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ORIGINAL ARTICLE

Laparoscopic sleeve gastrectomy in Asia: Long term outcome and revisional surgery

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Summary *Background:* Laparoscopic sleeve gastrectomy (LSG) is a popular stand-alone bariatric surgery, despite a paucity of long-term data. Hence, this study is to report the long-term outcome of LSG as primary bariatric procedure and the result of revisional surgery.
Methods: With retrospective analysis of a prospective bariatric database, participants who defaulted clinic follow-up were interviewed by telephone. A total of 667 LSG was performed as primary bariatric procedure (2006–2012) with mean age of 34.5 ± 9.7 years old, female 74.7%, mean body mass index (BMI) 37.3 ± 8.1 kg/m^2. A 36-F bougie was used for all cases.
Results: There were 61 patients available with long-term data. The weight loss outcome at 1 year, 2 years, 3 years, 4 years, and 5 years showed a mean BMI 26.3, 25.2, 25.3, 27.1, and 26.2 with mean excess weight loss (EWL) 76.0%, 79.6%, 77.3%, 73.4%, and 72.6% respectively. However, 17% patients developed *de novo* gastro-esophageal reflux disease (GERD). Eighteen patients (2.2%) needed surgical revisions due to weight regain ($n = 6$), persistent type 2 diabetes mellitus (T2DM; $n = 2$), stricture ($n = 2$), and GERD ($n = 8$). The revision resulted in an additional mean excess weight loss of 23.8% with mean BMI 24.9 kg/m^2 at 6 months postoperatively. There was a 23.7% mean reduction of HbA1c with one patient who was in complete diabetic remission at 1 year.
Conclusion: Our results showed LSG is a durable bariatric procedure with > 70% EWL at 5 years despite a high incidence of GERD. The need for revision of LSG is low and mainly for GERD.

Conflicts of interest: The authors have no conflicts of interest.

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1. Introduction

Laparoscopic sleeve gastrectomy (LSG) has been gaining popularity as a stand-alone bariatric surgery worldwide since the first inception of this novel procedure in 1988. It was first described as the initial step, as part of biliopancreatic bypass with duodenal switch (DS) for obesity by Dr. Doug Hess[1] in March 1998. In a similar development, Dr. Gagner et al[2] used it as a first stage bariatric procedure for high risk patients in order to reduce the risk profile of patient, and later performed gastric bypass once adequate weight loss was achieved. However, it was noted that the sleeve gastrectomy alone could cause good weight loss before the second procedure. In fact, this finding was consistent with other published reports.[3,4] Due to its effectiveness in weight loss and resolution of comorbidities, it was then used as the primary restrictive bariatric procedure and verified in three International Consensus Summit of Sleeve Gastrectomy in 2007, 2009, and 2011 as a safe and feasible primary bariatric procedure.[5–7] In fact, the American College of Surgeons Bariatric Surgery Center Network has put it in the intermediate position between laparoscopic gastric banding and laparoscopic gastric bypass in terms of reduction of body mass index (BMI), complication rates, and resolution of obesity related illness.[8]

However, until now, the technique of LSG is still not standardized. This is because, different bougie sizes have been used to calibrate the diameter of the sleeve and variation of technical approaches might have led to different results from this procedure. At the moment, despite the paucity of long-term outcomes, sleeve gastrectomy has gained wide acceptance by patients based on the short and medium term data. In addition, with the expanding field of bariatric surgery and misconception of laparoscopic sleeve gastrectomy as an easier operation, the complication rate and the need of revisional surgery for complicated or failed primary LSG would be expected to increase especially in the hands of inexperienced surgeons.

Therefore, the aim of this study is to report our 7 years experiences of LSG in Asia as a primary bariatric procedure regarding the short- and long-term clinical outcomes especially in the maintenance of effective weight loss. It is also necessary to know the cause of failure of LSG as well as the indications and outcomes following revisional surgery for LSG. Key variations of surgical techniques over the years is also described in our practice.

2. Materials and methods

We performed a retrospective review of patients who underwent LSG from 2006 to 2012 who have completed at least 6 months follow-up. Informed consent was taken from all patients and data were collected prospectively into a database which was later analyzed retrospectively. The baseline characteristic, surgical outcome, weight loss and comorbidity resolution, and revisional surgery were included for this analysis. Patients who had surgery $>$ 5 years ago but defaulted follow-up, were contacted by telephone to enquire upon their weight status and reflux symptoms. A total of 667 LSG was performed as the primary bariatric procedure. The patients' mean age was 34.5 $\pm$ 9.7 years (range 14—71 years) with a female dominant cohort of 74.7%. The preoperative mean BMI was 37.3 $\pm$ 8.1 kg/m^2 (range 20.8—75.3 kg/m^2) with mean excess weight 41.7 $\pm$ 23.3 kg.

Effectiveness end points include BMI, percentage of excess weight loss (% EWL) from baseline to 6 months and yearly with trend up to 7 years. Safety end points were defined by the 30 days perioperative major and minor complications after surgery.

The indication for revision of LSG was examined. Failure of primary procedure is defined as inadequate weight loss ($<$ 50% EWL) or weight regain ($>$ 10 kg body weight), or failure of resolution of diabetes mellitus. Complicated LSG is defined as long-term side effects secondary to sleeve gastrectomy such as GERD. Surgery for treatment of perioperative complications occurring within 30 days after primary surgery were not included in the analysis for revisional surgery.

2.1. Surgical technique

Our surgical technique of sleeve gastrectomy has evolved over the years with reinforcement suture and invagination of the stapler line which was introduced in 2006[9] and reduced ports access surgery started in 2009 as previously reported.[10] Subsequently, we used the transumbilical two site modified single incision laparoscopic surgery (SILS) technique for all LSG.

Important surgical techniques are briefly described. All procedures were completed laparoscopically. Three skin incisions were placed at two sites of the abdomen, including two skin incisions along the natural fold of umbilicus for 10-mm port for videoscope and a 12-mm port for the left working port, and one skin incision at left lateral abdominal wall for a 5-mm port as right working port. A 2-mm Kircher wire was used as liver retractor and inserted through a subxiphoid skin puncture for exposition of the angle of His. The greater omentum and short gastric arteries were dissected by using 5-mm blunt tip laparoscopic Ligasure (Covidien, Norwalk, CT, USA) system, starting at 4 cm from pylorus (2nd branch of right gastro-epiploic artery) to the angle of His sparing the sling fibers near cardio-esophageal junction and gastro-epiploic vessels. A large fat pad at an angle of His was dissected to provide a clean field for gastric fundus resection. Meticulous dissection was performed at the angle of His with full mobilization of the gastric fundus. The posterior wall of the stomach was freed from the pancreatic adhesion if present. Once the stomach was completely mobilized, an oro-gastric tube size 36 F was placed along the lesser curvature of stomach directed toward the pylorus as a calibrator before starting the gastric resection. Vertical transection of the stomach was accomplished with five to six firings of a 60-mm linear stapler (Endo GIA, Covidien, Norwalk, CT, USA). The firing stapler height was determined by thickness of the gastric tissue, using a green (4.1 mm) or black (4.4 mm) stapler near the antrum and a blue (3.5 mm) stapler for the rest of the gastric resection. The important technical details during the gastric transection includes symmetrical lateral traction of the stomach to ensure an equal proportion of the