Laparoscopic Sleeve Gastrectomy with Duodenojejunal Bypass: Technique and Preliminary Results

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Abstract

Background Obesity and metabolic disorders related to it have become a serious problem in Asia. Furthermore, gastric cancer in Asia is one of the frequent diseases on which to perform treatments. We introduced the technique of laparoscopic sleeve gastrectomy with duodenojejunal bypass (LSG/DJB) for patients with a risk of gastric cancer and compared the results of our initial series with those of other procedures.

Methods Twenty-one patients underwent a LSG/DJB from April 2007 to November 2008. The mean preoperative weight and body mass index (BMI) were 108.0 kg and 41.0 kg/m², respectively. High risks of gastric cancer were determined as having a Helicobacter pylori positive with atrophic change of mucosa or a family history of gastric cancer. Operations were performed with five ports. Initially, SG and dissection of posterior wall of duodenum were carried out. Subsequently, DJB was added with 50–100 cm of biliopancreatic tract and 150–200 cm of alimentary tract. DJB consisted of a jejunojunostomy created by a linear stapler and hand sewing closure and duodenojunostomy by hand sewing with two layers.

Results A LSG/DJB was performed successfully in all patients. The mean operation time was 217±38 min. The weight loss and percent excess BMI loss for LSG/DJB were similar to those for laparoscopic Roux-en-Y gastric bypasses. There was no mortality; however, one patient had leakage from a staple line of esophagogastric junction and required drainage and stenting. No dumping, stenosis, marginal ulcer, or nutritional problems were observed during postoperative follow-up. All of the main comorbidities improved after this procedure.

Conclusion LSG/DJB is a feasible, safe, and effective procedure for the treatment of morbidly obese patients with the risk of gastric cancer.

Keywords Laparoscopic sleeve gastrectomy · Duodenal jejunal bypass · Gastric cancer · Morbid obesity

Introduction

Obesity and metabolic disorders related to it have become a serious problem in Asia. Bariatric surgery is still not common in Asia, but the results of bariatric surgery for Asian people are as good as they have been for Westerners. In the series of bariatric surgeries I have performed in Japan, the results of laparoscopic Roux-en-Y gastric bypass (LRYGBP) has been superior to restrictive procedures such as adjustable gastric banding (AGB) or laparoscopic sleeve gastrectomy (LSG) regarding weight loss and cure of comorbidities [1]. However, there is an important problem for the investigation of the excluded stomach after RYGBP in countries with a high occurrence rate of gastric cancer as is the case for Japan. There are a few procedures and techniques to examine the excluded stomach after RYGBP. Double balloon enteroscopy is one of the most reliable procedures [2], but the instrument itself is still not common. We have already performed LRYGBP with simultaneous remnant gastrectomy in three patients. However, an
enlargement of the wound was required to retrieve the remnant stomach. Therefore, there is an increased risk of wound-related complications such as a hernia or infection.

Laparoscopic sleeve gastrectomy allows a physiologic passage of food without leaving any excluded stomach. LSG is an effective procedure for weight loss and reduction of appetite [3, 4] due to the postoperative reduced level of ghrelin [5], even in Asian people. However, LSG is an only restrictive procedure and could not obtain an adequate weight loss during a long-term follow-up. An exclusion of the proximal small intestine from contact of food with ingested nutrients and faster passage to the distal small intestine such as a duodenojejunal bypass (DJB) could be implicated in the mechanism of improving glucose tolerance [6, 7]. Therefore, we introduced LSG/DJB (Fig. 1) to obtain the following factors: (1) a feasible and safe procedure; (2) no excluded area of the stomach; (3) easy access to the remnant stomach by standard endoscopic instruments for the incidence of gastric cancer; (4) the restrictive and malabsorptive effects.

**Patients and Methods**

**Indication of Bariatric Surgery**

The Asian Pacific Bariatric Surgery Society [8] proposed a statement of the indication of bariatric surgery for Asian people as follows: (1) obese patients with a body mass index (BMI)>37 kg/m²; (2) obese patients with a BMI>32 kg/m² in the presence of diabetes mellitus or another two significant comorbidities related to obesity; (3) obese patients who have been unable to lose or maintain weight loss through dietary or other forms of medical management; (4) patients whose ages range from 18 to 65 years old. We applied those criteria to consider the indication of bariatric surgery.

**Risk Factors of Gastric Cancer**

Risk factors of gastric cancer are followed as [9, 10]: (1) Helicobacter pylori (H.P) positive, (2) atrophic change of gastric mucosa including intestinal metaplasia with or without H.P infection, (3) family history of gastric cancer. We applied those criteria to select sleeve gastrectomy (SG).

We adopted LSG/DJB for the patients who fulfilled the above indications and who were at risk of cancer in their excluded stomach. Patients were given complete information regarding the risks and benefits of this surgical procedure, and informed consent was carried out.

Twenty-one patients were enrolled in this study from April 2007 to November 2008. They were four men and 17 women with a mean age of 40 years (range, 29–58), a mean body weight of 108 kg (range, 88–138), and a mean of BMI of 41 kg/m² (range, 32–58).

**Surgical Procedure**

Under general anesthesia, the patient was placed in the supine position with the legs being separated. Five ports were used as in Fig. 2. The supra-umbilical port is for the laparoscope, and 5-mm port in the sub-xiphoid space is for the retraction of the liver. Two 12-mm ports are placed in the left subcostal margin and 10 cm caudal side from left costal margin. A 15-mm bladed port is placed in the right upper abdomen to retrieve a specimen from the abdominal cavity. Sleeve gastrectomy with 45Fr boogie was performed with linear staplers from a 5-cm oral from the pyloric ring. Over-sewing of the staple line on the remnant stomach was added to prevent leakage and bleeding. Dissection of the posterior wall of the duodenum was carefully performed, and the first portion of the duodenum was completely devascularized. The duodenum was divided with a blue cartridge of linear stapler with an absorbable buttress material. The bilopancreatic limb was measured 50–100 cm from the ligament of Treitz, and the jejunum is divided with a white cartridge of linear stapler. The alimentary tract was also measured 150–200 cm. The jejunoojejunosotomy was performed with a linear stapler, and an entry hole was closed by hand-sewing. The mesenteric defect was also closed by hand-sewing. The omentum was divided to avoid the tension of anastomosis during an

Fig. 1 Laparoscopic sleeve gastrectomy with duodeno-jejunal bypass
antecolic reconstruction. A duodenojejunal end-to-side anastomosis was created by two layers of running suture with an absorbable one. An endoscopic observation to check for leakage from the staple line and the insertion of drain were done in all patients.

Postoperative Care

Oral intake started from the first postoperative day after confirming the passage of the remnant stomach by swallowing contrast medium. The postoperative diet regime is same as after those of LSG or LRYGBP. Patients are discharged on the third postoperative day. All patients returned at the first, third, sixth, ninth, and twelfth postoperative month in the outpatient clinic and followed with a visit every half year after 1 year.

Results

A LSG/DJB was performed successfully in all patients. The mean operation time was 217±38 min (range, 149–300). The weight loss and percent excess BMI loss (%EBMIL; mean ± standard deviation (SD)) at the third, sixth, ninth, twelfth, and eighteenth month follow-up points were 18±4.5, 25±7.5, 27±6.2, 31±8.2, 37±5.0 kg and 47±29, 63±23, 66±23, 78±24, 96±10%, respectively. In comparison with our series of other procedures [1], the weight loss was not enough during a short-term observation; however, the %EBMIL of LSG/DJB was similar to that for LRYGBP and superior to LSG and laparoscopic AGB (LAGB) (Table 1).

Postoperative complications revealed a leakage from the angle of His requiring re-operation in one patient. There was no surgical mortality. We had no observation of bleeding, leakage or stenosis of anastomosis, marginal ulcer, dumping syndrome, or wound-related complications, such as infection or herniation. On the other hand, the rate of stenosis in LRYGBP within our series was 8%. Two patients required a medication for the symptoms of heartburn. Therefore, LSG/DJB provided a better outcome than LRYGBP regarding stenosis. No nutritional problems have been observed at present.

In preoperative comorbidities, eight patients had diabetes mellitus (DM), and six patients had impaired glucose tolerance (IGT). The resolution and improvement of DM and IGT were 13 patients (92.9%) and one (7.1%), respectively. The patient showing improvement only and not resolution was the eldest one. Although three patients required self-injection of insulin over 50 to 130 U/day preoperatively, all of them were free from this within 3 days to 3 weeks postoperatively. Eleven out of 15 patients who were followed over three postoperative months had hyperlipidemia (HL) preoperatively. The resolution rate of HL showed 100% after over postoperative 3 months. Seven out of 15 patients who were followed over three postoperative months had hypertension (HT) preoperatively. The resolution and improvement of HT was in six patients (85.7%) and one patient (14.3%), respectively. The patient showing improvement only was also the eldest one. All of the main comorbidities improved after this procedure.

Discussion

There are two methods of procedures in the field of bariatric surgery, restrictive and malabsorptive ones. Combination procedure including RYGBP or biliopancreatic diversion with duodenal switch (BPD/DS) is thought to be more effective, but the complication rate and surgical skill requirements are higher than a restrictive procedure only.

Table 1  The results of weight loss and %EBMIL

<table>
<thead>
<tr>
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<th>LSG/DJB</th>
<th>LRYGBP</th>
<th>LAGB</th>
<th>LSG</th>
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<tr>
<td>Weight loss (kg)</td>
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<tr>
<td>3 months</td>
<td>18±4.5</td>
<td>21±7.8</td>
<td>11±5.4</td>
<td>21±6.5</td>
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<tr>
<td>6 months</td>
<td>25±7.5</td>
<td>32±8.6</td>
<td>15±4.6</td>
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<tr>
<td>9 months</td>
<td>27±6.2</td>
<td>37±10.3</td>
<td>20±7.9</td>
<td>36±11.1</td>
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<tr>
<td>12 months</td>
<td>31±8.2</td>
<td>44±11.9</td>
<td>22±9.1</td>
<td>22±15.6</td>
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<tr>
<td>18 months</td>
<td>37±5.0</td>
<td>44±10.7</td>
<td>28±10.6</td>
<td>42±4.6</td>
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<tr>
<td>%EBMIL(%)</td>
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<tr>
<td>18 months</td>
<td>96±10</td>
<td>89±28</td>
<td>70±26</td>
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such as SG or AGB. Smith et al. [11] reviewed the case-controlled studies of the comparison of gastric banding, gastric bypass, and sleeve gastrectomy. Gastric bypass (GBP) was superior to AGB regarding weight loss, reoperation rate, and reduction of comorbidities [12-15]. SG was also superior to AGB regarding excess weight loss in a randomized study [16]. However, GBP creates an excluded stomach as a result of the procedure itself. Therefore, we considered the combination of SG and DJB as one of malabsorptive procedures to achieve an effective weight loss and easy access to the remnant stomach.

In our study for Japanese patients, there was no significant difference in change of BMI between LSG/DJB and LRYGBP. %EBMIL of LSG/DJB showed better reductions at 6, 12, and 18 months follow-up compared with those of LSG and LAGB (p<0.05). LSG/DJB is a combined procedure with adding malabsorptive component to SG. Therefore, the weight loss of LSG/DJB is more effective than that of LSG and LAGB. LSG/DJB has a possibility of weight regain in long-term follow-up due to a big gastric pouch compared with LRYGBP; however, LSG/DJB itself preserves a pyloric valve which is the narrowest part of gastrointestinal tract; the preservation of pyloric valve would be expected to prevent weight regain. Further study should be necessary to observe the change of body weight or BMI.

This procedure is complicated due to the additional maneuver of entero–entero anastomosis. Technical aspects of this procedure are almost same as that for laparoscopic biliopancreatic diversion with duodenal switch (LBPD/DS) [17, 18]. The less favorable technical issue concerns the method of duodenal anastomosis. To preserve the function of pylorus, we prefer to perform it by hand-sewing of the two layers. Indeed, this anastomosis is more complicated than a gastrojejunostomy. This maneuver requires to be medial to the bile duct and the papilla to avoid technical injuries; to dissect the duodenum from the pancreatic parenchyma and the gastroduodenal artery without injury or damage; and to maintain blood supply to the duodenum [19]. Genio et al. [20] reported a feasibility of this procedure in a pig model. Animal models of this procedure could reveal the absence of histological abnormalities in the duodenal wall after surgery. Although recent report of LBPD/DS had low mortality and morbidity rates [21], we experienced no leakage or stenosis of the duodenojejunal anastomosis in this study. Therefore, we think that LSG/DJB is a feasible and safe procedure if it is performed with careful surgical technique by an experienced surgeon.

In general, LRYGBP has been widely performed for patients with morbid obesity all over the world, and it has been revealed to have one of the most reliable results among the many bariatric procedures [22]. However, in areas with a high risk of gastric cancer, such as northern Asia including Japan, the surgical procedure of LRYGBP seems to increase the occurrence risk of remnant gastric cancer due to the difficulty of postoperative assessment of the excluded stomach after reconstruction. The remnant stomach of GBP is susceptible to the development of several pathological entities including duodeno-gastric reflux, perforation, ulceration, hemorrhage, and malignancy. We reported on the usefulness of a double balloon enteroscopy for the examination of remnant stomach [2]. However, it is not easy to perform for the patients without symptoms as a screening examination. In Japan, most gastric cancers are detected in a condition of early stage through a screening endoscopy. Therefore, we introduced LSG/DJB to avoid the surgical procedure with the creation of an excluded stomach. The remnant stomach after this procedure can be easily explorable by standard endoscopic instruments.

In perioperative results, the operation time (217±38 min) was much longer than that of LRYGBP (153±75 min) and LSG (92±22 min). We think that this means it is a premature result on the learning curve for this procedure. Regarding postoperative complications, this procedure showed similar results of LBPD/DS regarding marginal ulcer or anastomotic stenosis (AS). In our series of LRYGBP, the rate of AS was approximately 8%; however, we have no experience of AS in this procedure.

All preoperative comorbidities including diabetes mellitus, hypertension, and hyperlipidemia were improved after this procedure. These findings showed similar or superior outcomes compared with those of LRYGBP. We think that LSG/DJB is an effective treatment for the resolution of comorbidities.

The other advantage of LSG/DJB over LRYGBP is to preserve the integrity of the branch of the Latarjet nerve, so that the stomach can keep its motor function [23, 24], and preserve the pylorus to avoid the dumping phenomenon. Furthermore, the resection of the fundus with the related decrease of plasmatic level of ghrelin seems to be effective for the reduction of appetite [5].

The advantage of LSG/DJB over LSG is to add the exclusion of the duodenum and proximal small intestine from contact with food. That procedure would be beneficial for a resolution of type 2 diabetes mellitus [6, 25, 26]. In fact, our resolution rate of DM by LSG/DJB was 93%, and it was much higher than that of LSG in our experience (67%) [1] and Rosenthal et al. (63%) [27]. We suppose that the advantage of LSG/DJB over LBPD/DS is a less malnutritional complication. Amount of protein intake in Japanese are much less than that of western population due to the different dietary habits. The experience of LBPD/DS in Asia is limited, and a long-term disadvantage regarding nutritional deficiency after BPD/DS is unknown for the Asian population. Patient after BPD/DS needs to take enough amount of protein to avoid malnutrition [28, 29]. It seems difficult for Japanese to take enough amount of daily

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protein after BPD/DS. However, we have no experience of malnutritional complication after LRYGBP in long-term follow-up. Therefore, we created length of limbs same as LRYGBP in the reconstruction of LSG/DJB. We believe that LSG/DJB can avoid risk of malnutrition, but the long-term observation of the nutritional change was needed for the patients who were performed LSG/DJB.

From these findings, LSG/DJB will become one of the reliable procedures for bariatric surgery.

In conclusion, LSG/DJB consisting of previous standardized procedures and malabsorptive effects is a safe and feasible procedure, particularly for patients with a risk of gastric cancer, and provides similar outcomes compared with LRYGBP in short-term follow-up. However, a long-term follow-up is necessary to evaluate the efficiency of LSG/DJB.

References