 DM	4 (30)	5 (40)	0.9	0.52
Complete resolution	2 (50)	3 (70)		
Partial resolution	2 (50)	2 (30)		
Hypertension	3 (20)	4 (30)	156	0.4
Complete resolution	2 (66.6)	4 (100)		
Partial resolution	1 (33.3)	0		
Dyslipidemia	5 (25)	8 (40)	1.31	0.3
Complete resolution	3 (60)	7 (87.5)		
Partial resolution	2 (40)	1 (12.5)		
Obstructive sleep apnea	2 (10)	1 (5)		
Osteoarthritis	5 (25)	3 (15)		
Polycystic ovary	1 (5)	2 (10)		

FE, Fischer's exact test; LSAGB, laparoscopic single anastomosis gastric bypass; LSG, laparoscopic sleeve gastrectomy.

Table 5 Postoperative complications

Complications	LSG (*N*=20) [*n* (%)]	LSAGB (*N*=20) [*n* (%)]	*Z* test	*P*
Early				
Bleeding (no exploration)	1 (5)	0	0	1
Wound infection (SSI)	1 (5)	2 (10)	0.1	1
Nausea and vomiting	3 (15)	1 (5)	0.5	0.59
Late				
Dumping	0	8 (40)	3.03	0.002*>
Symptomatic reflux	4 (20)	6 (30)	0.37	0.72
Symptomatic cholelithiasis (surgery)	2 (10)	3 (15)	0.1	1

LSAGB, laparoscopic single anastomosis gastric bypass; LSG, laparoscopic sleeve gastrectomy. Dumping syndrome was statistically significant in the LSAGB not in LSG. **P* value less than 0.05: significant.

Table 6 Comparison according to bariatric analysis and reporting outcome system

BAROS results	LSG (*N*=20) [*n* (%)]	LSAGB (*N*=20) [*n* (%)]	*Z* test	*P* value
Failure	2 (10)	1 (5)	–	1
Good	4 (20)	2 (10)	0.4	0.7
Very good	2 (10)	3 (15)	–	1
Excellent	12 (60)	14 (70)	0.33	0.74

BAROS, bariatric analysis and reporting outcome system; LSAGB, laparoscopic single anastomosis gastric bypass; LSG, laparoscopic sleeve gastrectomy. *Z* test was used to compare two proportions in two groups. No statistical significance was found between both groups regarding BAROS.

and none in LSAGB; wound infection was recorded in one case in LSG and two cases in LSAGB; and postoperative nausea and vomiting in three cases in LSG and one case in LSAGB, and all were managed conservatively, with no statistical difference.

Regarding late complications, dumping symptoms were exclusively LSAGB complications in eight patients, with statistically significant difference ($P<0.05$). Symptomatic reflux was found in four patients in LSG and six in LSAGB, and all of them were managed conservatively. Symptomatic cholelithiasis was obvious in seven patients in LSG, where five were managed conservatively and two patients needed cholecystectomy, whereas five patients in LSAGB had symptomatic cholelithiasis, where two were managed conservatively and three needed cholecystectomy (Table 5).

According to BAROS score, 70% of patients in the LSG and LSAGB had an excellent or very good outcome. Good outcome was observed in 20% of the patients in the LSG group and in 10% in the LSAGB group, which was not statistically difference. Failure was observed in 10% of the patients in the LSG group and in 5% in the LSAGB group (Table 6).

Discussion

Mostafa *et al.* [14] described in their work comparing sleeve with MGB that both groups were comparable for demographic data as well as the distribution of the associated comorbidities, which was similar to our study result.

Lee and Lin [15] described that the mean (SD) BMI was 30.6 kg/m^2 (25.1–34.7) and the mean age was 45 years (34–58). The baseline characteristics were similar across the randomized groups, with no difference between the SAGB and SG group was observed, which is similar to our result.

Gaby *et al.* [16] described that the mean (SD) BMI was 30.6 kg/m^2 (25.1–34.7) and the mean age was 45 years (34–58). The baseline characteristics were similar across the randomized groups, with no difference between the SAGB and SG group was observed, which was similar to our result.

Mostafaa Elsayed *et al.* [17] described in their study that both groups were comparable for demographic data, which was similar to our study result.

Saad *et al.* [18] described in their study that the two groups were matched considering the demographic data, which was similar to our study result.

Plamper *et al.* [19] found that the duration of the surgery and as well as the time of the hospital stay showed to be significantly shorter for MGB. This is unlike our study, which showed significantly shorter hospital stay for the LSG not for the LASGB.

Mostafa *et al.* [14] found that the mean operative time was 68 min in LSG, whereas it was 73 min in LMGB. The mean duration of hospital stay was 2.2 days in LSG, whereas it was 3 days in LMGB. The mean starting oral intake was 1.23 days in LSG, whereas it was 1 day in LMGB, which is similar to our study.

Saad *et al.* [18] described the mean operative time for LSG in our study was 53.25 min, whereas in the LMGB, it was 74.75 min. The operative time for LMGB was statistically significantly longer than LSG. In our study, we showed that there was no statistically significant difference regarding operative time.

Tucker *et al.* [20] reported a mean operative time of 60 min for LSG, which is shorter than our study.

Young *et al.* [21] analyzed the data of 5000 patients who underwent LSG and reported a mean operative time of 101 min for LSG, which is longer than our study.

Mognol *et al.* [22] reported a mean operative time of 120 min for LSG.

Rutledge *et al.* [23] reported a mean operative time of 52±18.5 min for MGB, which was shorter than our study.

Sczepaniak *et al.* [24] compared sleeve gastrectomy with MGB and found %EWL was 54.7 at 6 months and 69.4 at 12 months for gastric bypass and %EWL was 50.0% at 6 months and 60.2% at 12 months for sleeve gastrectomy.

Oria and Moorehead [25] reported the percentage of excess BMI loss represents other reporting methods; however, these are also confounded by extremes in size. In addition, BMI has its own shortcomings, including its lack of accountability for sex, body composition, and ethnicity.

Boza *et al.* [26] have reported the results of 1000 LSG, with a mean EWL of 84.5% at follow-up of 12 months.

Abd El-rahim *et al.* [27] reported that the mean weight loss in LSG cases was 45.33% after 1 year, and in LMGB cases was 64.65% after 1 year .The mean 1 year %EWL was greater in LMGB cases than in LSG cases.

LSAGB in obese patients with T2DM has been shown to be effective in control of T2DM [28].

Milone *et al.* [29] reported that 31 morbidly obese patients were included in the study. All patients were diagnosed with T2DM. A total of 15 patients underwent LSG and 16 patients underwent LMGB. At the 1-year follow-up, 66.7% of LSG group achieved diabetes remission versus 87.5% in LMGB group.

Mokdad *et al.* [30] reported the main risk factor for T2DM is obesity, and most of the patients with T2DM are obese.

Gill *et al.* [31] found that LSG results in T2DM resolution ranging from 80 to 96% in morbidly obese patients. Laparoscopic MGB in morbidly obese patients with T2DM has been shown to be effective.

Capoccia *et al.* [32] observed that 55% of diabetic patients are in complete remission and 17% in partial remission.

Gaby *et al.* [16] observed that rates of improvement of coexisting conditions did not differ between LSG and LMGB for type 2 diabetes (90.5 vs. 92.6%; P=0.79), which was more than our study, and HTN (28.7 vs. 30.9%; P=0.69), which was less than our study.

Kular *et al.* [33] reported that postoperative bleeding occurred in 4.3% in LSG and 0.9% in LMGB, which is similar to our study.

Georgia *et al.* [34] reported that obesity is associated with a high risk of GERD. Approximately half of the obese patients have GERD.

Tolone *et al.* [35] showed in their study that at follow-up after MGB (in contrast to SG), gastroesophageal reflux was not increased, demonstrated by diminished intragastric pressure and GE pressure gradient using endoscopy and 24-h pH-impedance monitoring.

The study by Mahawar *et al.* [36] showed four cases developed symptomatic acid reflux in SG and seven cases developed symptomatic bile reflux in MGB. This is similar to our study.

Li *et al.* [37] stated that no significant difference in development of symptomatic cholelithiasis between the two groups (8.7 vs. 3.8%).

Miguel *et al.* [38] did not see any dumping syndrome in their study, which is in contrast to our study.

Rutledge *et al.* [23] reported two patients died in the first month postoperatively, giving a 30-day mortality rate of 0.18%.

Regarding BAROS in our study, 12 (60%) patients in LSG evaluated the quality of life as 'excellent,' two (10%) as 'very good,' four (20%) as 'good,' and two (10%) as 'failure,' whereas in LSAGB, 14 (70%) patients evaluated the quality of life as 'excellent,' three (15%) as 'very good,' two (10%) as 'good,' and one (5%) as 'failure.'

Piotr *et al.* [39] found no significant differences in body weight loss between the two types of procedures with improvement of obesity-related diseases together with significant enhancement the quality of life.

Costa and Soares [40] reported that using the BAROS, QOL improvement was classified as failure in 2%, good in 8%, very good in 24%, and excellent in 66% in following patients after LMGB.

Dejeu *et al.* [41] investigated the weight changes and the effect of LSG on quality of life after 1 year; they reported a significant improvement in all domains of MA-QOLQII in 1 year.

Azzam *et al.* [42] showed that prevalence of very good BAROS in LSG operation (30.2%), which was higher than bypass (25.3%). The good BAROS result after LSG was higher than bypass in the present study (24.5 and 20.3%, respectively).

Felsenreich *et al.* [43], using BAROS as well, identified a good score at 10+ years after the procedure.

Keren *et al.* [44] found mean BAROS scores of 7.6 and 6.9 in their two groups of patients at 2 years after LSG, which denote 'very good' results.

Conclusion

LSG has proved to be an effective bariatric surgery, with a rate of success that is similar to LSAGB, which appears to reduce obesity-related comorbidities with low complication rate.

BAROS analyzes outcomes in a simple and easily applicable test. Both procedures offer a good quality of life. Our research is still considered a small-scale study, so more research is needed on a larger number of patients.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Doğan S, Önmez A, Çetin MF, Özaydın İ, Pehlivan M. Residual gastric volume relationship and weight loss after laparoscopic sleeve gastrectomy. Obse Surg 2020; 30:1929–1934.

2 Li J-F., Lai D-D., Lin Z-H., Jiang T-Y., Zhang A-M., Dai J-F. Comparison of the long-term results of roux-en-y gastric bypass and sleeve gastrectomy for morbid obesity: a systematic review and meta-analysis of randomized and nonrandomized trials. Surg Laparosc Endosc Percutan Tech 2014; 24:2014.

3 Franco JVA, Ruiz PA, Palermo M, Gagner M. Review of studies comparing three laparoscopic procedures in bariatric surgery: sleeve gastrectomy, Roux-en-Y gastric bypass and adjustable gastric banding. Obes Surg (2011) 21:1458–1468.

4 Hamed AMM, Hassan A-EA, Younis MMS, Kamal A-MM. Prevalence of obesity and overweight among primary schools children in Qena, Egypt. Egypt J Hosp Med 2019; 77:4899–4905.

5 Schauer PR, Schirmer BD. The surgical management of obesity. In: Brunicardi FC (editor). Schwartz's principles of surgery. Chapter 26, 10th ed., Copyright © 2015 by McGraw-Hill Education; 2015. pp. 685–701. All rights reserved. Printed in the United States of America.

6 Helmiö M, Victorzon M, Ovaska J, Leivonen M, Juuti A, Peromaa-Haavisto P, *et al.* Comparison of short-term outcome of laparoscopic sleeve gastrectomy and gastric bypass in the treatment of morbid obesity: a prospective randomized controlled multicenter sleevepass study with 6-month follow-up. Scand J Surg 2013; 0:1–7.

7 Lim RB, Blackburn GL, Jones DB. Benchmarking best practices in weight loss surgery. Curr Probl Surg 2010; 47:79–174.

8 Wu C, Bai R, Yan W, Yan M, Song M. Clinical outcomes of one anastomosis gastric bypass versus sleeve gastrectomy for morbid obesity. Obes Surg 2020; 30:1021–1031.

9 Sarkhosh K, Birch DW, Sharma A, Karmali S. Complications associated with laparoscopic sleeve gastrectomy for morbid obesity: a surgeon's guide. Can J Surg 2013; 56:5.

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

11 Wei-Jei L, Yu P-J., Wang W, Chen T-C, Wei P-L, Huang M-T. Laparoscopic Roux-en-Y versus mini-gastric bypass for the treatment of morbid obesity: a prospective randomized controlled clinical trial. Ann Surg 2005; 242:1.

12 Adel Z, Soltan H, Sabry M, Mustafa RR, Hagag M, Rogula T. Preoperative weight loss regimen, does it affect the outcomes of bariatric surgery? Jsoard 2018; 14:S99–S196.

13 Moorehead MK, Ardelt-Gattinger E, Lechner H, Oria HE. The validation of the Moorehead-Ardelt quality of life questionnaire II. Obes Surg 2003; 13:684–692.

14 Mostafa MM, Mostafa MM, Hablas WR, El-Kordy MA. Comparative study between effect of sleeve gastrectomy and mini-gastric bypass on weight loss and improvement of co-morbidities. Egypt J Hosp Med 2019; 75:2071–2080.

15 Lee WJ, Lin YH. Single-anastomosis gastric bypass (SAGB): appraisal of clinical evidence. Obes Surg 2014; 24:1749–1756.

16 Gaby K, Lechaux D, Delarue J, Badic B, Gall ML, Guillerm S, *et al.* Laparoscopic sleeve gastrectomy versus laparoscopic mini gastric bypass: one year outcomes. Int J Surg 2016; 33:18–22.

17 Mostafaa Elsayed A, Abdel Wahaba EM, Abo Sayed YG, Gafar MH. Laparoscopic sleeve gastrectomy versus laparoscopic mini? gastric bypass in management of morbid obesity and its comorbidities. Menoufia Med J 2018; 31:1181–1186.

18 Saad A, Hemida M, Ashour M, Ramadan R, Zidan A. Comparative study between laparoscopic sleeve gastrectomy and laparoscopic mini gastric bypass for treatment of morbid obesity. Int J Adv Res 2018; 6:1011–1029.

19 Plamper A, Lingohr P, Nadal J, Rheinwalt KP. Comparison of mini?gastric bypass with sleeve gastrectomy in a mainly super? obese patient group: first results. Surg Endosc 2017; 31:1156–1162.

20 Tucker O, Szomstein S, Rosenthal R. Indications for sleeve gastrectomy as a primary procedure for weight loss in the morbidly obese. J Gastrointest Surg 2008; 12:662–667.

21 Young MT, Gebhart A, Phelan MJ, Nguyen NT. Use and outcomes of laparoscopic sleeve gastrectomy vs. laparoscopic gastric bypass: analysis of the American College of Surgeons NSQIP. J Am Coll Surg 2015; 220:880–885.

22 Mognol P, Chosidow D, Marmuse J-P. Laparoscopic sleeve gastrectomy as an initial bariatric operation for high-risk patients: initial results in 10 patients. Obes Surg 2005; 15:1030–1033.

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

24 Sczepaniak JP, Owens ML, Shukla H, Perlegos J, Garner W. Comparability of weight loss reporting after gastric bypass and sleeve gastrectomy using BOLD data 2008–2011. Obes Surg 2015; 25:788–795.

25 Oria HE, Moorehead MK. Updated bariatric analysis and reporting outcome system (BAROS). Surg Obes Relat Dis 2009; 5:60–66.

26 Boza C, Salinas J, Salgado N, Pérez G, Raddatz A, Funke R. Laparoscopic sleeve gastrectomy as a stand? alone procedure for morbid obesity: report of 1,000 cases and 3 year follow? up. Obes Surg 2012; 22:866–871.

27 Abd El-rahim MM, Aagdy MM, Abd El-Maksoud MA. Comparative study between effect of sleeve gastrectomy and mini-gastric bypass on type 2 diabetes mellitus. Med J Cairo Univ 2018; 86:4235–4241.

28 Lee W-J., Ser K-H., Lee Y-C., Tsou J-J., Chen S-C., Chen J-C. Laparoscopic Roux-en-Y vs. mini-gastric bypass for the treatment of morbid obesity: a 10-year experience. Obes Surg 2012; 22:1827–1834.

29 Milone M, Lupoli R, Maietta P, Di Minno A, Bianco P, Ambrosino P. Lipid profile changes in patients undergoing bariatric surgery: a comparative study between sleeve gastrectomy and minigastric bypass. Int J Surg (Engl) 2015; 14:28–32.

30 Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP. The continuing epidemics of obesity and diabetes in the United States. JAMA 2001; 286:1195–1200.

31 Gill RS, Karmali S, Sharma AM. Treating type 2 diabetes mellitus with sleeve gastrectomy in obese patients. Obesity 2011; 19:701–702.

32 Capoccia D, Guida A, Coccia F, Guarisco G, Testa M, Leonetti F, Silecchia G. Weight regain and diabetes evolution after sleeve gastrectomy: a cohort study with over 5 years of follow-up. Obes Surg 2020; 30:1046–1051.

33 Kular KS, Manchanda N, Rutledge R. Analysis of the five-year outcomes of sleeve gastrectomy and mini gastric bypass: a report from the Indian subcontinent. Obes Surg 2014; 24:1724–1728.

34 Georgia D, Triantafyllou S, Natoudi M, Albanopoulos K, Leandros E, Zografos G, Theodorou D. GERD-related questionnaires and obese population: can they really reflect the severity of the disease and the impact of GERD on quality of patients' life? Obes Surg 2015; 25:1882–1885.

35 Tolone S, Cristiano S, Savarino E, Lucido FS, Fico DI, Docimo L. Effects of omega-loop bypass on esophagogastric junction function. Surg Obes Relat Dis 2016; 12:62–69.

36 Mahawar KK, Jennings N, Brown J, Gupta A, Balupuri S, Small PK. 'Mini' gastric bypass: systematic review of a controversial procedure. Obes Surg 2013; 23:1890–1898.

37 Li VKM, Pulido N, Fajnwaks P, Szomstein S, Rosenthal R. Predictors of gallstone formation after bariatric surgery: a multivariate analysis of risk factors comparing gastric bypass, gastric banding, and sleeve gastrectomy. Surg Endosc. 2009; 23:1640–1644.

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

39 Piotr M, Matłok M, P□dziwiatr M, Migaczewski M, Budzyński P, Stanek M, *et al.* Quality of life after bariatric surgery. Obes Surg 2015; 25:1703–1710.

40 Costa JM, Soares JB. Bariatric Analysis and Reporting Outcome System (BAROS): toward the uniform assessment of bariatric surgery outcomes. GE Port J Gastroenterol 2015; 22:85–86.

41 Dejeu V, Dejeu D-A, Dejeu P, Babe? A. Correlation between excessive weight loss and quality of life improvements 12 months after laparoscopic sleeve gastrectomy. Med Con June 2016; 11:21–28.

42 Azzam AK, Siddiqui ZR, Malik AM, Naami MA. Comparison of the efficacy of standard bariatric surgical procedures on Saudi population using the bariatric analysis and reporting outcome system. Saudi Med J 2017; 38:3.

43 Felsenreich DM, Langer FB, Prager G. Weight loss and resolution of comorbidities after sleeve gastrectomy: a review of long-term results. Scand J Surg 2019; 108:3–9.

44 Keren D, Matter I, Rainis T, Lavy A. Getting the most from the sleeve: The importance of post-operative follow-up. Obes Surg 2011; 21:1887–1893.