Bougie size 32 versus 40 french in laparoscopic sleeve gastrectomy

Medhat Helmy

Department of General Surgery, Ain Shams University Hospitals, Cairo, Egypt

Correspondence to Medhat Helmy, MD, MRCS, Department of General Surgery, Ain Shams University Hospitals, Cairo, 11351, Egypt.
Tel: 01001653647;
e-mail: medhat.abdelhalim@med.asu.edu.eg

Received 3 January 2018
Accepted 8 March 2018

The Egyptian Journal of Surgery
2018, 37:200–208

Background
Laparoscopic sleeve gastrectomy (LSG) is considered as one of the most popular bariatric procedures worldwide. Although LSG appears simple, there is still no standard procedure across different surgical teams. The most debatable issue in sleeve gastrectomy is the gastric pouch size; by changing the size of the bougie, we can create different volumes of the stomach tube.
Aim
The aim was to compare the outcome following LSG results when using 32 versus 40-Fr bougie as regards the effects of each on the clinical outcome: weight loss of the patients and possible complications.
Patients and methods
Our study is a prospective, comparative study of 60 patients, who underwent LSG between 'March 2015 and March 2016' with a 1-year follow-up. The patients were classified into two groups: group A (n=30) who underwent LSG using a bougie size of 32 Fr and group B (n=30) who underwent LSG using a bougie size of 40 Fr. We recorded the operative time, hospital stay, and intraoperative and postoperative complications.
Results
A total of 60 patients [17 (28.3%) men and 43 (71.7%) women] underwent LSG. Patients had a mean age of 35±10 years (range: 18–58 years). The mean;Deg;BM; Deg;I was 46.66±4.30 kg/m^2 (range: 34.6–57.5 kg/m^2); the duration of hospital stay in group A was 56±28.07 h, with group B being 36.4±10.68. As regards the weight loss both groups had the same excess weight loss over 1 year; postoperative persistent vomiting was in favor of group A with four (13.3%) patients, two of them required intervention either by endoscopy or conversion to bypass, in comparison to one patient in group B who was managed conservatively.
Conclusion
The use of bougie size 32 Fr did not result in significant excess weight loss differences than bougie size 40 Fr; however, more complications were observed.

Keywords:
bariatric procedure, bougie size, laparoscopic sleeve gastrectomy, morbid obesity

Egyptian J Surgery 37:200–208

1110-1121

Introduction

Laparoscopic sleeve gastrectomy (LSG), first described as a modification of the biliopancreatic diversion with duodenal switch, is emerging as a popular operation for the treatment of morbid obesity, with acceptable morbidity, and long-term weight loss compared with the laparoscopic Roux-en-Y gastric bypass and laparoscopic adjustable gastric band [1].

Although LSG appears to be a simple procedure, there is still no standard procedure across different surgical teams [2]. The gastric pouch size usually varies from 60 to 120 ml yet by many factors, by changing the size of the bougie, we can create different volumes of the SG [3].

So, bougie size is considered one of the debatable issues in sleeve gastrectomy. To illustrate that Parikh *et al*. [4] reported the calculated volumes of a cylindrical tube according to varying bougie sizes, consider 25-cm-long sleeve, and revealed that the difference in sleeve volume created by a 40 and 32-Fr bougie would be about 6 cm^3. Talking about bougie size opens the discussion to know how it is measured, what is meant by the unit of measurement (French) unit. Knowing that 1 Fr is equivalent to 0.33 mm. Therefore, 32 Fr bougies have a 1.1-cm diameter, those of 36 Fr have 1.2 cm, and those of 40 Fr have 1.3 cm. Considering that most authors who perform LSG use catheters between 32 and 40 Fr, is it possible that there are so many differences among patients treated with these types of catheters when the difference between their sizes is minimal? Some authors believe that the diameter of the

 DOI: 10.4103/ejs.ejs_1_18

catheter is a determining factor in the amount of excess weight loss (EWL) [5].

In the current study, we address these observations for procedural optimization regarding the proper bougie size and hopefully improvement in patients' outcome.

Aim

The aim of the study was to compare the outcome following LSG results when using 32 versus 40-Fr calibrated bougie as regards the effects of each on the clinical outcome: weight loss of the patients and possible complications.

Patients and methods

Our protocol included a prospective, comparative study of 60 patients who underwent LSG between 'March 2015 and March 2016' with 1-year follow-up. Patients were chosen randomly from Ain Shams University Hospital bariatric clinic. Randomization was done by Card Selection method. Ethical approval from Ain Shams University Hospitals' ethics committee and informed consent from all patients including approval of protocol of treatment were obtained. The 60 morbidly obese patients were classified into two groups:

(1) Group A: this group is composed of 30 morbidly obese patients who underwent LSG using bougie size 32 Fr.
(2) Group B: this group is composed of 30 morbidly obese patients who underwent LSG using bougie size 40 Fr.

Inclusion criteria

Age: more than 16 years.
Sex: both sexes.
BMI greater than 40 kg/m^2 or greater than 35 kg/m^2 with comorbidity.
Bulky eaters.
No endocrinal causes for obesity.
Psychologically stable.

Exclusion criteria

Pregnant or breastfeeding patients.
Patients suffering from any severe psychiatric illness.
Patients with significant, long-standing heart/lung disease or other severe systemic diseases.

All patients in this study were subjected to preoperative assessment to figure out any associated comorbidities, proper history taken, preoperative investigations, and psychological and nutritional evaluation were done. All the patients were admitted on the day of the surgery.

Main steps of our standardized technique

The patient under general anesthetic position is supine with split legs. The patient is secured to the table not to slide during positioning of the table throughout the procedure. The surgeon stands between the patient's legs with two assistants on each side.

For pneumoperitoneum, our preferable technique is through introduction of the first supraumbilical 12 mm visiport, slightly to the left, under direct vision. Inflating the peritoneal cavity with CO_2 up to a pressure of 15 mmHg is usually enough.

Following pneumoperitoneum and under vision we continue by insertion of four more ports, ideally 5–10 mm port is placed in the epigastrium for liver retraction and two 12–15 and 12 mm disposable working ports are placed in the right and left mid-epigastrium. Finally, a 5-mm port is placed in the left upper quadrant for lateral gastric retraction.

Using a 30° scope, first, laparoscopic exploration of the abdomen was performed. The first step was to identify the pyloric ring. Then we started dissection 3–4 cm from the pylorus near the greater gastric curvature along the gastrocolic ligament using laparoscopic Harmonic device or LigaSure.

Dissection is continued upwards toward the left crus of the diaphragm dividing the gastrosplenic ligament and coming through the short gastric vessels till freeing the whole fundus from its attachments. This step was very important for complete resection of the fundus in the subsequent steps. We continued to free all the posterior adhesions between the gastric wall and the pancreas up to the lesser curvature posteriorly.

The bougie was then inserted into the stomach; the anesthesiologist inserted the 32-Fr bougie (for group 1) or 42-Fr bougie (for group 2) under laparoscopic vision. The first fire is started 3–4 cm proximal to the pylorus using 60–4.8 mm (green reload), endo-GIA stapler (Autosuture Bariatrics/Covidien, USA). After applying the stapler and before firing we make sure that the bougie moves freely in and out; this is to be repeated before all the subsequent firings. Subsequent firing is done using 60 mm, 3.5 mm (blue reload), endo-GIA stapler (Autosuture Bariatrics; Covidien). We ensured that the transection is symmetrical all the way between the anterior and the posterior gastric wall and close enough, however, allowing for smooth mobilization of the bougie during the

procedure. Transection then was continued along the stomach proximally while the bogie is in place. We ensured that the whole of the gastric fundus was resected.

Using methylene blue, staple line is checked for being watertight by filling the gastric tube through the bougie while obstructing the antrum using a long grasper. The resected stomach is extracted through the umbilical wound. Tube drain was inserted in all cases.

Postoperative care

Close observation for vital signs with ICU admission is essential. Encourage early mobilization with anticoagulants according to body weight such as deep vein thrombosis, prophylaxis, proper pain management, third-generation cephalosporins in the form of cefoperazone 1 g intravenously on induction of anesthesia and then twice per day till discharge; proton pump inhibitors such as omeprazole 40 mg intravenously twice per day and then by oral administration after discharge for at least for a month.

The patients were started oral fluids (if tolerated) 6 h postoperatively. Gastrografin swallow was performed if there was suspicion of leakage or potential acute stenosis. The drain was removed after tolerating oral fluid intake with no leakage or bleeding. All patients are to be discharged 24 h postoperatively after meeting the discharge criteria of no bleeding, no leakage, and no other complications. Some patients were discharged later than 24 h if there were any significant adverse outcomes.

All patients returned for their first outpatient clinic appointment in 10 days. For the diet, patients were advised to start clear fluid-only diet for 10 days which is then advanced gradually to a semisolid diet for 10 days, followed by mashed food for 10 days. They were then advanced to regular healthy diet thereafter. There were follow-up visits in the outpatient clinic at 1 month and then at 6 and 12 months.

Outcomes assessment

Many parameters are used to determine the differences between the two groups as operative time, intra-operative, postoperative complications (early or late), length of postoperative hospital stay, and weight loss which is assessed by the change in BMI and the change in %EWL measured at 6 and 12 months after surgery.

Assessment of weight loss

The BMI was calculated according to the following formula:

$$\mathrm{BMI} = \frac{\text{weight}}{\text{height}^2\left(\mathrm{kg/m^2}\right)}.$$

The percentage of EWL was defined according to the following equation [6]:

$$\%\ \mathrm{EWL} = \left(\frac{\text{preoperative weightfollow} - \text{up weight}}{\text{preoperative weightideal body weight}}\right) \times 100.$$

Ideal body weight (IBW) was defined by Miller's formula. This formula is different for men and women. Men: IBW (kg)=56.2+1.41 kg per inch over 5 feet. Women: IBW (kg)=53.1+1.36 kg per inch over 5 feet (1 m=3.28084 ft).

Data management and statistical analysis

The collected data were revised, coded, tabulated, and introduced to a PC using the Statistical Package for the Social Sciences (Released 2011, IBM SPSS Statistics for Windows, version 20.0; IBM Corp., Armonk, New York, USA). Data were presented and suitable analysis was done according to the type of data obtained for each parameter.

(1) Descriptive statistics:
   (a) Mean±SD and range for parametric numerical data.
   (b) Frequency and percentage of nonnumerical data.
(2) Analytical statistics:
   (a) Student's t-test was used to assess the statistical significance of the difference between the two study group means.
   (b) χ^2-The test was used to examine the relationship between two qualitative variables.
   (c) *P* value indicates the level of significance as in the following:
      (i) *P* value of greater than 0.05: non-significant.
      (ii) *P* value of less than 0.05: significant.
      (iii) *P* value of less than 0.01: highly significant.

Results

A total of 60 patients [17 (28.3%) men and 43 (71.7%) women] underwent LSG between March 2015 and March 2016. All the patients were followed up for 1 year. Patients had a mean age of 35±10 years (range: 18–58 years). The mean BMI was 46.66±4.30 kg/m^2 (range: 34.6–57.5 kg/m^2). The patients were classified into two groups: the characteristics of the patients of

each group are illustrated in Table 1. There was no statistically significant difference between the two groups as regards the baseline characteristics.

There was no statistically significant difference between the two groups as regards the operative time (Table 2).

As regards postoperative hospital stay, there was longer hospital stay in favor of group A with a bougie size of 32, which was 56±28.07 h. The mean of each group was calculated, there is a statistically significant difference between the two groups as shown in Table 3. As regards the pouch shape Fig. 1 illustrates the shape of the pouch of both groups by GG early postoperatively.

Body weight was measured and BMI at 1, 6, and 12 months. Figure 2 illustrates the mean BMI among both groups at 1, 6, and 12 months. Statistical analysis shows that there is no statistically significant difference between the two groups as regards BMI changes as shown in Table 4.

The mean of EWL was calculated at 6 and 12 months postoperatively. Statistical analysis conveys no significant difference between the two groups as regards %EWL (Table 5).

As regards postoperative bleeding, we reported three cases: Two patients in group A and one patient in group B, as shown in Table 6. One patient managed conservatively as the patient's hemodynamics improved

Table 1 Baseline characteristics of the patients before surgery

Variables	Group A (Bougie 32 F) (*N*=30)	Group B (Bougie 40 F) (*N*=30)	*P* value	Significance
Age				
Mean±SD	36.57±11.52	33.93±8.47	0.317•	NS
Range	18–58	22–53		
Sex [*n* (%)]				
Males	7 (23.3)	10 (33.3)	0.390*	NS
Females	23 (76.7)	20 (66.7)		
Preoperative weight (kg)				
Mean±SD	132.37±14.76	133.60±10.47	0.710•	NS
Range	100–160	117–161		
Preoperative BMI (kg/m^2)				
Mean±SD	46.50±4.35	46.82±4.25	0.772•	NS
Range	34.6–55.4	40.9–57.5		

•Independent *t*-test; *χ^2-test.

Table 2 Mean operative time among both groups

Variable	Group A (Bougie 32 F) (*N*=30)	Group B (Bougie 40 F) (*N*=30)	*P* value	Significance
Operative time (min)				
Mean±SD	107.93±18.10	111.17±15.46	0.460	NS
Range	88–160	90–140		

Table 3 The hospital length of stay among the two groups

Variable	Group A (Bougie 32 F) (*N*=30)	Group B (Bougie 40 F) (*N*=30)	*P* value	Significance
Postoperative hospital length of stay (h)				
Mean±SD	56±28.07	36.4±10.68	0.05	Significance
Range	24–120	24–72		

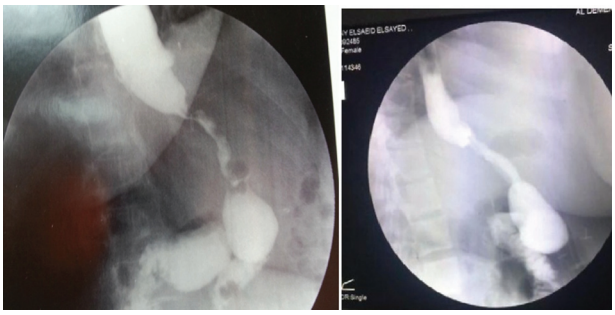
Table 4 A comparison between group A and group B as regards preoperative BMI and postoperative BMI at 1, 6, and 12 months

Variables	Group A (Bougie 32 Fr) (*N*=30)		Group B (Bougie 40 Fr) (*N*=30)		*P* value	Significance
	Mean±SD	Range	Mean±SD	Range		
Baseline BMI	46.50±4.35	34.6–55.4	46.82±4.25	40.9–57.5	0.772	NS
BMI 1 month	43.31±3.72	36.5–51.2	43.38±4.33	38.1–55.3	0.642	NS
BMI 6 months	34.21±3.85	27.6–41.5	35.51±4.66	30.1–48	0.243	NS
BMI 12 months	29.30±3.48	22.9–36.3	30.34±4.51	24.3–42	0.323	NS

when received 3 units of packed red blood cells and 2 units of fresh frozen plasma. The bleeding stopped on the third postoperative day.

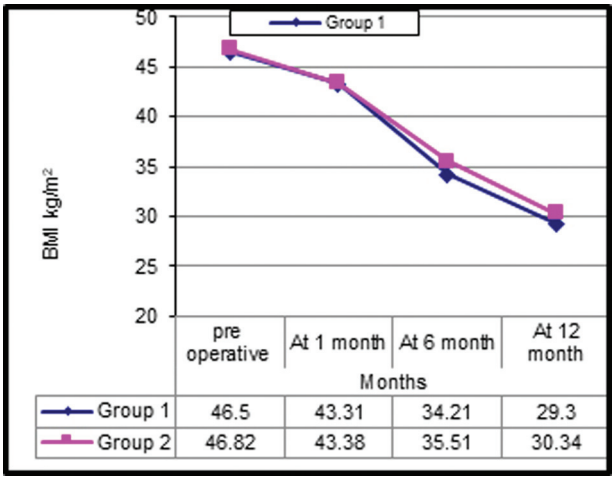
Two patients required reoperation. The first patient was from group A, had bleeding 1 h postoperatively as 500 ml fresh blood was noticed in the drain along with hemodynamic instability. The patient was rushed to the operating theater and opened to find the bleeding vessel from the greater epiploic arcade. It was controlled and the postoperative course passed uneventful. The second patient was from group B, presented by postoperative hemodynamic instability and fresh bleeding on post operative day (POD) 1. Re-exploration on the same day, evacuation of hematoma, and peritoneal lavage was done. However, there was no definitive source of bleeding.

Figure 1



GG postoperatively, the right one for group A with bougie size 32, the left for group B with bougie size 40.

Figure 2



Line chart demonstrating the change in BMI at 1, 6, and 12 months.

In terms of leakage there was only one patient, who was in group A; his clinical examination revealed tachycardia POD 1, confirmed by the positive gastrografin study which showed leakage in gastro-oesphogeal junction (GEJ). The patient was re-explored laparoscopically on the same day; intraoperative methylene blue leak test was positive for leakage at GEJ. Laparoscopic primary repair was done and omental patch was placed over the site of repair (Fig. 3). The patient was given total parenteral nutrition postoperatively. Few days later, gastrografin study was done and was negative for leakage. Gradual oral feeding started following the same protocol without other events.

We reported five patients who were presented with postoperative vomiting among both groups: four cases in group A (bougie 32 Fr.) and one case in group B (bougie 40 Fr), as shown in Table 6. As regards group A, the first patient was woman, 22 years old and who had uneventful LSG. However, on POD 2 the patient complain of difficulty of any oral fluid intake with persistent vomiting. The patient was readmitted on regular intravenous antiemetic therapy (primperane and ondansetron) and intravenous fluids. The patient had their condition gradually improved giving her ability to tolerate oral fluid along with improving her vomiting. She was discharged asymptomatically and followed up on outpatient basis.

Table 5 A comparison between group A and group B in terms of percentage excess weight lost at 6 and 12 months

Parameters	Group A (Bougie 32 Fr) (*N*=30)		Group B (Bougie 40 Fr) (*N*=30)		*P* value	Significance
	Mean±SD	Range	Mean±SD	Range		
%EWL at 6 months	51.60±11.00	24.29–71.68	46.50±8.83	26.2–60.06	0.052	NS
%EWL at 12 months	71.65±11.06	51.13–96.53	67.76±11.78	41.41–89.29	0.193	NS

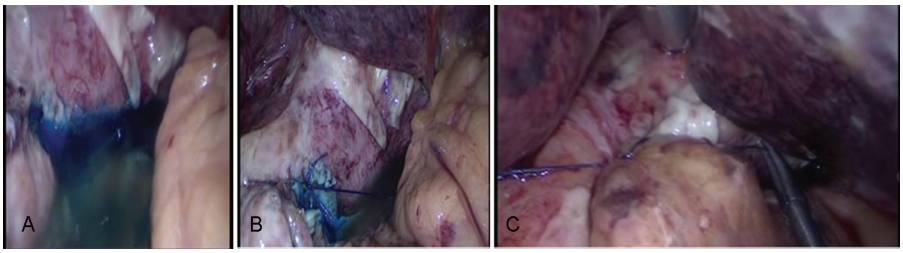
EWL, excess weight lost.

Table 6 Statistical analysis of the complications among both groups

	Group A (Bougie 32) [*n* (%)]	Group B (Bougie 40) [*n* (%)]	*P* value	Significance
PO bleeding	2 (6.66)	1 (3.3)	0.076	NS
PO leak	1 (3.3)	0 (0)	0.313	NS
PO vomiting	4 (13.3)	1 (3.3)	0.019	S
Portside hematoma	1 (3.3)	0 (0.0)	0.313	NS

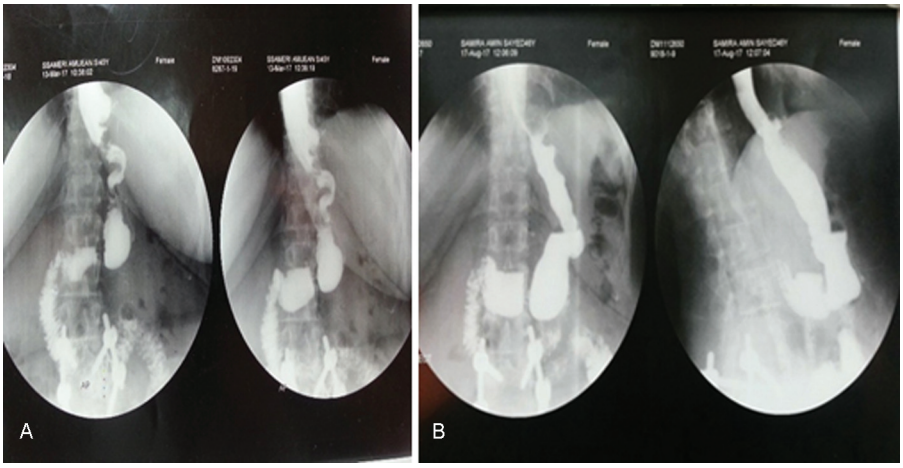
PO, postoperative.

Figure 3



(a) Positive methylene blue test and (b) laparoscopic primary repair of gastric perforation, (c)omental patch over the repair.

Figure 4



(a) Stenosis at the proximal sleeved stomach and (b) 1 week after endoscopic dilatation.

The second patient was presented with postoperative bleeding which was controlled conservatively. However, on POD 20 as the patient started to introduce meshed food when she complained of severe dysphagia and persistent vomiting, which gradually progressed even with oral fluid which was previously tolerated. Upper gastrointestinal endoscopy showed stenosis in the upper sleeve and dilatation of the stenotic region was done. Gastrografin study 1 week later showed free flow of the dye (Fig. 4). The patient reports gradual improvement of her symptoms.

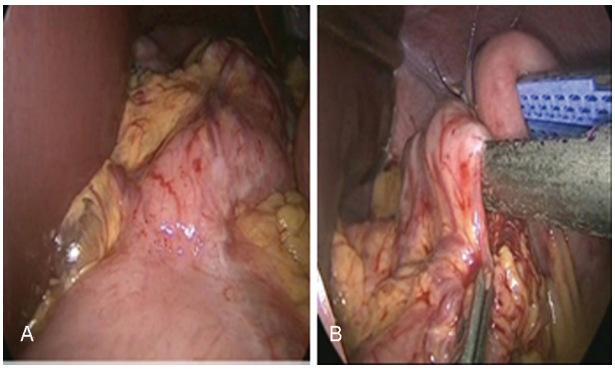
The third patient was presented 5 months after with uneventful LSG by 1 month history of dysphagia to solids with ability to tolerate only liquids, occasional vomiting, and upper colicky abdominal pain. Gastrografin series was done and showed mild kinking in the midsleeve. The patient was admitted on intravenous fluid therapy, antispasmodics, and antiemetics. She showed improvement of her symptoms thereafter.

The fourth patient was discharged on POD 1 after uneventful LSG. However, she presented with persistent vomiting as well as intolerability for solids more than fluid diet. She had frequent hospital readmissions, due to severe dehydration and anemia, with intravenous fluids, total parenteral nutrition, parenteral antiemetics, and sometimes packed red blood cells transfusion. GG study revealed kinking and stenosis at the incisura, and UGI endoscopy confirms the site of the stenotic; there was an obvious stenosis site with poststenotic antral dilatation. The decision was to go for Roux-en-Y gastric bypass with gastrojejunal anastomosis applied above the site of the stricture (Fig. 5).

As regards group B (bougie 40 Fr), we have one patient who presented by postoperative persistent nausea and vomiting on POD 2.The GG study showed narrowing in midsleeve at the level of incisura. The patient was discharged on regular antiedematous and antiemetic therapy on POD 3. On follow-up 7 days later, the patient reported improvement of her manifestations. Gastrografin study was done and revealed free flow of the dye.

As regards other complications, we reported on the case of portside hematoma in group A (bougie size 32 Fr) and one case of symptomatic

Figure 5



(a) Stenosis site with poststenotic antral dilatation and (b) gastrojejunal anastomosis.

Table 7 Range of MOOREHEAD-ARDELT Quality of Life Questionnaire after 1-year follow-up

	M-A QoLQ range
Group A (with bougie size 32)	2.5–3
Group B (with bougie size 40)	2.5–3

M-A QoLQ, MOOREHEAD-ARDELT Quality of Life Questionnaire.

cholelithiasis 1 month postoperatively for which she had laparoscopic cholecystitis (bougie size 40 Fr). None of these complications showed statistically significant difference between the two groups (Table 6).

To assess the patient quality of life in both groups after 1-year follow-up we used the original MOOREHEAD-ARDELT Quality of Life Questionnaire (M-A QoLQ) [7], which is a one-page questionnaire using simple drawings to offer answer options in each of the five important quality of life domains such as self-esteem, physical activity, social life, work conditions, and sexual activity. We found differences between the two groups as shown in Table 7.

Discussion

Sleeve gastrectomy is one of the restrictive procedures for the management of morbid obesity and metabolic syndrome which is gaining increasing popularity nowadays [8]. Despite its ongoing popularity, LSG still exhibits technical variations; many are still debatable issues in International Consensus Summit on Sleeve Gastrectomy (ICSSGs) and American Society of Metabolic and Bariatric Surgery (ASMBS) meeting. The main technical point beyond controversy adopted by most bariatric surgeons is the standardization of LSG diameter and hence volume with a bougie or orogastric tube [9].

On one hand, there is concern that the wider the initial LSG, the more likely it is to stretch, resulting in long-term sleeve dilation and weight regain. In addition, theoretically with a wider bougie, a larger part of gastric fundus, with its content of ghrelin-producing cells, may be retained. Currently, however, there is no scientific evidence showing lower satiety scores and increased hunger scores associated with wider diameter bougies [10].

On the other hand, smaller-sized bougies causing greater restriction may result in maladaptive eating and adoption of increased intake of sweets, high-calorie liquids, and meltable calories making it more likely that the patients regain weight in the long term [11].

In this study, we aimed to compare the effect of bougie sizes of two different diameters on the final outcome of LSG as regards postoperative weight loss as well as the complications rate. It is a prospective comparative study which was done between March 2015 and March 2016 at Ain Shams University Hospital, Cairo, Egypt. The study included 60 obese patients, 30 of them underwent LSG using bougie 32 Fr and other 30 patients underwent LSG using bougie 40 Fr.

We present our data as regards %EWL. At 6 months, mean %EWL for group A (bougie size 36 Fr) is 51% ranging from 24 to 71%. For group B (bougie size 46 Fr), the mean %EWL was 47% ranging from 26 to 60%. At 1 year, we obtained %EWL which exceeds 70% with the range between 51 and 96%. For group B (bougie size 40 Fr), the mean %EWL reached 67% ranging between 41 and 89%. And these differences in mean %EWL between the two groups were statistically nonsignificant.

Similar to our data, Spivak *et al.* [11] found no significant difference in BMI, EWL, or change in comorbidities at 1-year postoperatively when retrospectively comparing a group of patients who had LSG with a 42 Fr versus those who in whom a 32 Fr bougie was used [11]. Moreover, in a large meta-analysis of 9991 cases conducted by Parikh *et al.* [12], there was no significant difference in weight loss in the first 36 months when patients who had LSG calibrated with bougies of size less than 40 Fr were compared with those with a bougie size of more than or equal to 40 Fr. However, they identified that utilizing a bougie greater than or equal to 40 Fr may decrease leak without impacting %EWL up to 3 years [12]. Spivak *et al.* [11] conveyed the message; the size of the calibration bougie (42 vs. 32 Fr) has no predictive value at least in the first year, in regard to weight reduction and resolution of comorbidities, as these were identical

for the two groups and comparable to other reported data. Hawasli *et al*. [13] compare between bougie sizes 32 and 36 Fr and concluded that the bougie size used during sleeve gastrectomy does not affect the long-term %EWL with greater than 70% reduction in excess weight after 1 year using a bougie size of 40 Fr.

In contrast, data from the Spanish registry has shown that a smaller bougie size (32–36 Fr) had initial better weight loss outcomes compared with 38–60 Fr of up to 12 months after LSG, without a difference in complication rate. However, there was no significant impact on weight loss beyond 12 months in the two groups [14].

In addition it is well known that 1 Fr is one-third of a millimeter. Thus, the 8 Fr difference in the bougie size makes 40 Fr to be just 2.6 mm bigger in diameter than 32 Fr. This would explain the negligible difference in the effect on the long-term weight loss between bougie sizes around 40 Fr.

In our study, the overall incidence of leakage was 1.66% which is close to the incidences reported in the literatures. We have one case of leakage in group A (bougie size 32 Fr), while we did not report any case of leakage in group B (bougie size 40 Fr). Although this finding did not reach statistical significance, this may be attributed to low statistical power.

It was suggested by Gagner *et al*. [15] that these small bougies were related to an increase in the rate of leakage [16]. This suggestion was later potentiated by a systematic analysis performed by Aurora *et al*. [17], who concluded that the use of bougies with diameter 40 Fr or more resulted in decreased instances of staple line leakage compared with the use of bougies with a diameter of less than 40 Fr.

Moreover, Yuval *et al*. [18] published a review that recommend against the use of the smallest bougie because the risks of leak may outweigh the benefits (0.9% leaks with bougies $\geq$40 Fr vs. 2.9% leaks with bougies $<$40 Fr; $P<0.05$). They conclude that larger size bougies are associated with a significant decrease in the incidence of leak.

Among the complications, the most commonly recognized and major early complication is certainly the postoperative bleeding which can occur in up to 16% of patients with a reported average of 3.6% [19]. Frezza [20] observed that the risk of postoperative bleeding after LSG is between 1 and 6%.

We suffered three (5%) cases of postoperative bleeding with average rate among the series. Of our three cases, one case detected 1 h postoperatively and underwent laparotomy to find a bleeding vessel from the caudal gastroepiploic arcade. One patient who was hemodynamically stable was managed conservatively. One patient, who was hemodynamically unstable, was re-explored laparoscopically, evacuation, and lavage of hematoma without identifying obvious source.

This was similar to the approach of managing bleeding following sleeve gastrectomy as described by Weiner *et al*. [21]. They advised to control bleeding by surgical intervention (hematoma evacuation, oversewing, and drainage) in hemodynamically unstable patients. In hemodynamically stable patients, conservative methods with fluid resuscitation, blood transfusion (if necessary), and careful observation usually succeed to control the hemorrhage. Our data have shown that the smaller bougie could have an impact on increasing incidence of persistent postoperative vomiting. We reported five patients among our series that complained of persistent postoperative vomiting, four of them in group A (bougie size 32 Fr) and one in group B (bougie size 40 Fr). Although we did find a statistically significant difference among both groups, however, the higher incidence in group A (bougie 32 Fr) could be attributed to other factors rather than the bougie size solely.

Among the cases, one patient had early postoperative hematoma that was complicated 2 weeks later by postoperative stenosis and kink that was relieved by endoscopic dilatation. The hematoma, which was managed conservatively, could have induced scarring that lead to retraction along the part of the staple line. This possibly produced a kink that lead to obstruction. Zundel *et al*. [22] have reported a case of acute obstruction and after laparoscopic exploration, a large hematoma was found compressing the gastric tube. A more close pathological circumstance was described by Paikh *et al*. [12] as they reported a case of symptomatic stenosis that started 36 days after LSG. A large hematoma was found on the neo-greater curve of the mid-body of the sleeve as well as twisting of the gastric tube. In our case, however, one session of endoscopic dilatation, without the need for surgical intervention, relieved the kinked gastric tube with evidence of free flow of the dye through the previously seen stenotic part of the stomach.

In addition, we did report a significant increase in hospital length of stay in group A (bougie 32 Fr) which

could be related to the frequency of the morbidities that occurred among this group.

Hawasli *et al*. [13] evaluated the effect of bougie size in the immediate postoperative period after sleeve gastrectomy. They concluded that the smaller bougie size did have a significant effect on increasing postoperative hospital length of stay, which probably was, in part, due to the increase in nausea. The trend toward the increased use of this antiemetic drug was evident indirectly in the increase in hospital length of stay. They reported higher number of hospital readmissions among group of smaller bougie size. In addition, in their study, Hawasli *et al*. [13] believed that there was more dehydration in the smaller bougie group due to the increased pressure and decreased food intake from the smaller sleeve size.

Conclusion

The use of the calibrating tube in LSG is out of discussion. Over the years, LSG showed evolution into a tighter sleeve by decreasing the bougie size and other technical variabilities. The use of bougie size 32 Fr did not result in significant %EWL differences than bougie size 40 Fr. However, more complications were observed with the use of a bougie size of less than 40 Fr including postoperative leak, bleeding, and vomiting.

For instance, a larger scale study with a longer follow-up would illustrate the long-term clinical effects of bougie size on the outcome after LSG.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1 Eisenberg D, Bellatorre A, Bellatorre N. Sleeve gastrectomy as a stand-alone bariatric operation for severe, morbid, and super obesity. JSLS 2013; 17:63–67.

2 Ferrer-Marquez M, Belda-Lozano R, Ferrer-Ayza M. Technical controversies in laparoscopic sleeve gastrectomy. Obes Surg 2012; 22:182–187.

3 Trelles N, Gagner M. Sleeve gastrectomy. Oper Tech Gen Surg 2007; 9:123–131.

4 Parikh M, Gagner M, Heacock L, Strain G, Dakin G, Pomp A. Laparoscopic sleeve gastrectomy: does bougie size affect mean %EWL? Short-term outcomes. Surg Obes Relat Dis 2008; 4:528–533.

5 Roa PE, Kaidar-Person O, Pinto D, *et al.* Laparoscopic sleeve gastrectomy as treatment for morbid obesity: technique and short-term outcome. Obes Surg 2006; 16:1323–1326.

6 Montero PN, Stefanidis D, Norton HJ, Gersin K, Kuwada T. Reported excess weight loss after bariatric surgery could vary significantly depending on calculation method: a plea for standardization. Surg Obes Relat Dis 2010; 7:531–534.

7 Ardelt E, Moorehead MK. The validation of the Moorehead-Ardelt Quality of Life Questionnaire. Obes Surg 1999; 1113.

8 Braghetto I, Cortes C, Herquinigo D, Csendes P, Rojas A, Mushle M, *et al.* Evaluation of the radiological gastric capacity and evolution of the BMI 2–3 years after sleeve gastrectomy. Obes Surg 2009; 19:1262–1269.

9 Rosenthal RJ. International sleeve gastrectomy expert panel consensus statement: best practice guidelines based on experience of >12,000 cases. Surg Obes Relat Dis 2012; 8:8–19.

10 Borg CM, Adamo M. LSG: current controversies obesity. Bariatr Metab Surg 2016; 3:535–539.

11 Spivak H, Rubin M, Sadot E, Pollak E, Feygin A, Goitein D. Laparoscopic sleeve gastrectomy using 42-French versus 32-French Bougie: the first-year outcome. Obes Surg 2014; 24:1090–1093.

12 Parikh M, Issa R, McCrillis A, *et al.* Surgical strategies that may decrease leak after laparoscopic sleeve gastrectomy. Ann Surg 2013; 257: 231–237.

13 Hawasli A, Jacquish B, Almahmeed T, *et al.* Early effects of Bougie size on sleeve gastrectomy outcome. Am J Surg 2015; 209:473–477.

14 Sánchez-Santos R, Masdevall C, Baltasar A, Martínez-Blázquez C, García Ruiz de Gordejuela A, Ponsi E, *et al.* Short- and midterm outcomes of sleeve gastrectomy for morbid obesity: the experience of the Spanish National Registry. Obes Surg 2009; 19:1203–1210.

15 Gagner M, Hutchinson C, Rosenthal R. Fifth International Consensus Conference: current status of sleeve gastrectomy. Surg Obes Relat Dis 2016; 12:750–754.

16 Gagner M. Leaks after sleeve gastrectomy are associated with smaller Bougies prevention and treatment strategies. Surg Laparosc Endosc Percutan Tech 2010; 20:166–169.

17 Aurora AR, Khaitan L, Saber AA. Sleeve gastrectomy and the risk of seak: a systematic analysis of 4888 patients. Surg Endosc 2012; 26: 509–1515.

18 Yuval JB, Mintz Y, Cohen MJ, Rivkind AI, Elazary R. The effects of Bougie caliber on leaks and excess weight loss following laparoscopic sleeve gastrectomy. Is there an ideal Bougie size? Obes Surg 2013; 23: 1685–1691.

19 Trastulli S, Desiderio J, Guarino S, Cirocchi R, Scalercio V, Noya G, *et al.* Laparoscopic sleeve gastrectomy compared with other bariatric surgical procedures: a systematic review of randomized trials. Surg Obes Relat Dis 2013; 9:816–829.

20 Frezza EE. Laparoscopic vertical sleeve gastrectomy for morbid obesity. The future procedure of choice? Surg Today 2007; 37:275–281.

21 Weiner RA, El-Sayes IA, Weiner SR. LSG: complications – diagnosis and management (Chapter 27). In: Sanjay A, editor. Obesity, bariatric and metabolic surgery. Springer; 2016. 535–539.

22 Zundel N, Hernandez JD, Galvao Neto M, Campos J. Strictures after laparoscopic sleeve gastrectomy. Surg Laparosc Endosc Percutan Tech 2010; 20:154–158.