Laparoscopic Collis Gastroplasty and Nissen Fundoplication for Reflux Esophagitis With Shortened Esophagus in Japanese Patients

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Background: There is an extremely small number of surgical cases of laparoscopic Collis gastroplasty and Nissen fundoplication (LCN procedure) in Japan, and it is a fact that the surgical results are not thoroughly examined.

Purpose: To investigate the results of LCN procedure for shortened esophagus.

Patients and Methods: The subjects consisted of 11 patients who underwent LCN procedure for shortened esophagus and followed for at least 2 years after surgery. The group of subjects consisted of 3 men and 8 women with an average age of 65.0 ± 11.6 years, and an average follow-up period of 40.7 ± 14.4 months. Esophagography, pH monitoring, and endoscopy were performed to assess preoperative conditions. Symptoms were clarified into 5 grades between 0 and 4 points, whereas patient satisfaction was assessed in 4 grades. The use of postoperative acid-reducing medication and the recurrence of esophagitis were also investigated.

Results: None of the patients experienced intraoperative complications, received transfusions, required conversion to open surgery, or died postoperatively. The average preoperative heartburn, regurgitation, and dysphagia scores were 2.36 ± 1.29, 2.27 ± 1.19, and 1.82 ± 1.78 points, respectively. These scores improved after surgery to 0.55 ± 1.21 ($P = 0.0063$), 0.55 ± 1.21 ($P = 0.0094$), and 1.0 ± 1.18 ($P = 0.1236$) points, respectively. All patients had esophagitis preoperatively, which recurred in 3 patients (27%). In these 3 patients, acid-secreting mucosa was confirmed on the oral side of the wrap, by positive Congo-red staining. Hiatal hernia recurred in one patient, who also experienced recurrent esophagitis. Five patients received acid-reducing medication postoperatively. The degree of satisfaction was excellent in 2, good in 6 patients, fair in 2, and poor in 1 patient(s).

Conclusions: Although the LCN procedure can be performed safely, the outcome was not necessarily satisfactory. The LCN procedure requires avoidance of residual acid-secreting mucosa on the oral side of the wrapped neoesophagus. If acid-secreting mucosa remains, continuous acid suppression therapy should be employed postoperatively.

Key Words: reflux esophagitis, laparoscopic Nissen fundoplication, laparoscopic Collis gastroplasty, shortened esophagus, Japanese

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Nissen fundoplication, Hill's posterior gastropexy, Belsey-Mark IV procedure, Toupet fundoplication, and Dor fundoplication have been performed to surgically treat gastroesophageal reflux disease (GERD). First introduced in the latter half of the 1980s, laparoscopic surgery has rapidly been adopted to treat GERD and now represents a standard technique. Laparoscopic Nissen fundoplication and laparoscopic Toupet fundoplication are widely performed.[1–4]

Shortened esophagus, stricture, and penetrating ulcers are complications of reflux esophagitis.[5] Among patients with a shortened esophagus, in many cases simple antireflux surgery cannot remedy reflux esophagitis; instead, it has to generally be combined with Collis procedure, an esophageal lengthening procedure. To prevent reflux, therefore, the Collis-Nissen procedure (ie, Collis gastroplasty and Nissen fundoplication) is often performed.[6–9]

As compared with European countries, surgery for reflux esophagitis in Japan is limited. The Collis-Nissen procedure has been performed for some time in Western countries, with favorable results.[7,8] Additionally, the Collis-Nissen procedure is currently performed laparoscopically, with numerous favorable short-term results reported from Western contries.[9–13] However, in Japan, there have been few reports on the laparoscopic Collis-Nissen procedure other than this present report. However, there is hardly a report on laparoscopic Collis gastroplasty and Nissen fundoplication, and the outcome

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of surgery for a shortened esophagus has not been examined, except for our cases in Japan. We investigated the results of the laparoscopic Collis-Nissen procedure performed at our institution.

PATIENTS AND METHODS

From December 1994 to October 2005, laparoscopic fundoplication was performed for 180 patients. Of these, 11 patients with shortened esophagus who underwent the laparoscopic Collis-Nissen procedure and were followed for at least 2 years served as subjects. Although there is no precise definition of shortened esophagus, we defined it as the presence of an esophagogastric junction at least 5 cm above the esophageal hiatus.[14–16] The group of subjects consisted of 3 men and 8 women with an average age of 65.0 ± 11.6 years. The average disease duration was 61.8 ± 56.8 months (Table 1). The average duration of postoperative follow-up was 40.7 ± 14.4 months.

Barium esophagography, ambulatory 24-hour esophageal pH monitoring, and upper gastrointestinal endoscopy were performed before surgery. Barium esophagography was performed to ascertain the type and size of the esophageal hiatal hernia. Esophageal pH was monitored using Digitrapper Mk III (Medtronic Functional Diagnostic A/S, Skovlunde, Denmark). The administration of acid-reducing medication was suspended for 1 week before monitoring. A pH catheter was placed approximately 5 cm above the esophagogastric junction under fluoroscopic guidance. GastroSoft (Medtronic Functional Diagnostic A/S, Skovlunde, Denmark) was used to analyze data, and the number of reflux episodes (times/d), number of episodes lasting more than 5 minutes (times/d), longest reflux episode (in minutes), and percentage of time with < 4 pH (%) were determined. Upper endoscopy was performed to assess the presence and severity of esophagitis according to the Los Angeles classification,[17] and the shape of the cardiac orifice was assessed based on valve factor.[18] According to this classification, however there is no hiatal hernia, the cardia opens by infusing around 500 mL of air into the stomach is V2; on the other hand, when there is a hiatal hernia and the cardia opens by infusing around 500 mL of air into the stomach is V3. V2 and V3 are equivalent to chalasia.

Each subject underwent a comprehensive interview. The severity of 3 symptoms (heartburn, regurgitation, and dysphagia) was clarified into 5 grades (4 points: at every meal; 3 points: almost daily; 2 points: a few times per week; 1 point: several times per month; 0 points: never). Patient satisfaction was also assessed as one of 4 grades (excellent: very satisfied; good: fairly satisfied; fair: neutral or slightly dissatisfied; poor: dissatisfied).

Postoperatively, we diagnose it by interviewing the patient about heartburn and dysphagia in detail at the time of the scheduled visit as an outpatient every 1 or 2 months, during 1 year after the operation. In addition, esophago-gastroduodenoscopy (EGD) and upper gastrointestinal tract series perform after the operation for the early stage for less than 3 months. Furthermore, we evaluate the patient for a relapse of esophagitis using EGD after surgery by all means for less than 1 year. However, EGD and upper gastrointestinal tract series perform each time when the patient appealed for a symptom.

Surgical Procedures

With the head slightly elevated, each patient was placed in a 15-degree recumbent position on the right side. The surgeon stood on the right side of the patient, while an assistant stood on the left side. The same surgeon performed all operations. In general, surgery adhered to the University of Pittsburgh Laparoscopic Collis Technique.[9] A total of 5 trocars were used: two 12-mm trocars and three 5-mm trocars. A 12-mm trocar was first inserted above the navel by the open method. After which a 5-mm trocar under the costal arch along the right midclavicular line and xiphoid process, a 12-mm trocar under the costal arch along the left mid clavicular line, and a 5-mm trocar

TABLE 1. Characteristics of Patients

Case	Sex	Age	Hunchback*	Alcohol*	Smoking*	Past History* of Laparotomy	Duration of Disease	Symptom†			Stricture	Previous History of PD§	Esophagitis‡	Type of Hernia	Valve Factor	pH < 4 HT(%)
								H	R	D						
1	M	68	0	1	1	0	3 y	3	3	0	0	0	D	I	3	28.3
2	F	60	0	0	0	1	5 y	3	3	4	1	1	D	I	3	33
3	F	74	1	0	0	0	2 y 6 m	2	2	4	1	1	D	I	3	—
4	F	69	1	0	0	1	8 y	3	3	1	0	0	C	III	3	5.7
5	F	71	0	0	0	1	10 y	3	3	0	0	0	A	III	3	14.9
6	M	55	0	1	1	0	1 m	0	0	3	1	1	A	I	3	4.1
7	F	71	0	0	0	0	None	0	0	0	0	0	A	I	3	
8	F	73	0	0	0	0	4 y	3	3	0	0	0	B	I	3	19.4
9	M	35	0	1	0	1	1 m	2	2	3	1	1	A	I	3	
10	F	74	1	0	0	0	10 y	4	3	4	1	1	D	III	3	8.8
11	F	65	0	0	0	1	14 y	3	3	1	0	0	B	I	3	14.9

*0, no; 1, yes.
†Symptom score (0-4), H, heartburn; R, regurgitation; D, dysphagia.
‡Los Angeles classification.
§PD, pneumatic dilation.

TABLE 2. Score of Symptoms Before and After Operation

	Symptom		
	Heartburn	Regurgitation	Dysphagia
Before operation	2.36 ± 1.29*	2.27 ± 1.19**	1.82 ± 1.78
After operation	0.55 ± 1.21	0.55 ± 1.21	1.00 ± 1.18

*$P = 0.0063$.
**$P = 0.0094$.

in the flank along the left anterior axillary line under the guidance of laparoscopy. By preserving the anterior and posterior trunks of the vagus nerve, the esophagus was exposed and the short gastric vessels were dissected. At this stage, the trocar along the midclavicular line under the left costal arch was exchanged with a 33-mm trocar. For esophageal calibration, a 56 Fr esophageal bougie was inserted orally into the stomach. Next, through the 33-mm trocar, a 21-mm EEA was inserted. At approximately 5 cm below the esophagogastric junction, a full-layer small hole was created in the gastric anterior and posterior walls. Through this hole, a 45-mm Endo-GIA II stapler was inserted, and the stomach was divided along the long axis of the esophagus to prepare a tension-free intra-abdominal neoesophagus. The neoesophagus was then wrapped with the mobilized gastric fundus by a 2-cm floppy Nissen fundoplication with the 56 Fr esophageal bougie in place.

With respect to intraoperative and perioperative factors, we analyzed intraoperative complications, operation time, transfusion, start of oral intake, postoperative hospital stay, postoperative complications, and morbidity. The patients were followed postoperatively, and any changes in symptoms, need for acid-reducing medication, and recurrence of esophagitis assessed.

Statistical Analysis

The Wilcoxon signed-rank test was used to compare symptom scores before and after surgery. The level of significance was set at $P < 0.05$.

RESULTS

Symptoms

Case 7 demonstrated no symptoms preoperatively. Case 6 exhibited severe dysphagia, but no symptoms associated with acid reflux. Table 2 shows the changes in symptom scores before and after surgery. Heartburn and regurgitation scores were significantly improved after surgery.

Operation Time, Intraoperative Complications, and Postoperative Hospital Stay

The average operative time was 212 ± 42 minutes (Table 3). No intraoperative complications were noted. None of the patients received blood transfusions, required conversion to open surgery, or died. The median time of nasogastric tube removal was 1 day (range: 0 to 1 d). The median time to start oral intake was 2 days (range: 1 to 4 d), and the median postoperative hospital stay was 9 days (range: 7 to 17 d).

Reflux Esophagitis

At the initial visit, erosive esophagitis of grade A or higher was confirmed in all patients. The valve factor was V3 in all cases, and calasia was noted. During postoperative follow-up, reflux esophagitis recurred in 3 patients (27%) (Fig. 1), for whom acid-secreting mucosa was identified on the oral side of the wrap (part of the neoesophagus). In this area, the mucosa was stained black by Congo-red staining.

Esophageal Hiatal Hernia

Esophageal hiatal hernia was confirmed in all patients: type 1 in 8 patients and type 3 in 3 patients (Table 1). Case 10 exhibited mild recurrent esophageal hiatal hernia postoperatively, with recurrence of grade D esophagitis.

pH Monitoring

Excluding 3 patients who did not consent to discontinuation of acid-reducing medication, pH mon-

TABLE 3. Intraoperative and Postoperative Condition of Patients

Case	Operation Day	Operative Time (min)	Intraoperative Complication*	Hospital Stay	Recurrence of Esophagitis*	Recurrence of Hernia*	Symptom†			PPI or H2RA*‡	PD After Operation*§
							H	R	D		
1	Oct 1999	234	0	16	0	0	0	0	0	0	0
2	Jul 2000	280	0	17	1	0	3	3	2	1	0
3	Jan 2002	175	0	9	1	0	0	0	1	1	0
4	May 2002	240	0	9	0	0	0	0	3	1	1
5	Aug 2002	280	0	15	0	0	0	0	0	0	0
6	Nov 2002	200	0	8	0	0	0	0	1	0	0
7	Dec 2002	170	0	10	0	0	0	0	1	0	0
8	Feb 2003	220	0	7	0	0	0	0	0	1	0
9	Mar 2003	190	0	9	0	0	0	0	0	0	0
10	Mar 2003	164	0	9	1	1	3	3	3	1	1
11	Aug 2003	185	0	12	0	0	0	0	0	0	0

*0, no; 1, yes.
†Symptom score (0-4): H, heartburn; R, regurgitation; D, dysphagia.
‡Administration of proton pump inhibitor (PPI) or histamine H2 receptor antagonists (H2RA) after operation.
§PD, pneumatic dilation.

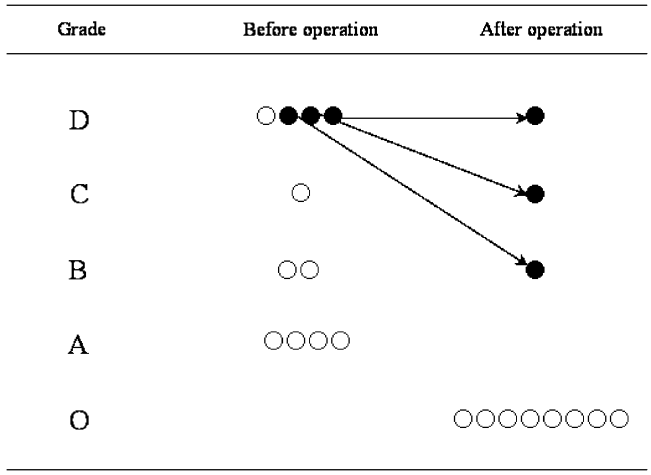

FIGURE 1. Severity of reflux esophagitis before and after surgery. ○, no recurrence after surgery. ●, recurrence after surgery. Grade: Los Angeles classification.

itoring was performed preoperatively in the other 8 patients. The number of reflux episodes was 219 ± 159 times/d. The number of episodes lasting more than 5 minutes was 9.6 ± 6.3 times/d. The longest reflux episode was 34.0 ± 14.1 minutes. The proportion of time at < 4 pH was 16.1 ± 10.4%.

Acid-reducing Medication and Clinical Course

The use of acid-reducing medication was resumed or continued postoperatively in 5 patients (Table 3). The 3 patients with recurrent esophagitis took 20 mg/d of omeprazole or 30 mg/d of lansoprazole. In 2 of the 3 patients (cases 2 and 3), oral proton pump inhibitor administration resolved the esophagitis, and symptoms such as heartburn. In the other patient (case 10), despite oral proton pump inhibitor administration, only slight improvements were observed, from grade B to C. Case 4 also took 20 mg/d of famotidine due to oral administration of a nonsteroidal anti-inflammatory drugs for lumbar pain. Case 8 took 10 mg/d of raftidine for indigestion.

Two patients underwent endoscopic dilatation due to postoperative dysphagia. One of the 2 patients (case 10) developed recurrent esophagitis. The other patient (case 4) did not suffer from recurrent esophagitis, and no stricture was observed preoperatively.

Satisfaction

The degree of satisfaction at least 1 year after surgery was excellent in 2 patients, good in 6 patients, fair in 2 patients, and poor in 1 patient. Eight of the 11 patients (73%) were either very or fairly satisfied. The degree of satisfaction for each of the 3 patients with recurrent esophagitis was good (case 3), fair (case 2), and poor (case 10).

DISCUSSION

Shortened esophagus is a serious complication of reflux esophagitis. Although there is no clear definition of shortened esophagus, most reports in Western countries have defined shortened esophagus as the location of the esophagogastric junction at least 5 cm above the esophageal hiatus. We defined shortened esophagus in the same manner.

With respect to surgical treatment of esophageal hiatal hernia and GERD, Skinner and Belsey[19] examined long-term results for 1030 patients. Although the overall recurrence rate was 5%, the recurrence rate for standard antireflux surgery for shortened esophagus was as high as 37%. This indicates that treatment of shortened esophagus should incorporate measures in addition to standard antireflux surgery. In general, esophageal lengthening is performed. The Collis procedure[20] is the most common gastroplasty procedure and can be combined with complete or incomplete fundoplication.

Richardson and Richadson[8] investigated long-term results for the Collis-Nissen procedure in 52 patients who were closely followed. With an average follow-up period of 7 years, reflux was well controlled, and dysphagia improved in all patients. Of 44 patients who had strictures preoperatively, 38 required dilatation postoperatively, which proved to be a short-term problem in all cases. The researchers found the Collis-Nissen procedure extremely effective. Other studies have also reported the effectiveness of the Collis-Nissen procedure.

Reports of laparoscopic fundoplication for GERD were first published in the 1990s.[21] In 1998, Johnson et al[11] documented the results of the laparoscopic Collis-Nissen procedure for shortened esophagus in 9 patients. The proportions of patients with symptom severity score of 3 or higher for heartburn, regurgitation, and dysphagia were 44%, 33%, and 11%, respectively, but 0% for all 3 symptoms postoperatively, indicating extremely favorable results. Luketich et al[9] followed 50 patients for at least 3 years who had undergone the laparoscopic Collis-Nissen procedure, and found that as high as 48 patients (96%) remained asymptomatic.

In Japan, the number of patients undergoing surgery for esophageal hiatal hernia or GERD is much lower than that in Western countries, and the number of reports on the results of antireflux surgery of all types is significantly lower. To our knowledge, we are the first to report the laparoscopic Collis-Nissen procedure from Japan. So far, we have performed laparoscopic fundoplication on some 180 patients. About 6% of these patients have undergone the Collis-Nissen procedure. The ratio of the Collis-Nissen procedure among fundoplication in Western countries has ranged from 1.5% to 15%,[6,22,23] with slightly different figures given by different institutions. In Western countries, many patients with shortened esophagus have paraesophageal hiatal hernia. In the present study, only 3 patients (27%) demonstrated a shortened esophagus and paraesophageal hiatal hernia. Although the potential involvement of paraesophageal hiatal hernia as a causal factor in the shortened esophagus

remains unclear, the incidence of shortened esophagus in mixed-type esophageal hiatal hernia seems to be higher than that for sliding-type esophageal hiatal hernia.

As to the outcome, our results were less favorable than those observed in Western countries. Although the scores for heartburn and regurgitation were improved significantly, the rate of recurrent esophagitis, 27%, was high. Our surgical methods most closely resemble the Pittsburgh procedure, and no major problems were noted with these surgical procedures. In general, esophagitis recurs after antireflux surgery if (1) the wrap slips from the intra-abdominal esophagus (slipped/twisted fundoplication); (2) the wrap and intra-abdominal esophagus are displaced into the mediastinal space (transdiaphragmatic fundoplication herniation); or (3) the wrap is ineffectively formed to prevent reflux.[24,25] The wrap did not slip in any of the 3 patients with recurrent esophagitis, and mild translocations (recurrent hiatal hernia) were observed in 1 patient. Hence, these factors do not seem to be the major factors in recurrent esophagitis. Naturally, the intra-abdominal neoesophagus formed by the Collis procedure is gastric tissue and includes acid-secreting mucosa. Therefore, if acid-secreting mucosa is found on the oral side of the wrapped intra-abdominal neoesophagus, gastric acid may affect the esophagus on the oral side of the intra-abdominal neoesophagus. In particular, if motility and clearance of the esophageal body are reduced, acid may remain on the oral side of the neoesophagus. In fact, postoperative endoscopy in the 3 patients with recurrent esophagitis showed gastric mucosa (acid-secreting mucosa) on the oral side of the wrapped neoesophagus. This mucosa was stained black by Congo-red staining. Performing laparoscopic Collis gastroplasty on 15 patients, Jobe et al[26] reported the clinical course for 14 patients. Heartburn persisted in 2 patients (14%) and abnormal pH monitoring scores were seen in 7 patients (50%). Esophagitis was confirmed postoperatively in 5 patients (36%). These findings are not necessarily favorable. One reason is the presence of acid-secreting mucosa on the proximal side of fundoplication, which agrees with our findings. With the Collis-Nissen procedure, it is important to avoid placing acid-secreting mucosa on the oral side of the intra-abdominal neoesophagus to be wrapped. Continuous acid suppression therapy should be employed postoperatively if acid-secreting mucosa remains on the oral side of the wrapped intra-abdominal neoesophagus for significant shortened esophagus.

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