Original Article

Early Clinical Efficacy of Laparoscopic Sleeve Gastrectomy as a Bariatric Surgery for Obese Patients: A Uni-center Report in China*

YANG Jian Jun, WANG Bing, LIANG Yong Kang, SONG Zhi Cheng, and GU Yan#

Department of General Surgery, Affiliated Shanghai No.9 People's Hospital of Shanghai Jiaotong University Medical School, Shanghai 200011, China

Abstract

Objective To report the experience with laparoscopic sleeve gastrectomy as a bariatric surgery in our center.

Methods Twenty obese patients were followed up for 1 year after receiving laparoscopic sleeve gastrectomy as a bariatric surgery in our center from January 2009 to October 2010, during which their general conditions, complications, and improvement of obesity-related diseases were assessed.

Results Of the 20 patients, 19 underwent laparoscopic sleeve gastrectomy and 1 underwent open sleeve gastrectomy with no death occurred. The average weight loss was 36.4±10.0 kg, the average BMI decreased from 46.1±11.5 to 33.6±5.6 kg/m^2, and the excess weight loss was 55.9%±14.2% one year after the operation. The majority of obesity-related diseases were improved. In one year after the operation, excellent, good, fairly good and poor scores were achieved in 2 (10.0%), 8 (40.0%), 7 (35.0%), and 3 patients (15.0%), respectively.

Conclusion Laparoscopic sleeve gastrectomy as a bariatric surgery is a safe and feasible procedure for obesity with excellent short-term effects. More studies with a long-term follow-up are needed to validate its benefits.

Key words: Obesity; Bariatric surgery; Laparoscope; Gastrectomy

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INTRODUCTION

Overweight and obesity, as a major public health concern, have become a global epidemic. In China, the prevalence of overweight and obesity in 2002 was 22.8% and 7.1%, a respective increase by 40.7% and 97.2% since 1992. This indicates that approximately 401 million overweight or obese people now live in this country[1-3]. Overweight, obesity and the related diseases pose a serious health threat and impose a heavy burden on the Chinese healthcare system. For example, the direct medical cost of obesity-related type 2 diabetes mellitus (DM) and its complications are estimated to be 26 billion USD, representing 16% of the total Chinese health expenditure in 2007[4]. The incidence and cost of this disease in China are predicted to escalate continuously along with the urbanization process. Therefore, it is urgent to address the issue of overweight, obesity and related diseases.

Bariatric surgery, the most effective approach for treating severe or morbid obesity, produces not only significant and sustained weight loss, but also

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#Correspondence should be addressed to GU Yan. Tel: 86-21-23271025. Fax: 86-21-63087768. E-mail: yangu@sjtu.edu.cn

Biographical note of the first author: YANG Jian Jun, male, born in 1977, Ph. D candidate, majoring in bariatric surgery.

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resolution or improvement of obesity-related diseases. Bariatric surgery has become a common procedure for morbid and severe obesity in western countries[5] but it was introduced into China not until a decade ago. The development of bariatric surgery in China has been slow, far behind that in western countries, and is thus difficult to meet the domestic needs of a large obese population. This may be owing to its technical complexity, especially in relation to laparoscopic Roux-en-Y gastric bypass (LRYGP) for patients who in lack of health knowledge refuse to undergo surgery for weight loss with special concern over an implanted foreign banding as with laparoscopic adjustable gastric banding (LAGB). Laparoscopic sleeve gastrectomy (LSG) is a relatively new procedure for obesity. The majority of stomach along the greater curvature is removed, leaving a narrow tube resembling a banana, with a remnant upper gastrointestinal tract to maintain integrity to a certain extent. LSG gains advantage over other procedures with its simplicity, comparable results, short duration of operation, and less complications[6]. LSG has been accepted gradually by doctors and patients and has recently become more popular in Asia[7-8]. The 6th International Asia-Pacific Metabolic and Bariatric Surgery Society (APMBSS) Congress held in Singapore recently stated that LSG obtained the fastest growth in Asia than the other bariatric procedures, with the number of this procedure increased from 4 (1% of the total bariatric procedures) in 2004 to 520 (24.8%) in 2009, similar to the number of LRGBP (580, 27.7%) in the same year. This rise parallels the global trends[9]. Unfortunately, data from China were not available to have been presented at this congress because Chinese bariatric surgery was then still in its infancy. For example, LSG was performed for the first time in our center not until March of 2009. We believe that it is helpful to present the early outcomes of LSG in Chinese obese patients as a primary procedure.

MATERIALS AND METHODS

The clinical data about 20 obese patients who underwent LSG in our center from September 2009 to September 2010 were retrospectively analyzed. Their mean age was 30.9±9.7 years (range 18-55 years), the female/male ratio was 11:9, their preoperative mean weight was 127.6±26.6 kg (range 92-178 kg), their preoperative mean body mass index (BMI) was 46.1±11.5 kg/m^2 (range 35.9-58.8 kg/m^2) and their preoperative mean excess weight (measured from a BMI of 23) was 63.8±22.5 kg (range 35.3-103.5 kg). All the patients satisfied the inclusion criteria according to the Guidelines for Surgical Treatment of Obesity in China (2007) formulated by the Endocrine Surgery Group, Laparoscopic and Endoscopic Surgery Group, Gastrointestinal Surgery Group of the Surgery Branch of the Chinese Medical Association[10].

The admitted patients were treated by a fixed team consisting of surgeons, anesthetists, dieticians, and pre- and post-surgical nurses. A group consisting of dietician, physiotherapist, endocrinologist, cardiologist, and gastroenterologist provided a preoperative management program for the patients. The patients were given a DM-type integral protein diet (41.8-62.7 kJ/kg/d) for at least 2 weeks before surgery, for building up their physical conditions to ensure future successful surgery and modification of postoperative dietary habits. The diet, exercise and behavioral modification were monitored throughout the pre- and postoperative periods. The patients received a full and objective preoperative examination for the assessment of surgical risk and underwent upper gastrointestinal series and ultrasonography for liver, gallbladder, and pancreas. Blood gas and cardiopulmonary functions were assessed, and obstructive sleep apnea hypopnea syndrome (OSAHS) was diagnosed by overnight polysomnography. If necessary, continuous positive airway pressure therapy was initiated at least 2 weeks before and after operation. The benefits, disadvantages, and potential risks of each surgical procedure were carefully explained to the patients. The procedure-related complications, the necessary changes in eating habits and lifestyle, and the need for frequent and long-term follow-up were discussed in detail. Written informed consent was obtained from each patient. All operations were performed by the same surgical team. Cephalosporin and metronidazole of the second generation were administered for prevention of perioperative infection and stretch hose was used for prevention of deep vein thrombosis. In addition, an orthopedic operation table was necessary to bear the excessive weight of the patients.

Surgical Procedures

Surgical procedures involved the placement of 5 trocars. First, the V-shaped liver suspension technique (V-LIST) was used to gain a broad operative view of the gastroesophageal junction[11-12]

and a silicone Penrose drain was inserted into the peritoneal cavity and stapled to the pars condensa of the lesser omentum and parietal peritoneum using 2-0 Prolene (Ethicon) for liver retraction. The left lobe of liver was retracted with the V-shaped suspension technique. The greater curvature of stomach was freed beginning from 6 cm proximal to the pylorus to the angle of His with the harmonic scalpel (Ethicon). Care was taken to preserve the gastroepiploic vessels. A bougie (36-40 Fr) was placed in the stomach against the lesser curvature to guide the stapling. Gastric resection was performed with a stapler (Echelon 60, Ethicon) along a line parallel to the bougie beginning from 6 cm proximal to the pylorus and extending to the cardia. The stomach was removed from the abdominal cavity by slightly enlarging the incision where the Versaport cannula was placed. Intraoperative gastroscopy was performed for each patient to ensure that he or she had no bleeding or stricture. A leak check was performed at the same time by insufflating with a gastroscope with the remnant gastric section submerged in irrigation fluid and by infusing sterile methylene blue through a nasogastric tube. The staple line was oversewn (3-0 Vicryl, Ethicon), only along the bleeding and leakage areas, or areas with the potential for such complications. A nasogastric decompression tube was placed to monitor bleeding and an intraperitoneal drain was placed under an anastomotic stoma. All patients underwent upper gastrointestinal imaging with water-soluble contrast medium to inspect the shape of gastric remnant and check the staple line for leakage on day 1 after operation. If there were no abnormalities, the nasogastric tube was removed and patients were allowed to have oral fluids. The intra-abdominal drain was not removed until patients' discharge from hospital so as to monitor whether internal hemorrhage or gastric leakage occurred. The majority of patients were discharged on day 3 or 4 after operation.

The patients were followed up for at least one year with their weight loss assessed at a monthly interval, during which data were collected including the initial weight, pre/postoperative weight loss, occurrence of obesity-related diseases, medication, operation time, recovery from the operation, length of hospitalization, weight loss, complications, resolution of obesity-related diseases and symptoms delaying recovery. Weight loss, amelioration of obesity-related diseases, complications, and quality of life were assessed with the bariatric analysis and reporting outcome system (BAROS)[13]. BAROS defines the major surgical complications as need for re-operation or endoscopic procedure, or bleeding requiring transfusion, or an event resulting in prolonged hospitalization over 7 days. Minor surgical complications are defined as an operation-related morbidity which does not prolong the hospitalization for over 1 week. Late surgical complications are minor if the patient has symptoms related to the operation that delays the normal recovery and prohibits the normal daily activity[13]. Complete blood cells were counted, body was weighed, medication was checked, and general well-being and physical status were recorded during a routine 1-year follow-up period. Resolution of obesity-related diseases was assessed according to the diminished or discontinued medication due to the normalization of laboratory values.

Statistical Method

All data, expressed as mean±SD, were compared between groups by paired Student's *t*-test and analyzed by one-way ANOVA test using SPSS 16.0 for Windows. $P<0.05$ was considered statistically significant.

RESULTS

Of the 20 patients enrolled in this study, 19 underwent LSG and 1 underwent open SG due to the trocar-induced transverse mesocolon branch vein injury. The mean operation time was 100.6 min (range 61-150 min) with a mean blood loss of 65 mL (range 20-600 mL). The operation time of open SG was 138 min with a blood loss of 600 mL. The mean blood loss in the 19 patients who underwent LSG was 30 mL (range 20-50 mL). No death occurred. The mean length of hospitalization was 5.6 days (range 4-8 days) after the operation.

Weight Loss

The average weight was 91.2 kg, the average weight loss was 36.4 kg, the average BMI was 33.6 kg/m^2 with a drop of 12.5 kg/m^2, and the excess weight loss (EWL, measured from a BMI of 23) was 55.9% for the patients 1 year after operation. The lowest EWL was 33.5% and 33.8% respectively. One patient had a poor compliance for moderate eating and 1 patient liked sweet food which could not be changed. Extreme morbid obesity with BMI >50 kg/m^2 was present in 27.8% of the patients (n=5) before operation and was 0% after operation (Table 1).

Amelioration of Obesity-related Diseases

The majority of obesity-related diseases were resolved or improved after operation. The obstructive sleep apnea hypopnea syndrome was improved in 15 patients 1 year after LSG. Of the 6 patients with hypertension, 4 had their the blood pressure returned to normal after withdrawal of antihypertensive agents, 1 decreased the dose of antihypertensive agents, and 1 turned to take a milder antihypertensive agent. Of the 6 patients with type 2 DM, 5 were able to maintain their stable fasting blood glucose and glycosylated hemoglobin levels through diet alone or exercise, and 1 reduced dosage of the antidiabetic drug. Although the total cholesterol (TC) and triglyceride (TG) level in the patients with hyperlipemia after operation were not different from those before operation, they returned to normal in 50% of them and 1 patient decreased the dosage of antilipemic agents after operation. The symptoms of OSAHS were resolved or improved in all patients (Tables 2 and 3).

BAROS Score and Changes in the Quality of Life Questionnaire

The average score and changes in the Moorehead-Ardelt quality of life questionnaire before and after operation are shown in Table 4.

Table 1. Weight Loss of 20 Patients before and after Operation

Parameter	Before Operation	After Operation	Change	*P* Value*
Mean Weight (kg)	127.6±26.6	91.2±21.3	36.4	0.000
Mean BMI (kg/m^2)	46.1±11.5	33.6±5.6	12.5	0.000
Mean Excess Weight (kg)	63.8±22.5	27.4±19.0	36.4	0.000

Note. BMI=Body Mass Index. *Paired Student's *t*-test. Excess weight was measured from a BMI of 23.

Table 2. Improved and Remitted Obesity-related Diseases

Co-morbidity	Preoperative No.	Postoperative No. (%)		
		Remission	Improved	Unchanged
II-DM	6	4 (66.67)	1 (16.67)	1 (16.67)
Hypertension	6	3 (50.00)	2 (33.33)	1 (16.67)
Hyperlipemia	4	2 (50.00)	1 (25.00)	1 (25.00)
OSAHS	15	12 80.00)	3 (20.00)	0

Note. II-DM=type 2 diabetes mellitus; OSAHS =obstructive sleep apnea hypopnea syndrome.

Table 3. Objective Indications for Obesity-related Diseases

Metric	Ⅱ-DM (*n*=6)		Hyperlipemia (*n*=4)		Hypertension (*n*=6)		OSAHS (*n*=15)	
	FBG	GHb(%)	TG	TC	SBP	DBP	AHI	$NLSaO_2$
Preoperative	9.3±1.3	8.1±1.4	2.4±0.1	5.4±0.2	166.7±7.5	101.7±13.7	48.7±39.1	66.4±15.4
Postoperative	6.7±1.9	6.0±0.2	2.2±0.1	5.0±0.4	150.8±12.0	88.3±6.8	10.5±14.0	80.4±7.9
P value*	0.011	0.018	0.083	0.144	0.008	0.038	0.000	0.000

Note. II-DM=type 2 diabetes mellitus; OSAHS=obstructive sleep apnea hypopnea syndrome; FBG=fasting blood glucose; GHb=glycosylated hemoglobin; TG=triglyceride; TC=total cholesterol; SBP=systolic pressure; DBP=diastolic pressure; AHI=apnea-hypopnea index; $NLSaO_2$=nocturnal lowest arterial oxygen saturation. *Paired samples *t* test.

Table 4. Average Score and Changes in Quality of Life Questionnaire before and after Operation (*n*=20)

Items	Average Score		*P* Value*	Changes in Quality of Life Questionnaire after Operation				
	Preoperation	Postoperation		Much Worse (%)	Worse (%)	Same (%)	Better (%)	Much Better (%)
Self-esteem	-0.225	0.225	0.017	1 (5.00)	1 (5.00)	2 (10.00)	6 (30.00)	10 (50.00)
Physical activity	-0.188	0.188	0.000	0	1 (5.00)	2 (10.00)	7 (35.00)	10 (50.00)
Social involvement	-0.188	0.138	0.006	0	2 (10.00)	6 (30.00)	7 (35.00)	5 (25.00)
Labor	-0.200	0.113	0.001	0	1 (5.00)	5 (25.00)	8 (40.00)	6 (30.00)
Sexual	-0.238	0.0375	0.007	1 (5.00)	1 (5.00)	7 (35.00)	7 (35.00)	4 (20.00)

Note. *Mann-Whitney U test.

Complications

All surgical and medical complications were stratified as major and minor or early and late according to the Oria and Moorehead classification. The only major early surgical complication occurred in patient who was transferred to open SG due to a blood loss of 600 mL. Another 2 minor early surgical complications were found in 2 patients with umbilical site infection that responded to conservative wound care. Four minor early surgical complications took place in 3 patients due to dehydration which were potentially related to transient gastric dysmotility in the first month. One patient, readmitted 2 months after LSG due to blood vomiting, was diagnosed as chronic gastritis and bleeding by gastroscopy, with their symptoms disappeared after conservative therapy. These 4 patients remained in hospital for less than 1 week. The 3 minor early medical complications, including dyspepsia, reflux or vomiting, were resolved spontaneously after patients were instructed to chew carefully and swallow slowly. One patient suffered from Guillain-Barre syndrome on day 62 after LSG. However, whether it was related to the bariatric operation remains unknown. These patients were recommended to receive low sugar, calorie, and high protein diet. Food intake after LSG was around 25% of what had been prepared, and all patients received a routine oral multivitamin supplementation (one tablet a day). The patients were asked to have plenty of fluids and enough protein, establish healthy eating habits and avoid eating too much. Folate deficiency was identified in 1 female patient (5%) with megaloblastic anemia, and hypocalcaemia occurred in 1 (5%) male patient 1 year after operation. No severe nutrition complication was observed in the patients after operation.

Final BAROS Scores

The excellent, good, fairly good and poor BAROS scores were achieved in 2 (10.0%), 8 (40.0%), 7 (35.0%), and 3 patients (15.0%), respectively.

DISCUSSION

Currently, there are several options of bariatric surgery. LRYGP and LAGB are the most common. LRYGP has become the “gold standard” for morbid obesity in USA, while LAGB is the most popular procedure in Australia and Europe. Sleeve gastrectomy (SG) is a relatively new procedure, first described by Hess in 1988[14], and was initially described as a first-step procedure followed by either biliopancreatic diversion with duodenal switch or Roux-en-Y gastric bypass in severe obese patients. Sleeve gastrectomy not only limits the amount of food by reducing the volume of stomach to 50-100 milliliters which is about the size of a banana, approximately one tenth of what the stomach is able to hold before, but also restricts the gastric volume and reduces the number of glands that produce ghrelin after removal of the gastric fundus. Therefore, the procedure also functions as an appetite suppressant[15], and is thus not purely a restrictive bariatric surgery[7-8]. With the development of minimally invasive surgery in 1999, the first LSG was performed as a first part of biliopancreatic diversion with duodenal switch[16]. To date, no standardized and objective method is available for choosing an appropriate surgical technique. The choice of procedure is influenced by patients’ BMI, age, sex, adherence, psychosocial status and knowledge about bariatric surgery. For lack of appreciable health education, many obese people in China refuse invasive surgery and often prefer to take conservative therapy because they are afraid of the surgical risks. The patients in our group were only 30.85±9.66 years old, but the mean time of suffering from obesity was 11.1±4.6 years. All patients received conservative therapies, such as diet pills, exercise and acupuncture, which did not effectively reduce their weight. Surgery was thus the only available option for these patients. When informed of the effect, advantages and disadvantages of bariatric procedure in detail, many patients still refused to accept anatomic rearrangement of their intestinal anatomy or placement of an implanted band. Therefore, of the 27 patients who received bariatric surgery, only 2 underwent LRYGB, 5 underwent LAGB, and most (20) underwent LSG. Most of the patients receiving LSG were satisfied with the operation in our group with an average weight loss of 33.98 kg and an average excess weight loss of 55.89%. Furthermore, most of the obesity-related diseases were resolved or improved, and the quality of life of the patients was significantly elevated. It was recently reported that the average weight and BMI of 20 patients increased from 116.3 to 90.2 kg and 42.5 to 33.1 kg/m^2 respectively with an average excess weight of 49.6% and obvious improvement in obesity-related

diseases 1 year after LSG[17], indicating that LSG is safe and feasible as a first-line surgery for morbid obesity. It has been shown that the excess weight loss is 59.13% and 65% respectively 1 and 2 years after LSG with a good resolution of obesity-related diseases[18]. It was also reported that the excess weight was 83.3%±28.3% 1 year after LSG with a good resolution of obesity-related diseases[19]. A systematic review of the current literature on LSG indicated that the mean percentage of EWL was 33%-85%, with an overall mean EWL of 55.4%, and the follow-up for the weight loss was 3-60 months[8]. In contrast to previous studies, one report on LSG with a 5 year-follow-up showed a mean EWL of 55.0%±6.8% and a low plasma ghrelin level for 5 years after operation[20], indicating that SG produced stable weight loss. It was more recently reported that the EWL was >50% in 55% of patients after LSG as a definitive bariatric procedure[21].

In this study, no death, gastric staple line leaks, bleeding or stricture occurred during the perioperative period except for massive bleeding during LSG, suggesting that certain measures can reduce the complications. All patients in our group underwent intraoperative gastroscopy to ensure no bleeding or stricture formation. The staple line must be oversewn along the areas with leakage, bleeding or potential for these complications. These measures prolong the operation time but reduce the risk of complications. No standard distance is available from the pylorus to staple the proposed gastric remnant. The stomach should be removed beginning 10 cm away from the pylorus[22] or beginning 2 cm away from the pylorus[23-24]. The Third International Consensus Summit for Sleeve Gastrectomy reported that resection began 1.5-7.0 cm (mean 4.8 cm) proximal to the pylorus in 19 605 casesundergoing LSG[25]. In this study the stomach was removed beginning 6 cm proximal to the pylorus and extended the resection to the cardia as previously described[26], thus protecting the pylorus function, accelerating the gastric emptying and decreasing the bile reflux. V-shaped liver suspension technique (V-LIST) is cost-effective to gain a broad operative view of the gastroesophageal junction, and to remove the drain at the end of surgery, can avoid an additional subxiphoid wound and reduce the risk of iatrogenic liver injury. An intra-abdominal drain was left via the anastomotic stoma until the patient began to take oral fluids, which might delay the discharge from hospital, but would be able to monitor whether internal hemorrhage and gastric leakage occurred[27]. A multi-disciplinary team (MDT) approach is necessary for the treatment of morbid obesity and its complications. Patients needing bariatric intervention were assessed physically and their concerns were addressed by the team at admission. The advantages, risks, and disadvantages of bariatric surgery were discussed with patients in detail. The specific procedure selected was according to the preference of patients or contraindications for other bariatric procedures. A low calorie diet designed by dietitians induced weight loss to some degree. Consultations by MDT to decide a comprehensive plan for obesity and its related diseases are vital before bariatric surgery. Modification of diet, exercise and lifestyle and frequent follow-up must be conducted by MDT for a long time.

Most studies indicate that LRYGB and LSG are more effective than LAGB in achieving weight loss[28-29]. However, emerging researches indicate that LSG is comparable to LRYGB or GBP in weight loss and resolution of obesity-related diseases. LSG is a relatively simple technique with few complications, rare postoperative metabolic deficiency and no need for supplementation. In addition, LSG is safer than LRYGBP[7,30-31]. In this study, no death occurred, indicating that LSG is a safe procedure even for patients aged over 60 years or those aged less than 18 years[32-33]. For these reasons, some scholars support LSG as a single primary procedure to relieve obesity[8,34-37]. LSG is especially useful in a region, such as China at a higher risk of stomach cancer. It is known that the incidence of gastric cancer in Asia is much higher than in other continents, accounting for 42% of the total number of cases worldwide. Consequently, LSG as a definitive bariatric procedure has become more popular in Asia[7-8,34]. The absolute number of bariatric surgery procedures in Asia excluding China increased from 381 in 2004 to 2091 in 2009, LSG increased from 1% in 2004 to 24.8% in 2009, and LRYGB increased from 12% in 2004 to 27.7% in 2009, whereas LAGB and minigastric bypass decreased from 44.6% and 41.7% in 2004 to 35.6% and 6.7% in 2009 respectively[9]. LSG may result in long-term dilatation of the remaining stomach sleeve and consequently induce weight regain. Since obesity is a lifelong disorder, longer term comparative effectiveness data for LSG are needed.

In conclusion, LSG is an effective, feasible and safe procedure for obese patients, but more studies on a larger scale with a long term follow-up are needed to clarify its benefits in China.

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