Original Article

Weight Loss and Metabolic Outcomes after Laparoscopic Sleeve Gastrectomy in Vajira Hospital: A 5-Year Experience

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Objective: To assess the results of laparoscopic sleeve gastrectomy (LSG) in morbidly obese patients in terms of surgical outcomes, weight loss, and improvement or remission from metabolic co-morbidities.

Materials and Methods: Data of 28 patients who underwent LSG during July 2012 to June 2017 were reviewed. Data collected were surgical outcomes (operative time, blood loss, hospital stay, complications and mortality rate). Percentage of excess-weight loss (%EWL), and improvement or remission of metabolic co-morbidities were reported.

Results: No serious surgical adverse event or death were encountered. The mean %EWL was 54.4±16.8% at 2 years. The %EWL was significantly higher in the patients whose BMI ≤40 kg/m^2 than others at 1-year follow-up (64.7±18.1 vs. 46.5±15.5; *p*-value = 0.039). However, the 2-year %EWL difference was not significant (59.5±14.1 vs. 50.3±18.2; *p*-value = 0.232). At 2-year follow-up, the rate of improvement and remission of diabetes, dyslipidemia, and hypertension were 100%, 100%, and 46.2%, respectively.

Conclusion: LSG is a safe surgical procedure and effective to correct obesity and its metabolic co-morbidities.

Keywords: Bariatric surgery, Sleeve gastrectomy, Morbid obesity, Metabolic outcomes, Weight loss

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Obesity is currently a major global health problem. The prevalence of obesity has been estimated to be 41% in United States in 2015[1]. A cross-sectional survey in Thai adult population reported a trend of increasing prevalence of obesity, from 6.8% in 2004 to 9% in 2009[2].

Obesity can lead to many chronic illnesses; hence, a higher prevalence of obesity will result in higher incidence of other related diseases resulting in negative impact on health. A negative correlation between high body mass index (BMI) and life expectancy was reported in a study by Fontaine et al[3]. Most deaths of the obese individuals were from cardiovascular or cerebrovascular diseases. Another study by Drenick et al reported that the morbidly obese patients aged 25 to 35 years had 12 times higher risk of death compared to non-obese patients of the same age range[4].

Many treatment modalities which have been used to reduce the excess weight include lifestyle modification, pharmacologic intervention, and bariatric surgery[5]. Among these, bariatric surgery is the most reliable method for weight reduction comparing to other treatment options in terms of sustainable weight loss[6].

There are many types of bariatric surgery to treat obesity e.g. laparoscopic sleeve gastrectomy (LSG), laparoscopic Roux-en-Y gastric bypass (LRYGB), and biliopancreatic diversion (BPD)[7]. The most widely used of bariatric surgery is LSG which causes weight reduction by restriction mechanism[8]. An excess-weight loss (EWL) could be as high as 60% to 85% after LSG[9-11]. Along with weight loss which could be attained after the LSG, many associated morbidities could be reduced[12,13]. For example, up to 80% of diabetes mellitus in obese individuals could be better controlled[12] whereas 60% of hypertension could be resolved after LSG[13].

In spite of the benefits of LSG, the procedure of bariatric surgery is not commonly practiced in Thailand (approximately 300 procedures across Thailand in 2017)[14]. Considering about diet pattern and culture, outcomes after LSG in Thai people may differ from the western population. To the best of our knowledge, no study about the outcomes of LSG in Thai obese patients had been reported. In our institution, LSG has been performed since 2012.

The present study aimed to assess the outcomes of Thai obese patients who had undergone LSG. The outcomes of interest were surgical outcomes, weight loss, and metabolic outcomes among those who had metabolic co-morbidities.

Materials and Methods

Patients

A retrospective study was conducted after the approval from the ethics committees of the institution. All patients who underwent surgery for their obesity problem

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between July 2012 and June 2017 were identified from the institutional electronic database using ICD-9-CM code of 43.82. Inclusion criteria were obese patients who underwent LSG. The patients who had incomplete data were excluded. Generally, the surgeons in the Department of Surgery discussed with obese individuals, sought for consultation of treatment, and who had indication for surgery including body mass index (BMI) $\geq$32.5 kg/m^2 plus the presence of co-morbidities, or BMI $\geq$37.5 kg/m^2. Data of the patients who met inclusion criteria were retrieved for analysis.

Surgical practice and surveillance

The patient undergoing surgery was placed on reverse Trendelenburg position with the abduction of both arms. An abdominal cavity was accessed with an optical bladeless trocar. After a peritoneal cavity was insufflated with CO_2, Nathanson liver retractor and 3 additional trocars were inserted into the upper abdomen. By the using of a vessel sealing device, a greater omentum was detached from the gastric greater curvature starting from the antrum to the angle of His (acute angle between the cardia at the entrance to the stomach, and the esophagus). A 36 Fr Maloney bougie was inserted into the stomach and duodenum and served as a guide for vertical gastric transection. The bougie was positioned along the lesser curvature. Gastric division line would stay on the left of bougie and traveled from the antrum at the 6-cm point away from the pylorus to the angle of His 1 to 2 cm away from the esophago-gastric junction.

Complete vertical gastric transection was achieved through serial endo-linear staple sutures. The division line was imbricated with non-absorbable running sutures. A gastric specimen was removed via an extended incision at the end of the operation.

Intermittent sequential pneumatic compression was applied over both legs during the operation and postoperative period until the patient could ambulate. A single dose of low molecular weight heparin as a prophylaxis of deep vein thrombosis was injected subcutaneously before surgery. The patients were scheduled for follow-up visits at 1 month after surgery for surgical outcomes assessment and approximately every 3 months afterwards until 2 years for health status. Body weight was assessed at 1 year and 2 years after surgery. The status of co-morbidities was evaluated at 2 years. Telephone contact was made among the patients who did not return for a follow-up visit.

Data collection and statistical analysis

Data collected from the patients' medical records included: demographic data of the patients including pre-operative BW, height, and co-morbidities including diabetes mellitus (DM), hypertension (HT), and dyslipidemia (DLP); operative data including operative time, peri-operative complications and management including a conversion to laparotomy; length of hospital stay; and follow-up data including post-operative BW, and the status of metabolic co-morbidities among those who had the conditions. Data of weight loss outcome at 1 and 2 years after operation were collected. Status of co-morbidity, collected from medical records at 2-year post-surgery or telephone visit if the patients were treated in other hospitals, was defined as remission, improvement, and stable or worse. Remission or improvement referred to status when medical treatment was no longer required or less medication was needed respectively whereas stable or worse referred to same or additional treatment were prescribed.

All statistical analyses were performed using STATA version 13.0. All categorical data were summarized as a number along with percent. For continuous data, the estimation was presented as mean and standard deviation (SD), or median and interquartile range (IR) when appropriated. Percent of excess-weight loss (%EWL) was obtained by dividing the figure of weight loss with the excess body weight then converted to percentage. The excess body weight was a subtraction between pre-operative actual body weight and the ideal body weight.

The patients were divided into 2 groups according to age at 50 years and BMI at 40 kg/m^2. Independent t-test was used to compare the %EWL between 2 patient groups. Pearson's correlation coefficients were calculated to demonstrate the relationship between BMI and %EWL. A p-value $\leq$0.05 was considered as statistically significant.

Results

Baseline characteristics

A total of 28 patients who underwent LSG during July 2012 to June 2017 were identified. All met inclusion criteria and were included in the study. Nearly two-third or 64.3% of the patients were female (18 patients). The mean age was 46.2$\pm$12.7 years, with 15 patients (53.6%) aged more than 50 years. The mean BMI was 42.5$\pm$8.1 kg/m^2, with 13 patients (46.4%) had BMI $\leq$40 kg/m^2 and 15 patients (53.6%) had higher BMI. The patients in this cohort had personal history of DM, HT, and DLP in 57.1% (16 patients), 53.6% (15 patients), and 35.7% (10 patients), respectively. Baseline demographic characteristics of the patients included in the study are summarized in Table 1.

Hospital stay and complications

The median operative time was 3.4 hours (IR 3.1, 4.4 hours). The LSG could be accomplished in all 28 patients without a conversion to open procedure. The median blood loss was 50 ml (IR 20, 65 ml). The median hospital stay was 7 days (IR 6, 8 days). No events of staple line leakage, surgical site infection (SSI), thromboembolic events, or death were encountered in any patients.

During follow-up, stenosis of a gastric body was observed in 2 patients (7.1%) at approximately 1 month and 2 months after surgery. They were effectively treated with balloon dilation. Gastroesophageal reflux (GER) had been complained in the other 2 patients (7.1%) whose symptoms were completely resolved with a proton-pump inhibitor.

Weight loss outcomes

The mean %EWLs at 1 year and 2 years were

56.6±18.9% and 54.4±16.8% respectively. At 1 year, the patients with BMI ≤40 kg/m^2 gained significantly higher %EWL comparing to those with BMI >40 kg/m^2: 64.7±18.1 vs. 46.5±15.5 (*p*-value = 0.039). However, the difference was not statistically significant at 2-year; the corresponding %EWLs were 59.5±14.1 vs. 50.3±18.2 (*p*-value = 0.232) (Figure 1). The correlation coefficients between BMI and %EWL at 1- and 2-year were -0.46 (moderately negative linear correlation; *p*-value = 0.057) and -0.34 (weakly negative linear correlation; *p*-value = 0.142), respectively.

The present study did not find significant association of the 1- or 2-year %EWL and age >50 years or ≤50 years of the patients: 52.3±16.3 vs. 60.9±21.3 (*p*-value = 0.350) at 1 year and 51.6±16 vs. 57.8±18 (*p*-value = 0.426) at 2 years, respectively.

Metabolic outcomes

Among 19 patients who returned for a follow-up visit at 2-year after LSG, DM was diagnosed pre-operatively in 13 patients. Eleven (84.6%) had remission after LSG whereas 2 of them (15.4%) required fewer diabetic medications (improved). Among 7 patients who were diagnosed as DLP before surgery, lipid-lowering medication could be terminated in 5 patients (71.4%) and medication dosage could be reduced in the others. However, only 46.2% improvement or remission of HT was observed in this study. Table 2 shows the status of DM, DLP, and HT at 2-year after surgery among 19 patients who had these pre-operative co-medical morbidities.

Table 1. Baseline characteristics of obese patients (n = 28)

Characteristics	n (%)
Sex	
Male	10 (35.7)
Female	18 (64.3)
Age, mean ± SD	46.2±12.7
≤50 years	13 (46.4)
>50 years	15 (53.6)
Co-morbidity	
Diabetes mellitus	16 (57.1)
Dyslipidemia	10 (35.7)
Hypertension	15 (53.6)
Pre-operative body weight (kg), mean ± SD	119.7±20.8
Indication for surgery	
BMI ≥32.5 kg/m^2 + co-morbidities	7 (25)
BMI ≥37.5 kg/m^2	21 (75)
BMI, mean ± SD	42.5±8.1
≤40 kg/m^2	13 (46.4)
>40 kg/m^2	15 (53.6)

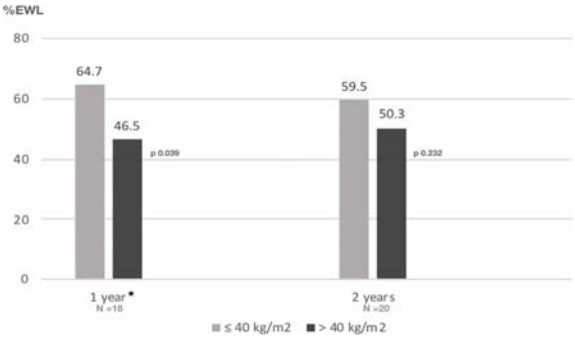

Figure 1. Mean %EWL at 1-year and 2-year after the operation (n = 28).

Discussion

Excellent results of bariatric surgery are contributed from a combination of good surgical technique and lifestyle modification. Regarding the surgical outcomes, LSG is considered as a safe procedure for obese patients taken into consideration the low serious complication rates ranging from 2.4% to 5.6% reported in previous studies[15-17]. Nevertheless, leakage is one of the major concerns of LSG due to a long staple line, and was reported to be 2.2%[18]. This study did not encounter any peri-operative complications including the conversion to laparotomy or gastric content leakage. Successful LSG in this study was attributed in part to the fact that all operations were performed by experienced laparoscopic surgeons specially trained in bariatric surgery. Delayed complications of gastric body stenosis or gastro-esophageal reflux were found in 14% of our patients which were resolved with endoscopic intervention or medications respectively. Actually, these complications were not specific to laparoscopic approach and could be found in laparotomy procedure as well. Mortality rate which was reported to be 0.43% in one previous study[15] was not found in the present study.

The %EWL of 50% demonstrated in the present study was lower than 60 to 80% as reported from other studies[9-11]. We explored and found that our institution was short of a team approach of other personnel e.g. dietician and/or behavioral therapist who specialized in post-bariatric care which might have lowered the maximal benefit of LSG. Nevertheless, higher %EWL in the patients with pre-operative BMI ≤40 kg/m^2 in this study was consistent with other previous studies which found higher benefit of EWL among less obese patients[11,19].

Although the present study could demonstrate only marginal benefit of LSG on weight loss, the advantages on metabolic outcomes were remarkable. This positive impact of LSG was also reported in other studies[12,20]. The present study also assessed the metabolic co-morbidity status at 2 years after surgery by information of the patient's medication as it should reflect the ultimate benefits in term of metabolic disease control rather than spot blood chemistry results. The 100% rate of DM improvement (15%) and remission (85%) found in this study was slightly higher than 80% reported in the study of Lessing et al[21] and in systematic reviews by Osland et al and Cho et al[12,20]. The 100% rate of DLP improvement (29%) and remission (71%) from DLP was

Table 2. Status of co-morbidity at 2 years after the operation (n=19)

Co-morbidity	Status at 2-year, n (%)			
	Remission	Improved	Stable	Worsen
Diabetes mellitus (n = 13)	11 (84.6)	2 (15.4)	-	-
Dyslipidemia (n = 7)	5 (71.4)	2 (28.6)	-	-
Hypertension (n = 13)	3 (23.1)	3 (23.1)	6 (46.2)	1 (7.7)

also higher than 44% and 67% reported in prospective studies of Peterli et al and Zachariah et al, respectively[15,22]. However, the 46% rate of improvement (23%) and remission (23%) of hypertension in the present study was not remarkable as with other metabolic disorders. This was lower than other reports which could demonstrate that approximately 80 to 90% of their obese patients had better control of blood pressure after the LGS[13],[15,22].

An improvement (reduction) of metabolic syndrome could be the ultimate goal taking each of its components (obesity and co-morbidities) into account. Despite a marginal benefit of weight reduction, other favorable metabolic outcomes could be achieved. The present study supported the active role of surgery on gut hormone modification as evidenced by the impact of LGS on the metabolic diseases independent of weight loss. Previous study reported significantly increase level of some gut hormones e.g. glucagon-like peptide-1 (GLP-1) and peptide YY (PYY) after sleeve gastrectomy, which might be one reason for better metabolic disease control[23].

Some limitations in the present study were awareness of especially incomplete data of non-surgical outcomes. Few reasons were observed. First, some patients had medical treatment for their illnesses in other hospitals and were referred to have LSG in our institution. Second, more than half of the patients were lost to follow-up. Although this might indirectly reflect the success of metabolic diseases being in remission or improvement, a definite conclusion could not be ascertained. Some active strategies must be implemented to increase the rate of follow-up to provide the actual status of outcomes after surgery. Training of medical personnel for post-bariatric care at registered primary care unit (PCU) might be an option to increase the patients' adherence to a follow-up program. Finally, the lack of multidisciplinary approach during pre- and postoperation to maximize the benefit of surgery had not been well defined. This might have led to lower rate of long-term weight control than other studies. Nevertheless, the information from this study should be useful and stimulate the skilled surgeons to work in collaboration with internal medicine physician to solve the problem of obesity and its related co-morbidities. Good national database registry or a health network of data sharing and well-designed prospective study are needed to demonstrate the benefits of LSG in Thai population. If further study could demonstrate the cost-utility benefit of bariatric surgery particularly LSG, this operation should be considered as one useful medical practice in Thailand.

In conclusion, LSG is safe and could be a standard of care for morbidly obese patients. Good results on metabolic diseases control can be expected from LSG. To maximize the benefit from surgery, however, a multidisciplinary approach is necessary.

What is already known on this topic?

The most effective treatment modality for morbid obesity is a weight-reduction operation, so called Bariatric surgery. LSG is one of bariatric operations which can provide successful operative outcomes and long-lasting weight loss. Also, LSG has been proven as a powerful method for controlling co-morbidities of obesity. For this reason, a lot of morbidly obese patients underwent LSG in the present day. In Thailand, however, LSG is an uncommon surgical procedure with limited reports.

What this study adds?

To the best of our knowledge, this study is the first report of weight loss and metabolic outcomes of LSG in Thai patients. The results from this study confirm the benefits of LSG in morbidly obese patients. Adequate weight loss and improved metabolic outcomes can be achieved in the Thai population comparable to the reports from the studies from the Western countries.

Potential conflicts of interest

The authors declare no conflict of interest.

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