OBES SURG (2014) 24:1870–1874
DOI 10.1007/s11695-014-1312-0

ORIGINAL CONTRIBUTIONS

Outcome Analysis of Single Incision vs Traditional Multiport Sleeve Gastrectomy: A Matched Cohort Study

Ameer Gomberawalla · Arsalan Salamat · Rami Lutfi

Published online: 9 June 2014

Abstract
Background Single incision laparoscopy remains controversial due to technical challenges which may cause suboptimal outcomes. This study aims to evaluate the feasibility and equivalency of the single incision sleeve gastrectomy (SISG) when compared to the traditional multiport sleeve gastrectomy (MPSG) approach in a matched cohort evaluating technical aspects and postoperative results.
Methods This is a retrospective analysis of prospectively collected data in a consecutive cohort of 113 SG (MPSG=77, SISG=36). The 36 patients who underwent SISG were included as the case group. Thirty-six MPSG patients were included in the control group, in 1:1 ratio with cases after matching for BMI, age, race, gender, and additional demographic data. Operative time (OT) in minutes and length of stay (LOS) in days was measured and excess weight loss (EWL) at 6 months and 1 year was collected and evaluated.
Results Mean BMI was equivalent (SISG 43.06, MPSG 43.72, p=0.36). Mean OT for the SISG was 116.78 and 118.25 for the MPSG (p=0.84), and mean LOS was 1.80 for the SISG and 1.75 for the MSPG (p=0.75). EWL at 6 months was 58.4 % for the SISG and 58.5 % for the MPSG (p=0.98) and 72.3 and 74.1 % (p=0.77) for 1 year, respectively. There were no leaks in either group. There was one reoperation for postoperative bleeding in the MPSG group.
Conclusions Sleeve gastrectomy can be performed safely using single incision techniques with equivalent outcomes for weight loss.

Keywords Morbid obesity · Single-incision surgery · Sleeve gastrectomy · Laparoscopic surgery · Minimally invasive surgery

Introduction

Single incision laparoscopy continues to gain momentum in the field of laparoscopic surgery, but remains controversial due to technical challenges. The first documentation of single-incision surgery dates back to 1972 when Wheeless performed tubal ligations through a single 1-cm infraumbilical incision [1]. Single incision techniques have also made their way into the treatment of morbid obesity [2].

Bariatric surgery has been shown to be effective in achieving and maintaining weight change and reducing obesity-related comorbidities [3, 4]. Within the past few years, bariatric surgeons have adopted the laparoscopic sleeve gastrectomy (LSG) as a bariatric operation. The sleeve gastrectomy has become increasingly popular in the field of bariatric surgery, comprising 36.3 % of all bariatric surgeries performed in academic centers, and an even higher percentage in community-based hospitals and is predicted to become the most popular form of bariatric surgery [5]. In the past decade, since being added to the list of appropriate weight loss procedures, the sleeve gastrectomy has been routinely performed using five to seven laparoscopic trocars with enlargement of one of the trocar sites for extraction of the gastric specimen [6].

The latest attempt in optimizing outcomes for LSG is the use of single-incision laparoscopy to perform the entire operation and was completed in 2008 [7]. This technique has

A. Gomberawalla (✉) · A. Salamat · R. Lutfi
Saint Joseph Hospital, Chicago Institute of Advanced Bariatric Surgery, 2900 N Lake Shore Drive, Chicago, IL 60657, USA
e-mail: ameergombera@gmail.com

A. Salamat
e-mail: arsalansal@gmail.com

R. Lutfi
e-mail: rami.lutfi@gmail.com

received criticism for being an inferior operation secondary to difficulty in dissection, as well as achieving optimal triangulation; both could potentially lead to suboptimal sleeve construction and consequently inferior outcomes. However, the increased interest in performing single incision sleeve gastrectomies has led to improvement in instrumentation resulting in equivalent surgical technique [8]. This study aims to evaluate the feasibility and equivalency of the single incision sleeve gastrectomy (SG) (SISG) when compared to the traditional multiport (MPSG) approach in a matched cohort looking at technical aspects and postoperative results.

Methods

This is a retrospective analysis of prospectively collected data in a consecutive cohort of 113 patients who underwent SG (MPSG=77, SISG=36). All procedures were done in a single teaching institution by a single surgeon (RL). The 36 patients who underwent SISG were included as the case group for a matched cohort study. Thirty-six MPSG patients were included in the control group, in 1:1 ratio with cases after matching for BMI, age, race, and gender. Additional demographic data including history of binge eating, smoking status, and marital status were also utilized in our analysis. Operative time (OT) in minutes and length of stay (LOS) in days was measured, and excess weight loss (EWL) at 6 months and 1 year was collected for these patients. Independent sample *t*-tests and chi-square tests were performed to evaluate if there was any statistical difference in OT, LOS, or EWL.

Surgical Technique for Multiport and Single-Incision Sleeve Gastrectomy

For our traditional MPSG, we use four working trocars including three 5-mm and one 12-mm port for stapling. Additionally, a Nathanson retractor is also used. For our single incision, we use a transumbilical approach which preserves the umbilical stalk followed by placement of a Quadport (Olypmus, Japan) access device. Liver retraction is achieved using a 2.3 mm MiniLap (Stryker, USA) grasper through a small epigastric stab. Visualization is provided by flexible tip laparoscope EndoEYE, Olympus HD II 5 mm Video laparoscope. Graspers with intra- and extracorporeal curves were used to avoid crossing the surgeon's hand. This in addition to the flexible tip laparoscope allows preservation of the triangulation principle and maintenance of proper orientation.

The sleeve technique involves freeing the greater curvature starting 5 cm proximal to the pylorus with complete dissection to the left crus to avoid leaving any retained fundus behind. The sleeve is constructed over a 34 french blunt tip bougie with a reinforced staple line (GORE SEAMGUARD, AR, USA). Special attention is paid to avoid tightness at the incisura and angle of His. All patients underwent a leak test by intraoperative endoscopy before completing the operation and an upper GI study on postoperative day 1 with planned discharge that day after meeting discharge criteria.

Single-Incision Inclusion Criteria

No strict inclusion criteria were used for SISG as it was a new technology that we implemented. The single-incision technique was presented as part of our seminar and was discussed with patients who showed interest on initial consultation. We excluded patients whose weight was more than 300 lb and BMI more than 50. Additionally, those with a history of upper gastrointestinal open surgery were excluded.

Results

The following results are based on 92 % follow-up at our clinic. The remaining patients were contacted via telephone and weight diaries which brought our follow-up to 100 %. Mean BMI for the two groups was equivalent (SISG 43.06 (37–48), MPSG 43.72 (34–50), $p=0.36$). Randomization also achieved equivalence in gender, age, and race between the two groups. Other patient factors, including history of binge eating, smoking history, and marital status were equivalent for both groups, as presented in Table 1. Mean OT for the SISG group was 116.78 (79–197) and 118.25 (57–218) for the MPSG group ($p=0.84$), and mean LOS was 1.80 (1–3) for the SISG group and 1.75 (1–3) for the MSPG group ($p=0.75$). EWL at 6 months was 58.4 % (38–102) for the SISG group and 58.5 % (44–95) for the MPSG group ($p=0.98$) and 72.3 % (24–125) and 74.1 % (33–108) ($p=0.77$) for 1 year, respectively (Table 2). There were no leaks in either group. There was one reoperation on postoperative day 2 in the MPSG group for an intraperitoneal hematoma. On diagnostic laparoscopy, a right upper abdomen clot was evacuated and no active bleeding was encountered. The patient recovered well with no further adverse events.

Discussion

In the past decade, bariatric surgeons have sought ways to improve patient experience and outcomes with weight loss surgery. Surgical outcome and safety of bariatric surgery has been the most important measure that bariatric surgeons that have sought to improve through innovation and technology. However, patient's experiences have not played as important of a role in the bariatric community. The movement from open to laparoscopic surgery has made a significant impact on acceptance of intra-abdominal surgery with data demonstrating faster recovery, less pain, less wound complications, and

Table 1 Patient characteristics

	SIGS (*N*=36)	MPSG (*N*=36)	*p* value
BMI	43.06 (37–48)	43.72 (34–50)	0.36
Age (years)	43.33 (27–62)	46 (31–72)	0.25
Race (White/AA/Hispanic/other)	13/9/14/0	17/9/8/2	0.38
Gender (male/female)	2/34	7/29	0.08
History of binge eating (yes/no)	4/32	3/33	0.97
Smoking history (current/past/never)	9/3/24	8/3/25	0.93
Marital status (married/single/divorced)	6/10/20	4/14/18	0.32

better cosmetic outcomes [9]. The next logical step would be moving towards decreasing or eliminating additional scars to provide reassurance to patients for whom the latter serves as a barrier to receiving optimal care for bariatric surgery. Such has been the case with SISG.

Single-incision bariatric surgery is ergonomically challenging due to patient body habitus and the complex nature of these operations. In the sleeve gastrectomy, the hiatal exposure and the ability to free up the stomach and left crus is the main dissection and can be particularly ergonomically challenging. However, with the utilization of a flexible tip laparoscope as well as curved instrumentation for the surgeon, the triangulation previously lost was restored inside the abdominal cavity to allow for an ergonomically improved procedure. Additionally, the use of low-profile trocars and a multichannel umbilical port helped to increase the range of motion and avoid clenching of the instruments. Also, we believe that the ergonomics of the SISG is favorable relative to other single-incision procedures; this is due to the relatively straight staple line created from the umbilicus going up parallel to the lesser curvature towards the angle of His. Moreover, in regards to positioning of the surgical team, this procedure required the use of a surgeon and assistant, with the assistant holding the camera on the patient's left side and the surgeon on the patient's right side (Fig. 1). We felt that this allowed for adequate spacing that is often difficult to achieve in other single site surgeries. Continued development in laparoscopic instruments and an increased focus on laparoscopic training also promises further improvement in the implementation of single-incision surgery.

The single-incision sleeve gastrectomy has been particularly adopted in the international literature. In 2011, Lakdawala et al. demonstrated that single-incision sleeve gastrectomy when compared to conventional laparoscopic sleeve gastrectomy has similar operative time and similar complication rates. They reported that patients were also happier in the SISG with their postoperative scars demonstrating its benefits in cosmesis [10]. A similar study was done in Barcelona by Delgado et al., showing equivalent weight loss in 6 months [11]. Our study demonstrated no significant difference in mean OT between the two groups. This data represents our initial experience with the SISG. Prior to implementation of this technology to the sleeve gastrectomy, the operating surgeon had experience with 40 single-incision laparoscopic adjustable band placements and 20 single-incision laparoscopic cholecystectomies. We believe that our similar OT is due to both the experience with the instrumentation as well as the ergonomics of the sleeve gastrectomy as described. Our specific mean OT was longer as compared to other studies due to the performance of intraoperative upper endoscopy to ensure an intact staple line. However, we do have strong experience with the use of intraoperative endoscopy, and this portion of the procedure was done utilizing identical technique regardless of whether the patient underwent a SISG or MPSG. While this may bias our operative time results, the variation should be minimal given the use of the same procedure in each group.

In terms of our outcomes, we had similar complication rates and slightly higher EWL when compared to other published data [11–13]. Only one patient required a reoperation, and this was in the MSPG group. It was

Table 2 Outcomes

	SISG	MPSG	*p* value
Mean OT (min)	116.78 (79–197)	118.25 (57–218)	0.84
EWL 6 months (%BW)	58.4 (38–102)	58.5 (44–95)	0.98
EWL 12 months (%BW)	72.3 (24–125)	74.1 (33–108)	0.77
Mean LOS (days)	1.80 (1–3)	1.75 (1–3)	0.75

Fig. 1 Single-incision port placement and surgeon positioning

secondary to an intra-abdominal bleed which required intraoperative evacuation with no direct identifiable cause. EWL was evaluated for both 6 months and 1 year and was shown to be similar. This length of follow-up is longer than other published data to our knowledge. An added element regarding the use of the SISG is the larger umbilical incision required for port placement and the concern for the development of a ventral hernia. While the use of single-incision methods has been associated with an increased rate of ventral hernias, our cohort did not experience this complication. There were no reported ventral hernias in either the MPSG or the SISG group after 1 year. Though this is a short-term follow-up, most of those ventral hernias associated with single-incision surgery were reported in the first year of the procedure [14]. Long-term follow-up is still being done to ensure no increase, and we hope to report such outcomes in the future.

Also, LOS was similar for both groups, adding more data to the argument that the SILS procedure can be performed with equivalent outcomes. Our study is one of the few discussing LOS and is slightly shorter than larger published series [12]. We implemented a 1-day discharge regimen for our patients. On postoperative day 0, they were required to ambulate in the hallway at least three times. On postoperative day 1, they received an upper GI swallow study to evaluate for any leak or stenosis/obstruction of the sleeve, after which they were initiated on a water trial consisting of two, 1 oz cups of water over the span of 2 h. If they were able to tolerate this, they would be advanced to clear liquids and then discharged if they tolerated their diet by finishing at least 10 oz of fluid. Those patients that were not able to tolerate this liquid, felt overly nauseous, or were not able to be discharged due to social reasons were kept until their symptoms or social issues resolved. Both populations were able to be discharged safely and no group had any 30-day readmissions.

The weaknesses of this study include nonrandomization of our patients. Future randomization is a possibility as more data becomes available to establish SISG as an equivalent alternative to MPSG. We were able to match for preoperative variables. Additionally, the inclusion of these specific demographic factors was utilized because they have been shown to affect weight loss in other studies evaluating weight loss after bariatric surgery [15–17]. After matching for these factors, we were able to demonstrate similar outcomes for our population. Moreover, our patient pool was also small, but we were able to achieve 100 % follow-up. Lastly, our data shows short-term outcomes, but we will continue to monitor our patients to evaluate more long-term data in the future.

Conclusions

The single-incision sleeve gastrectomy technique is as safe and as effective as traditional laparoscopic sleeve gastrectomy. It should be strongly considered as an alternative in appropriately selected patients.

Disclosures Dr. Lutfi reports other from Ethicon Endo Surgery, other from GORE outside the submitted work. Drs. Gomberawalla and Salamat have no conflicts of interest or financial ties to disclose.

References

1. Wheeless Jr CR. Elimination of second incision in laparoscopic sterilization. Obstet Gynecol. 1972;39(1):134–6.
2. Alevizos L, Lirici MM. Laparo-endoscopic single-site sleeve gastrectomy: results from a preliminary series of selected patients. Minim Invasive Ther Allied Technol. 2012;21(1):40–5. doi:10.3109/13645706.2011.651474.
3. Zhang F, Strain GW, Lei W, et al. Changes in lipid profiles in morbidly obese patients after laparoscopic sleeve gastrectomy (LSG). Obes Surg. 2011;21(3):305–9. doi:10.1007/s11695-010-0285-x.
4. Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systematic review and meta-analysis. JAMA. 2004;292(14):1724–37. doi:10.1001/jama.292.14.1724.
5. Nguyen NT, Nguyen B, Gebhart A, et al. Changes in the makeup of bariatric surgery: a national increase in use of laparoscopic sleeve gastrectomy. J Am Coll Surg. 2013;216(2):252–7. doi:10.1016/j.jamcollsurg.2012.10.003.
6. Cottam D, Qureshi FG, Mattar SG, et al. Laparoscopic sleeve gastrectomy as an initial weight-loss procedure for high-risk patients with morbid obesity. Surg Endosc. 2006;20(6):859–63. doi:10.1007/s00464-005-0134-5.
7. Saber AA, Elgamal MH, Itawi EA, et al. Single incision laparoscopic sleeve gastrectomy (SILS): a novel technique. Obes Surg. 2008;18(10):1338–42. doi:10.1007/s11695-008-9646-0.
8. Huang CK. Single-incision laparoscopic bariatric surgery. J Minim Access Surg. 2011;7(1):99–103. doi:10.4103/0972-9941.72397.
9. Batchelder AJ, Williams R, Sutton C, et al. The evolution of minimally invasive bariatric surgery. J Surg Res. 2013;183(2):559–66. doi:10.1016/j.jss.2013.02.036.
10. Lakdawala MA, Muda NH, Goel S, et al. Single-incision sleeve gastrectomy versus conventional laparoscopic sleeve gastrectomy—a randomised pilot study. Obes Surg. 2011;21(11):1664–70. doi:10.1007/s11695-011-0478-y.
11. Delgado S, Ibarzabal A, Adelsdorfer C, et al. Transumbilical single-port sleeve gastrectomy: initial experience and comparative study. Surg Endosc. 2012;26(5):1247–53. doi:10.1007/s00464-011-2002-9.
12. Shi X, Karmali S, Sharma AM, et al. A review of laparoscopic sleeve gastrectomy for morbid obesity. Obes Surg. 2010;20(8):1171–7. doi:10.1007/s11695-010-0145-8.
13. Gentileschi P, Camperchioli I, Benavoli D, et al. Laparoscopic single-port sleeve gastrectomy for morbid obesity: preliminary series. Surg Obes Relat Dis. 2010;6(6):665–9. doi:10.1016/j.soard.2010.01.011.
14. Marks JM, Phillips MS, Tacchino R, et al. Single-incision laparoscopic cholecystectomy is associated with improved cosmesis scoring at the cost of significantly higher hernia rates: 1-year results of a prospective randomized, multicenter,

single-blinded trial of traditional multiport laparoscopic cholecystectomy vs single-incision laparoscopic cholecystectomy. J Am Coll Surg. 2013;216(6):1037–47. doi:10.1016/j.jamcollsurg.2013.02.024. discussion 1047-1038.

15. Sysko R, Devlin MJ, Hildebrandt TB, et al. Psychological outcomes and predictors of initial weight loss outcomes among severely obese adolescents receiving laparoscopic adjustable gastric banding. J Clin Psychiatry. 2012;73(10):1351–7. doi:10.4088/JCP.12m07690.
16. Nagayasu S, Suzuki S, Yamashita A, et al. Smoking and adipose tissue inflammation suppress leptin expression in Japanese obese males: potential mechanism of resistance to weight loss among Japanese obese smokers. Tob Induc Dis. 2012;10:3. doi:10.1186/1617-9625-10-3.
17. Lutfi R, Torquati A, Sekhar N, et al. Predictors of success after laparoscopic gastric bypass: a multivariate analysis of socioeconomic factors. Surg Endosc. 2006;20(6):864–7. doi:10.1007/s00464-005-0115-8.