Initial Experience with Laparoscopic Loop Duodenojejunal Bypass with Sleeve Gastrectomy in Korean Obese Patients

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Laparoscopic loop duodenojejunal bypass with sleeve gastrectomy (LDJB-SG) has theoretical advantages compared with laparoscopic Roux-en-Y gastric bypass. We performed 7 cases of LDJB-SG from May 2019 to September 2019. All procedures were successfully completed by laparoscopy. The mean operative time was 282.9 (210~335) minutes and the mean estimated blood loss was 82.9 (20~150) ml. There was no intraoperative complications, however, there was 1 case of postoperative anastomotic leakage. The average length of postoperative hospital stay was 5.3 (3~12) days. The mean body weight at baseline was 117.1 (88.4~151.1) kg, and was decreased to 90.4 (69.4~130.9) kg at postoperative 3 month. The mean of HbA1c at baseline was 7.6 (5.5~9.4) %, and was decreased to 5.3 (4.8~5.6) % at postoperative 3 month. Although LDJB-SG is a technically demanding procedure, it can be a feasible and safe procedure if the learning curve can be overcome.

Keywords: Loop duodenojejunal bypass, Sleeve gastrectomy, Metabolic surgery, Obesity, Weight loss

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side of the patient; the scopist stood between the legs of the patient while an assistant stood on the left side of the patient. Liver retraction was achieved using the sling method with a straight needle or Nathanson retractor. Devascularization of the greater curvature of the stomach (4 cm from the pylorus to the left crus of the diaphragm) was performed with a Ligasure™ (Medtronic). Using a 38 Fr bougie placed within the stomach, a sleeve gastrectomy was performed with sequential shoots of the Signia™ stapling system (Medtronic). The initial firing was performed with a black cartridge, followed by purple cartridges. A reinforcement suture of the staple line on the sleeved stomach was added in some cases. A stay suture was placed at the distal part of the staple line on the stomach for counter-traction and a better surgical view of the 1st portion of the duodenum. Window formation at the supra- and infra-duodenal areas and tunneling behind the duodenum using a retractor for gastric banding (Karl storz) was performed. The duodenum was retracted anteriorly using umbilical tape to insert the stapler easily, and then the duodenum was transected using the curved tip of the tan cartridge. The omentum was divided in some cases to avoid tension of the anastomosis during an antecolic reconstruction. Two hundred centimeters of the jejunal loop from the ligament of Treitz was measured and fixed to the pylorus using a stay suture. Enterotomy from 1.5 cm to 2 cm at the 1st portion of the duodenum and jejunum was done, and hand-sewn anastomosis with V-LOC™ 90 absorbable 3–0 (Medronic) was performed in an isoperistaltic manner. An air leak test was performed with air insufflation through the inserted bougie to check the anastomosis. An interrupted suture with non-absorbable thread (2–0 Ethibond Excel®; Ethicon) was then done between the antrum and the jejunum a few centimeters proximal to the duodenoejunostomy. The interrupted suture between the His angle of the stomach and the left crus was performed to prevent gastroesophageal reflux. A few interrupted sutures between the sleeved stomach and the retroperitoneum were performed to fix the stomach and prevent twisting of the stomach. A continuous suture with V-LOC™ non-absorbable 3–0 (Medronic) was then used to close the Peterson defect. Finally, a Jackson–Pratt drain was inserted behind the duodenoejejunal anastomosis along the staple line of the stomach.

This study was approved by the Institutional Review Board of Soonchunhyang University Hospital Seoul.

RESULTS

In the author’s institution, patients who have uncontrolled type 2 diabetes mellitus (T2DM) with glycated hemoglobin (HbA1c) \( \geq 8.0\% \) or T2DM using insulin, or super-obese patients with a body mass index (BMI) \( \geq 50 \text{ kg/m}^2 \) were eligible for bypass surgery, such as LDJB–SG or LRYGB. The surgical procedure is determined according to the endoscopic findings, severity of gastroesophageal reflux symptoms, familial history of gastric cancer, cigarette smoking, the persistence of non-steroidal anti-inflammatory drugs, and the patient’s preference for one of the two procedures.

Seven cases of LDJB–SG were performed from May 2019 to September 2019. All procedures were completed successfully by laparoscopy. Table 1 lists the patient baseline characteristics. The average age was 43 years (range 28–55 years); five patients (71.4%) were female, and the mean body mass index (BMI) was 41.4 (32.7–59.9) kg/m\(^2\). Six patients (85.7%) had T2DM, and three patients (42.9%) were using insulin. The mean HbA1c and mean fasting plasma glucose (FPG) levels were 7.9 (5.5–10.8) % and 193.1 (92–305) mg/dl, respectively.

Table 2 lists the perioperative outcomes. The number of trocars used was 5.3 (5–6), and the number of sling methods for

| Variables                              | Baseline (N = 7) |
|----------------------------------------|-----------------|
| Age (years)                            | 43 (28 ~ 55)    |
| Female (%)                             | 5 (71.4%)       |
| BMI (kg/m\(^2\))                       | 41.4 (32.7 ~ 59.9) |
| Type 2 diabetes mellitus (%)           | 6 (85.7%)       |
| Use of insulin (%)                     | 3 (42.9%)       |
| Glycated hemoglobin (%)                | 7.9 (5.5 ~ 10.8) |
| Fasting plasma glucose (mg/dL)         | 193.1 (92 ~ 305) |

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Excel®: Ethicon}
Liver retraction was five (71.4%). The mean operative time was 282.9 (210 ~ 335) minutes and the mean estimated blood loss was 82.9 (20 ~ 150) ml. No intraoperative complications were encountered, but there was one case with postoperative complications. This was the first case of LDJB-SG and the patient was male, 180.4 cm in height, 147.7 kg in weight, and a BMI of 45.2 kg/m2. He had a high fever over 38°C on postoperative day (POD) 4. The abdominopelvic computed tomogram (APCT) revealed mild mesenteric fat infiltration with a small amount of fluid collection and air densities in the upper abdomen. Anastomosis leakage was suspected and the administration of intravenous broad-spectrum antibiotics was started. After seven days, APCT was re-checked with gastrograffin. No leakage of contrast material was observed and the level of mesenteric fat infiltration had improved. The patient was discharged on the next day. The average length of the postoperative hospital stay was 5.3 (3 ~ 12) days. One case of readmission was encountered. She had a history of cerebral infarction and was readmitted due to a severe headache on POD 14. She was discharged four days after conservative management.

Fig. 2 presents the individual body weights. The mean body weight at the time of surgery was 117.1 (88.4 ~ 151.1) kg, which decreased to 99.5 (78 ~ 140.6) kg and 90.4 (69.4 ~ 130.9) kg at postoperative one and three months, respectively. Fig. 3 shows the individual’s HbA1c levels. The mean of HbA1c at the baseline was 7.6 (5.5 ~ 9.4) %, which decreased to 5.3 (4.8 ~ 5.6) % at postoperative three months.

**DISCUSSION**

LDJB-SG is a novel bariatric procedure that was introduced less than 10 years ago. Although it is not popular, the number of cases, particularly in Korea, is very small. To the best of the authors’ knowledge, there are no reports of the long-term outcomes of LDJB-SG, nor have there been randomized controlled trials comparing LDJB-SG with other bariatric procedures, such as LRYGB or laparoscopic sleeve gastrectomy (LSG). A few studies showed that LDJB-SG is a relatively safe and effective metabolic surgery with significant weight loss and resolution of the co-morbidities during a short- and mid-term follow up period. Other studies compared retrospectively LDJB-SG with other procedures, such as mini-gastric bypass (MGB), LRYGB or LSG. Lee et al. reported that LDJB-SG has a significantly longer operative time and higher weight loss at one year after surgery than MGB or LRYGB. In addition, Huang et al. suggested that LDJB-SG was comparable to LRYGB in terms of weight loss, glycemic control, and co-morbidity resolution in T2DM patients with a BMI <35 kg/m² in the short-term. According to one study comparing the one-year results between LDJB-SG and LSG, LDJB-SG was superior to LSG in T2DM remission, triglyceride improvement,
and excess weight loss.

Despite the low number of cases, there were some difficulties encountered during surgery. The first is that loop duodenojejunal bypass is difficult if pancreatic tissue covers the duodenum or if there is a duodenal deformity caused by a previous duodenal ulcer. In such cases, it is advisable to sacrifice the pyloric vessels and convert it to Roux-en-Y fashioned duodenojejunal bypass. Loop duodenojejunal bypass has the theoretical advantages of lower complication rates, such as anastomotic leakage, stenosis, or internal hernia, and shorter operative time in that it has fewer Anastomosis and no jejuno-jejunal mesenteric defect compared to a Roux-en-Y duodenojejunal bypass.1,9 To date, however, there have been no comparative studies of these two techniques. In addition, when loop anastomosis is made by cutting the pyloric vessels, the incidence of complications, such as dumping symptoms, bile reflux, and marginal ulcer, may increase due to loss or weakening of the pyloric function. The second thing is to use a stapler with a curved tip for the transection of the duodenum. The movement of the duodenum is quite limited when preserving the blood vessels around the pylorus and duodenum. Therefore, it is difficult to insert the stapler below the duodenum through the small window. The curved tip makes it easier to pass through the posterior wall of the duodenum than with a straight tip because the curved tip is curved upward with a smaller sized tip.

In how many cases does LDJB-SG need to be performed to overcome the learning curve? This depends on the definition of the learning curve. According to Wehrtmann et al.,11 60 to 100 LSG and 70 to 150 LRYGB were required to reach the ‘proficiency’ phase of the learning curve, this means a further decrease in the number of postoperative complications and stabilization of the operative time. In the author’s experience, the most difficult parts of LDJB-SG were transecting the duodenum while preserving the pyloric vessels and suturing the duodeno-jejunal anastomosis using a hand-sewn method. The technical level of the duodenal transection was similar to making a gastric pouch of LRYGB, but duodeno-jejunal hand-sewn anastomosis was slightly more difficult than gastro-jejunal or jejuno-jejunal anastomosis. Thus, the authors believe that slightly more than 70 to 150 LDJB-SG cases are necessary to reach the ‘proficiency’ phase of the learning curve, which known as the learning curve of LRYGB.

In conclusion, although LDJB-SG is a technically demanding procedure, it can be feasible and safe if the learning curve can be overcome. A skilled laparoscopic suture technique is essential for safety.

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**AUTHORS’ CONTRIBUTIONS**

Conceptualization: Sang Hyun Kim, Yong Jin Kim. Formal analysis: Sang Hyun Kim. Methodology: Sang Hyun Kim, Yong Jin Kim. Writing—original draft: Sang Hyun Kim. Writing—review and editing: Sang Hyun Kim, Kyung Yul Hur, Yoona Chung.

**CONFLICT OF INTEREST**

None.

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**REFERENCES**

1) Huang C-K, Goel R, Tai C-M, Yen Y-C, Gohil VD, Chen X-Y. Novel metabolic surgery for type II diabetes mellitus: loop duodenojejunal bypass with sleeve gastrectomy. Surg Laparosc Endosc Percutan Tech 2013;23:481-485.
2) Pilichiewicz AN, Chaikomin R, Brennan IM, et al. Load-dependent effects of duodenal glucose on glycemia, gastrointestinal hormones, antropyloroduodenal motility, and energy intake in healthy men. Am J Physiol Endocrinol Metab 2007;293:E743-E753.
3) Bugger JI, Knop FK, Lund A, Vestergaard H, Holst JJ, Vilsbøll T. Impaired regulation of the incretin effect in patients with type 2 diabetes. J Clin Endocrinol Metab 2011;96:737-745.
4) Kasama K, Tagaya N, Kanehira E, et al. Laparoscopic sleeve gastrectomy with duodenojejunal bypass: technique and preliminary results. Obes Surg 2009;19:1341-1345.
5) Kwon IG, Kim JW, Kang GH, et al. 2014–2017 Nationwide Bariatric and Metabolic Surgery Report in Korea. J Metab Bariatr Surg 2018;7:49–53.
6) Ruan X, Zhang W, Cai H, Zheng R, Jiang F, Zhu H. Sleeve gastrectomy with duodenojejunal end-to-side anastomosis in the...
treatment of type 2 diabetes: the initial experiences in a Chinese population with a more than 4-year follow-up. Surg Obes Relat Dis 2017;13:1683–1691.

7) Lin S, Yang N, Guan W, Liang H. Can Chinese T2D patients with BMI 20–32.5 kg/m(2) benefit from loop duodenojejunal bypass with sleeve gastrectomy? Surg Obes Relat Dis 2019;15:1513–1519.

8) Nor Hanipah Z, Hsin M–C, Liu C–C, Huang C–K. Laparoscopic loop duodenaljejunal bypass with sleeve gastrectomy in type 2 diabetic patients. Surg Obes Relat Dis 2019;15:696–702.

9) Lee W–J, Lee K–T, Kasama K, et al. Laparoscopic single–anastomosis duodenal–jejunal bypass with sleeve gastrectomy (SADJB–SG): short-term result and comparison with gastric bypass. Obes Surg 2014;24:109–113.

10) Huang CK, Tai C–M, Chang P–C, Malapan K, Tsai C–C, Yolsuriyanwong K. Loop Duodenojejunal Bypass with Sleeve Gastrectomy: Comparative Study with Roux–en–Y Gastric Bypass in Type 2 Diabetic Patients with a BMI <35 kg/m(2), First Year Results. Obes Surg 2016;26:2291–2301.

11) Wehrtmann FS, de la Garza JR, Kowalewski KF, et al. Learning Curves of Laparoscopic Roux–en–Y Gastric Bypass and Sleeve Gastrectomy in Bariatric Surgery: a Systematic Review and Introduction of a Standardization. Obes Surg 2020;30:640–656.